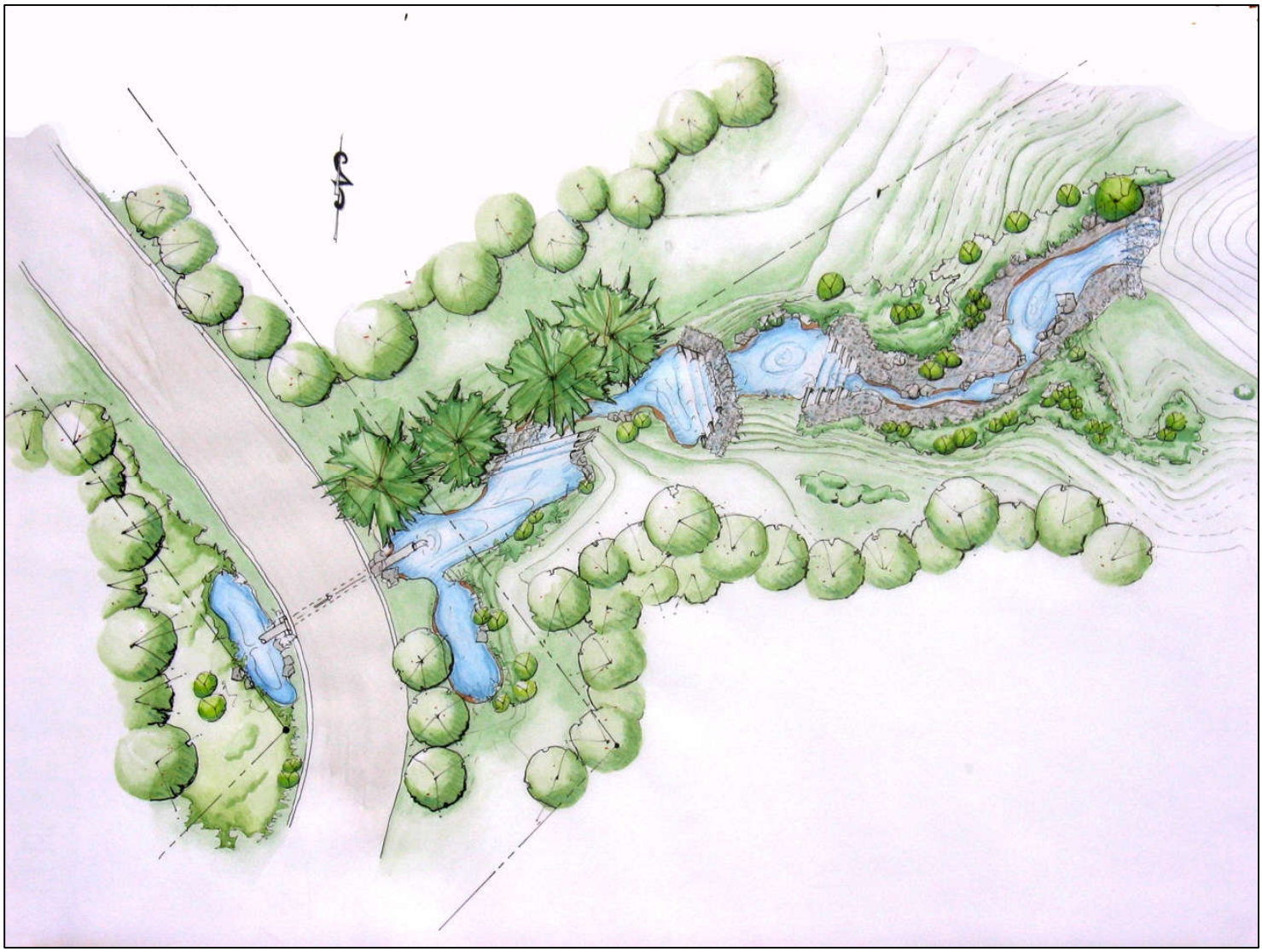
Department of Public Works
Specifications and Standards



Amended May 25, 2017

Town of Colchester, Vermont

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PREFACE

The “Town of Colchester Public Works Specifications and Standards” are applicable to all new construction and reconstruction of infrastructure due to obsolescence or deterioration. Variations from these standards and specifications will not be permitted except as provided for herein. In cases where the design of a facility is not governed by these standards and specifications, the latest design methods shall be used and included on the plans for acceptance by Town Officials. All engineering design shall be based on the latest methods and technology when determining sizes, strengths, and amounts. All plans and specifications shall have the following note stating, “All work shall be performed in accordance with the Town of Colchester Public Works Specifications and Standards”.

TABLE OF CONTENTS

Section 1. GENERAL PROVISIONS 12
1.1 GENERAL 12
1.2 BASIC DESIGN STANDARDS 12
A. SUBDIVISIONS 13
B. STREET NUMBERS 13
C. STREET GEOMETRIC STANDARDS 14
D. STORMWATER BASIS OF DESIGN 18
E. ROADWAY BASIS OF DESIGN 19
1.3 ENGINEERING PLANS 19
1.4 DEVELOPMENT TRAFFIC STUDIES 19
1.5 PROTECTION OF WORK PERSONNEL AND THE PUBLIC 21
1.6 PROTECTION AND REPAIR OF EXISTING UTILITIES 21
1.7 RECONSTRUCTION OF EXISTING UTILITIES 22
1.8 PERMITS 22
1.9 WORK OUTSIDE OWNED PROPERTY LIMITS OR WITHIN PUBLIC RIGHTS OF WAY 22
1.10 SUPERVISORS ON THE JOB SITE 22
1.11 MAINTENANCE AND PROTECTION OF TRAFFIC 23
1.12 TESTING AND INSPECTION REQUIREMENTS 24
A. GENERAL 24
B. ROAD INSPECTION SCHEDULE 25
C. UTILITY SYSTEMS 26
1.13 SUBMITTAL OF RECORD DRAWINGS 27
A. GENERAL 27
1.14 TRAFFIC AND ENGINEERING STUDY (SPEED STUDY) 29
1.15 OTHER MISCELLANEOUS REQUIREMENTS 30
A. STUMP DISPOSAL 30
1.16 OTHER REFERENCED STANDARDS 30
Section 2. EARTHWORK SPECIFICATIONS 32
2.1 GENERAL 32
2.2 EXCAVATION, BACKFILLING, AND COMPACTING 32
A. DESCRIPTION 32
B. QUALITY ASSURANCE 32
C. PRODUCTS 32
D. EXECUTION 33
2.3 TRENCHING, BACKFILLING, AND COMPACTING 37
A. DESCRIPTION 37

B. QUALITY ASSURANCE 37
C. PRODUCTS 37
D. EXECUTION 38
2.4 CONTROLLED BLASTING, EARTH AND ROCK EXCAVATION 42
A. DESCRIPTION OF WORK 42
B. DEFINITIONS 43
C. QUALITY ASSURANCE 44
D. BLASTING LIMIT CRITERIA 45
E. SUBMITTALS 46
F. JOB CONDITIONS 48
G. SAFETY PRECAUTIONS 49
H. MONITORING PROCEDURE 49
Section 3. ROADWAY SPECIFICATIONS 51
3.1 GENERAL 51
3.2 SOIL TESTING 51
3.3 SUBGRADE 51
3.4 DRAINAGE GEOTEXTILES 53
A. DESCRIPTION 53
B. MATERIALS 53
C. CONSTRUCTION REQUIREMENTS/INSTALLATION 53
3.5 STONE FILL OR RIPRAP CONTROL GEOTEXTILES 54
A. DESCRIPTION 54
B. MATERIALS 55
C. CONSTRUCTION REQUIREMENTS/INSTALLATION 55
3.6 SUBGRADE GEOTEXTILES 57
A. DESCRIPTION 57
B. MATERIALS 57
C. CONSTRUCTION REQUIREMENTS/INSTALLATION 57
3.7 UNDERDRAINS 60
A. DESCRIPTION 60
B. MATERIALS 60
C. CONSTRUCTION METHODS 60
3.8 SAND 61
A. DESCRIPTION 61
B. MATERIALS 61
3.9 GRAVEL BASE - BOTTOM COURSE 62
A. DESCRIPTION 62
B. MATERIALS 62
C. PREPARATION OF SUBBASE 62
3.10 GRAVEL BASE - TOP COURSE 63
A. DESCRIPTION 63

B. MATERIALS 63
3.11 BITUMINOUS CONCRETE (ASPHALT) PAVEMENT 64
A. GENERAL 64
B. PRODUCTS 65
C. WORK 68
3.12 PAINTED PAVEMENT MARKINGS 72
A. DESCRIPTION 72
B. MATERIALS 72
C. CONSTRUCTION METHODS 72
3.13 CEMENT CONCRETE CURB 73
A. DESCRIPTION 73
B. MATERIALS 73
C. CONSTRUCTION METHODS 73
3.14 CEMENT CONCRETE SIDEWALK 74
A. DESCRIPTION 74
B. MATERIALS 74
C. CONSTRUCTION METHODS 75
3.15 TRAFFIC CONTROL DEVICES 76
3.16 STREET LIGHTING 77
3.17 PLANTING OF TREES 83
3.18 STREET GUARD RAIL OR BARRIER 83
3.19 STREET SIDELINE MONUMENTS 84
A. DESCRIPTION 84
B. MATERIALS 84
C. CONSTRUCTION METHODS 84
Section 4. STORM DRAINAGE SPECIFICATIONS 85
4.1 GENERAL 85
4.2 PROJECT REQUIREMENTS 85
A. COMPLIANCE 85
B. STORMWATER MANAGEMENT PLAN 85
4.3 STANDARD TREATMENT PRACTICES 85
A. COMPLIANCE 85
B. ANALYSIS AND SIZING 85
4.4 MATERIALS AND PRODUCTS 86
A. TYPES OF PIPE 86
B. MANHOLES 87
C. CATCH BASINS 87
D. DRAINAGE SWALES 88
E. UNDERDRAINS 88
4.5 CONSTRUCTION METHODS 89
A. LAYING PIPE 89

B. PIPE BEDDING 89
C. BACKFILL 89
D. HEADWALLS 90
E. PIPE OUTFALLS 91
F. CATCH BASINS 91
G. ACCESS ROAD 91
H. CHAIN LINK FENCE 91
Section 5. WATER DISTRIBUTION SPECIFICATIONS 93
5.1 GENERAL 93
5.2 WATER DISTRIBUTION STANDARDS 93
Section 6. SANITARY SEWER SPECIFICATIONS 97
6.1 GENERAL 97
6.2 MATERIALS 97
A. TYPES OF PIPE 97
B. PVC SEWER PIPE 97
C. DUCTILE IRON PIPE 98
D. POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE 99
E. MANHOLES 99
F. MASONRY 102
6.3 CONSTRUCTION METHODS 103
A. EXCAVATION 103
B. LAYING SEWER PIPE 103
C. PIPE BEDDING 103
D. BACKFILL 103
E. CONCRETE CRADLE AND ENCASEMENT FOR PIPE 104
F. FROST PROTECTION FOR SHALLOW SEWERS 104
G. MANHOLE EXCAVATION AND SUBBASE 105
H. MANHOLE CONSTRUCTION 105
I. MASONRY 105
J. DEFLECTION TESTING FOR GRAVITY SEWERS 105
K. LEAKAGE TESTS AND ALLOWANCES FOR GRAVITY SEWERS 106
L. MANHOLE LEAKAGE TESTING 107
M. LEAKAGE AND PRESSURE TESTING FOR FORCE MAIN 110
N. CLEANING PIPELINES AND APPURTENANCES 110
O. SEWER SERVICE CONNECTIONS 110
P. CLEANOUTS FOR SEWERS 111
Q. CHIMNEYS 112
R. THRUST BLOCKS AND ANCHORS 112
S. AIR RELEASE VALVES AND MANHOLES 112
Section 7. WASTEWATER PUMPING STATIONS SPECIFICATIONS 112

7.1 GENERAL 112
7.2 PROJECT REQUIREMENTS 112
7.3 FACTORY BUILT WASTEWATER PUMPING STATIONS 114
A. GENERAL 114
B. FOUNDATION 115
C. WET WELLS 115
D. ENCLOSURE 116
E. SEWAGE PUMPS 117
F. VACUUM PRIMING SYSTEM 118
G. INTERIOR PIPING 119
H. VALVES 119
I. EMERGENCY STORAGE AND PUMPING REQUIREMENTS 120
J. EMERGENCY BACK-UP MEASURE 121
K. CONTROLS 122
L. WIRING 122
M. ACCESSORY EQUIPMENT 123
N. SPARE PARTS 124
7.4 FACTORY TESTS 124
7.5 SERVICES OF MANUFACTURERS REPRESENTATIVE 125
7.6 Pump - FIELD TESTING 125
7.7 OPERATING INSTRUCTIONS 125
7.8 REMOTE ACCESS AND Pump control system 126
7.9 ALARM TELEMETRY SYSTEM 127
7.10 level transmitter 128
7.11 ELECTRICAL SYSTEM 128
Section 8. EROSION, SEDIMENT AND DUST CONTROL 130
8.1 GENERAL 130
8.2 PROJECT REQUIREMENTS 130
A. COMPLIANCE WITH LOCAL & STATE REGULATIONS 130
B. EROSION PREVENTION & SEDIMENT CONTROL PLAN 130
C. DUST CONTROL 130
D. PROTECTION OF WATER COURSES 131
E. LIMIT DISTURBANCE AREA AND/OR TIME OF EXPOSURE 131
F. INSPECTIONS and maintenance 131
8.3 MATERIALS, PRODUCTS & BMPS 131
A. PERIMETER FENCE 132
B. STABILIZED CONSTRUCTION ENTRANCES 132
C. MULCH 132
D. EROSION CONTROL BLANKETS 132

E. STONE CHECK DAMS 132
F. SILT FENCE 133
G. INLET PROTECTION 133
H. POLLUTION PREVENTION 134
8.4 METHODS FOR INSTALLATION & EXECUTION 134
A. PERIMETER FENCE 134
B. STABILIZED CONSTRUCTION ENTRANCES 134
C. MULCH 134
D. EROSION CONTROL BLANKETS 135
E. STONE CHECK DAMS 135
F. SILT FENCE 135
G. INLET PROTECTION 135
H. POLLUTION PREVENTION 135
I. PERMANENT STABILIZATION 136
J. REMOVAL OF TEMPORARY CONTROLS 136
Section 9. LANDSCAPING & PERMANENT EROSION CONTROLS 137
9.1 GENERAL 137
9.2 PROJECT REQUIREMENTS 137
A. PERMANENT STABILIZATION OF DISTURBED AREAS 137
B. DELIVERY, STORAGE, AND HANDLING 137
9.3 MATERIALS 138
A. SEEDING REQUIREMENTS 138
B. TREES, SHRUBS, AND BUSHES 138
C. TOPSOIL 139
D. SOIL AMENDMENT MATERIALS 139
E. MULCH MATERIALS 140
F. ENVIRONMENTAL REQUIREMENTS 140
9.4 METHODS 140
A. PREPARATION OF SUBSOIL 140
B. PLACING TOPSOIL 140
C. FERTILIZING 141
D. SEEDING 141
E. HYDROSEEDING 141
F. SEED PROTECTION 142
G. PLANTING 142
H. PLANT RELOCATION AND RE-PLANTING 143
I. PLANT SUPPORT 143
J. TREE PRUNING 143
9.5 QUALITY CONTROL 143
9.6 MAINTENANCE 143

APPENDIX A: CHAMPLAIN WATER DISTRICT STANDARDS

APPENDIX B: TYPICAL ROADWAY CROSS-SECTIONS

APPENDIX C: SUPPORTING FIGURES

APPENDIX D: COLCHESTER STREET TREE MASTER PLAN

APPENDIX E: PROJECT CERTIFICATION FORM

FIGURE NO.	LIST OF ILLUSTRATIONS
SECTION 3	STREET DETAILS
3.1	Typical Roadway Cross-Section with Closed Drainage
3.2	Typical Roadway Cross-Section with Standard Open Drainage
3.3	Typical Roadway Cross-Section with Shallow Swale Open Drainage
3.4	Typical Unpaved Roadway Cross-Section
3.5	"Y" Turn Around
3.6	"L" Turn Around
3.7	Concrete Sidewalk
3.8	Typical Tapered Curb/Concrete Curb
3.9	Driveway Entrance On Curbed Street
3.10	Driveway Entrance On Uncurbed Street
3.11	Street/Driveway Offset Distances
3.12	Curbed Street Intersection with Existing Uncurbed Street
3.13	Sight Distance Chart
3.14	Replacement of Existing Bituminous Pavement
3.15	Sidewalk Ramps
3.16	Sidewalk Ramps and Median Islands
3.17	Bituminous Concrete Multi-Use Path
3.18	Crosswalk
SECTION 4	STORM DETAILS
4.1	Precast Catch Basin For Shallow Swale Open Drainage
4.2	Precast Catch Basin w/ Underdrain and/or Curb
4.3	Typical Storm Sewer Trench
4.4	Storm Outfall
4.5	Typical Drainage Swale
4.6	Typical Stone Lined Ditch
4.7	Stormwater Pond Access Road
4.8	Chain Link Fence and Double Gate Detail
SECTION 5	WATER DETAILS
5.1	Concrete Thrust Block Data
5.2	Air Release Manhole
5.3	Manual Air Release and/or Permanent Chlorine Injection Installation
5.4	6" or 8" Blowoff Assembly
5.5	Steel Sleeve Casing Spacer Detail
5.6	Steel Sleeve Encasement
5.7	Steel Sleeve Encasement Joint Weld Detail

5.8	Concrete Encasement
5.9	Water/ Sewer Line Crossing
5.10	Typical Tie-in to Existing Water Main or Large Diameter Service
5.11	Water Under Sewer Line Crossing
5.12	Tie-In Detail
5.13	River Crossing Trench Detail
5.14	Water Service Connection
5.15	Hydrant Assembly Detail
5.16	Typical Fire Service Connection Detail
5.17	Typical End of Line Pipe Anchor
5.18	Tapping Sleeve and Valve Detail
5.19	Typical Trench Detail
5.20	Stainless Steel Valve Stem Extension
5.21	Meter or Pressure Reducing Valve Vault Plan
5.22	Meter or Pressure Reducing Valve Vault Profile
5.23	Check Valve Vault Profile
5.24	Check Valve Vault Plan
5.25	Typical Concrete Thrust Block Details
5.26	Bearing Block Details
5.27	Hydrant Flag
5.28	Gravity Thrust Block Details
5.29	Gravity Thrust Block Details
SECTION 6	SANITARY SEWER DETAIL
6.1	Sanitary/Storm Manhole Detail
6.2	Manhole Channel/Insertion Detail
6.3	Sanitary Sewer Service Connection
6.4	Typical Sanitary Sewer Trench
6.5	Cleanout Detail (Storm and Sanitary)
6.6	Typical Drop Manhole
6.7	Force Main Into Manhole Detail
SECTION 7	WASTEWATER PUMPING STATIONS DETAILS
7.1	Wet Well Mounted Pump Station
7.2	Wet Well Mounted Pump Station Details
SECTION 8	EROSION DUST AND WATER CONTOL
8.1	Stabilized Construction Entrance
8.2	Guide to Mulch Materials, Rates, and Uses
8.3	Check Dam
8.4	Silt Fence

SECTION 9 LANDSCAPING & PERMANENT EROSION CONTROLS

9.1 Planting Details

SECTION 1. GENERAL PROVISIONS

1.1 GENERAL

This Section includes information regarding measures and materials for design and construction as needed for the design and completion of any project that falls under the authority of these Standards as defined herein.

Plan submittals on new improvements will not be required to duplicate the contents of these standards providing these standards are referenced on submitted plans and further, providing a copy of the standards are physically available at the construction site.

All projects involve a degree of uncertainty, especially with regard to subsurface conditions. Adherence to these minimum Municipal standards does not guarantee acceptance on the part of the Municipality for the final installation. When unexpected subsurface conditions are encountered, the Contractor must report the changed conditions to the Design/Project Engineer who in turn reports the situation to the Municipality before the work is allowed to proceed. A review will be made of conditions and if necessary, site-specific changes to the plans will be determined which will likely exceed the Municipality's minimum standards.

Providing the installation is then constructed on the basis of the revised and approved standards and all installations meet the required tests, Municipality acceptance will follow.

With regard to the reconstruction of existing facilities, it is the goal of the Municipality to make improvements over time to update the Municipal infrastructure to the standards outlined in this manual. The timing and implementation of improvements is not included in the Public Works Specifications and Standards.

In a case where the design of an item is not specifically covered by these standards, the submittal of such an item shall include sufficient information for the determination of acceptability by the Public Works Director. At a minimum the information will include a description of the item, detailed materials information or reference to universally recognized standards (AWWA, ANSI, etc.), a description of the methods to be used for construction and any testing necessary to verify the quality of the installation. The Public Works Director may also require a list of locations and contact personnel where the item has previously been installed or the procedure used. It is not the intent of this document to prevent alternative solutions; however the burden of proof for acceptability lies with the proponent.

1.2 BASIC DESIGN STANDARDS

All new proposed streets, utilities, and other public improvements shall be designed and

constructed in accordance with the latest minimum accepted standards and practices contained in these Public Works Specifications and Standards; the Colchester Subdivision Regulations, the American Association of State Highway and Transportation Official (AASHTO) Standards, the Vermont Agency of Transportation (VTrans) Standards, Specifications and Details, the current edition of the Town Road and Bridge Standards adopted by VTrans, the Street Design Guidelines recommended by the Institute of Transportation Engineers (ITE), and other standards stated herein.

A. SUBDIVISIONS

Where a subdivision borders on an existing road or an abutting developable parcel of land and when the Municipality determines that a realignment or widening of the road or a future road right-of-way would be in the public interest, the Municipality may require that such areas be shown and marked on the Final Property Plat "Reserved for Road Alignment and/or Widening Purposes or Future Road. All areas shown in this manner shall be dedicated to the Municipality".

All subdivision streets shall be constructed by the subdivider. No street shall be approved unless its elevations are above the elevation of the 100 year flood (as depicted on the Federal Digital Flood Insurance Rate Map). The layout and design of subdivision streets, pedestrian facilities, and utilities, shall apply the principles of connectivity to facilities adjacent to the subdivision. At the same time consideration shall be given to the functional classification of the streets, prevention of cut through traffic, traffic calming, emergency services vehicle access, and maintenance vehicle access.

The minimum width of rights-of-way, measured from property line, shall not be less than sixty feet (60').

The width of the bituminous concrete surface of a curbed street may not be less than twenty-six feet (26') and twenty-two feet (22') for an uncurbed street.

B. STREET NUMBERS

Prior to the issuance of a Certificate of Occupancy, the developer shall obtain the street numbers for each building from the Town Assessor's Office. Street Names and Numbers Policy shall match E911 Policy in Colchester Code of Ordinances.

The numbers shall be placed both on a United States Post Office approved mailbox at curbside and on the structure of the house at a point no more than two feet (2') away from the frame of the front door. The numbers shall be in the form of a minimum of two-inch (2") high Arabic numerals and shall be on a color contrasting background.

C. STREET GEOMETRIC STANDARDS

Vertical Alignment

Street grades shall not exceed ten percent (10%). In no case shall a grade of greater than eight percent (8%) be longer than three hundred feet (300'). The minimum grade shall not be less than one percent (1.0%). The maximum grades within one hundred feet (100') of the centerline intersection of two streets shall not be greater than three percent (3%). Every change in grade shall be connected by a vertical curve constructed so as to afford a minimum sight distance of one hundred and fifty feet (150') for residential streets and two hundred fifty feet (250') for collector, commercial and industrial streets. K-values shall be provided by the designer on the design plans for all proposed vertical curves.

Horizontal Alignment

Any roadway tangents sections deflecting from each other at any one point shall be connected with a curve the radius of which at the centerline shall not be less than one hundred fifty feet (150') for residential streets and two hundred fifty feet (250') for collector streets. Collector and residential streets shall have a minimum curb or edge of pavement radius of not less than thirty feet (30'). A tangent of at least fifty feet (50') in length shall be introduced between reverse curves on all proposed streets.

Clear Zone Recovery Area

For all new street designs without curb which do not incorporate guardrails or other protective barriers, a minimum of eight (8’) feet of horizontal clearance to obstructions such as trees, utility poles, light poles or other fixed objects shall be provided. For curbed streets, an 18” minimum clearance shall be required.

While single or double individual mailboxes may be placed on breakaway structures within the clear zone as long as they are also in accordance with US Postal Service requirements, larger central drop off and pickup stations or “cluster mailboxes” shall not be placed within the public right of way and shall not be located in areas which will conflict with traffic or cause congestion. Cluster mailboxes shall not obstruct driveways and shall not be placed within 100’ of an intersection with local or collector streets (or within 200’ of arterials.) Cluster mailboxes shall be placed in an area provided with pedestrian access and lighting. Where practical based on size or type of development, cluster mailboxes shall be placed adjacent to parking areas on common land.

Street Intersections

Street intersections shall be as near to right angles as possible and no intersection shall be

at an angle of less than 80 degrees.

New project intersections or affected adjacent existing intersections shall be constructed or reconstructed by the Developer to maintain the following level of service (LOS):

- Signalized intersections will be improved to maintain an overall minimum level of service (LOS) C.

Reduce LOS criteria may be acceptable, when approved by the Public Works Director on a case-by-case basis, especially within densely settled areas. Such determinations should take into consideration, at a minimum, the following:

- Current and future traffic volumes
- Essential Emergency Response routing and maintenance accessibility
- The delay incurred by the traveling public
- The volume to capacity (v/c) ratio
- Facility safety (crash rates)
- The negative impacts, (cultural, environmental, etc.) which may result to the surrounding area because if improvements required to achieve a Level of Service C for the facility
- Effects of economic suppression due to inadequate infrastructure and subsequent displaced development.

In extreme circumstances where the existing LOS is less than desired, and where the necessary geometric improvements are not feasible, a lower LOS may be acceptable as long as the safety and mobility of the traveling public is improved. Strategies effecting such improvements should include traditional engineering approaches such as:

- Installation of traffic and pedestrian signals
- Adjustment to signal phasing and timings
- Modification to existing lane configurations
- Pedestrian crossings
- Other similar measures

In addition, where appropriate, these approaches may be carried out with Transportation Demand Management (TDM) strategies or TDM strategies may be carried out independently.

Under no circumstances shall the LOS at existing intersections degrade more than 2 Levels as a result of construction or reconstruction by the developers, subject to the minimum LOS criteria established above.

Right and/or left turn lanes shall be constructed if warranted in accordance with the latest

methodology used by VTrans.

Traffic signals shall be installed if warranted in accordance with the methodology found in the latest edition of the MUTCD.

For unsignalized access spacing standards for public streets, the Town uses the lower limit of the AASHTO stopping sight distance approach. The resultant spacing standards, shown in Table 1.1, would enable a driver traveling at the design or posted speed to monitor only one street intersection at a time and, if necessary, to stop.

TABLE 1.1- UNSIGNALIZED ACCESS SPACING (FT)

Posted Speed or Design Speed (mph)	Unsignalized Access Spacing*(ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425

(*Spacing shown is based on level terrain: adjustment factors are required for segments with grades)
Source: Derived from Exhibit 3-1 (Pg.112) (Stopping Sight Distance) from AASHTO A Policy on Geometric Design of Highways and Streets, 2001

Sidewalks and Multi-Use Paths

Generally, the municipality shall require sidewalks on all residential and collector streets and may require multi-use paths in new developments. The minimum width of concrete sidewalks shall be five feet (5') and the minimum width of pavement for multi-use paths shall normally be ten feet (10'). See Typical Roadway Cross Section (Appendix B) for exceptions. Multi-use paths shall be designed in accordance with the latest edition of the AASHTO Guide for the Development of Bicycle Facilities, the Vermont Pedestrian and Bicycle Facility Planning and Design Manual, and Figure 3.17. Multi-use paths are required on all Minor Collector, Commercial, Industrial and Residential streets that exist within the planning corridors identified in the Colchester Bicycle Pedestrian Plan and Official Map. Multi-use paths shall also be required on Residential streets outside these

planning corridors when projected daily traffic volumes exceed one thousand (1,000) vehicles per day. Sidewalks shall be constructed continuous between public streets with no breaks at residential, commercial, or industrial drives. Sidewalks shall only break where there is an intersection with a public road. Refer to Figures 3.15 and 3.16, for various sidewalk ramp typicals.

Cul-de-Sac Streets

A cul-de-sac is a street terminating in a turn-around at one end. Cul-de-sac streets shall not be permitted, except where it is demonstrated that there is no other practical alternative. If a cul-de-sac is proposed, the length of a cul-de-sac street shall not exceed ten times the minimum required lot frontage for the district(s) involved. In no case shall a cul-de-sac exceed a total of one thousand five hundred feet (1,500') in length. All dead-end streets shall have a turn around. The turn-around on a dead-end street (cul-de-sac) shall be of a "Y-Type" design (see Figure 3.5) or a "L-Type" design (See Figure 3.6).

Driveways

Only one driveway per lot is permitted unless more are approved by the Public Works Department. More than one driveway may be approved in cases where public traffic circulation patterns or safety will be enhanced. All road pavement cuts in existing roads shall be performed in accordance with Chapter 13 of the Town of Colchester ordinances entitled Streets and Sidewalks. Driveway aprons accessing paved streets shall be either asphalt or concrete.

Any access serving five (5) or more residential dwellings; or other residential, retail, commercial and/or industrial access deemed by the Public Works Director to benefit the public's health, safety and general welfare, shall be developed and constructed in accordance with these Public Works Specifications.

Return radii and driveway width shall be minimum necessary to accommodate the Towns fire equipment and appropriate design vehicle for anticipated use.

It is the Town's intent to limit the number of traffic conflict locations and maximize safety of the traveling public by reviewing and implementing access management practices.

Unless a shared driveway is proposed, driveways shall be located as far apart as possible.

Before approval is granted for the location and size of new or reconstructed driveways, the town will review and consider the following in an effort to enhance access management.

- Minimizing the number of access points
- Spacing of access points
- Potential for shared access with adjoining properties
- Size of lot and ability to provide access
- Grades of access and roadway
- Pedestrian traffic
- Speed of roadway
- Number of traffic lanes and shoulder width
- Proximity to adjacent intersection (see Figure 3.11)
- Traffic volumes
- Sight distance (see Figure 3.13)

Parking Lots

The design and construction of parking lots are regulated by the Town's Zoning and Subdivision Regulation, and Colchester Code of Ordinances, Chapter 7. Nothing in these standards shall be interpreted to mean that any parking lot or portion thereof is a public street.

Easements

Easements for gas, telephone, electric, and cable t.v. and private utilities, should be located outside the street right-of-way where possible. All utilities shall be underground. Easements within the public street right-of-way of sufficient width shall be provided at locations acceptable to the Public Works Director. Typical easement widths shall be 20 feet, but may vary depending on site specific conditions. Where easements within the public street right-of-way are necessary a Quitclaim Easement Deed for Private Utility and Maintenance Agreement prepared by the Town shall be utilized.

The Developer must ensure access to all stormwater treatment practices at the site for the purpose of inspection and repair by securing all of the access and maintenance easements needed on a permanent basis. This may include easements benefiting individuals or Homeowner's/Condominium Associations. A Stormwater Maintenance Agreement may also be required for private stormwater infrastructure.

D. STORMWATER BASIS OF DESIGN

Stormwater systems include driveway culverts, catch basins, ditches, swales, stormwater pipes and stormwater ponds and detention basins. Sizing of stormwater drainage systems shall be based on detailed calculations of stormwater flows prepared by a Professional Engineer licensed in the State of Vermont.

E. ROADWAY BASIS OF DESIGN

The design of roadway underdrains and gravel base depth for roadways required to meet the Special Section cross-section shall be completed as required to effectively maintain the road subbase in a dry condition and to support the proposed traffic loading based on site-specific soil characteristics, seasonal groundwater elevations, etc. Soil characteristics such as load bearing capacity, moisture content and expansiveness, along with estimated equivalent single axel load values (ESALs) for the proposed new roadway shall be considered in determining the minimum depth of gravel base material to be used in the special section. Once the minimum depth of gravel base is determined, the minimum depth of the underdrain system shall be calculated based on the subgrade soil characteristics including the coefficient of permeability and the seasonal high groundwater elevation to ensure that the gravel base material remains dry across the entire cross-section of the roadway. If engineered products are to be used for base stabilization, moisture barrier, moisture transportation etc., manufacturer's literature shall be submitted to the Town Engineer for review along with the design calculations. If necessary the Town may require an independent, third-party review of the submittal to determine the acceptability of the design, with the cost of the review to be borne by the Developer.

1.3 ENGINEERING PLANS

At each stage of a project's development, engineering plans and documentation are required to determine project compliance with Municipal standards. The level of engineering detail required for approval generally increases with each stage of development approval. All engineering plans or documentation of an engineering nature submitted to the Town must be prepared by a Professional Engineer licensed in the State of Vermont.

1.4 DEVELOPMENT TRAFFIC STUDIES

One of the issues requiring resolution in the development of all projects is traffic access. The following guideline has been developed to assist in determining the need for and adequacy of traffic studies and impacts.

A complete traffic study will be required for all commercial and industrial developments and/or expansions and for any residential project with 10 or more living units. All projects regardless of type or size will require a sight distance and safety analysis. Because each project is unique, the Municipality reserves the right to modify the guidelines accordingly.

1. The scope of the study shall include the impacts of project driveways and intersections, adjacent signalized and unsignalized intersections, and other locations as stipulated by the Town Engineer.

2. The analysis periods shall be
   a. Base year - time of project or major phase completion.
   b. Planning year
      (1) If the project is fully completed in the base year - base year plus five years.
      (2) If the project is not fully completed in the base year - base year plus up to ten (10) years or year of final completion, whichever is longer.

3. Study content
   a. Listings of project development characteristics, trip generation rates, and related travel patterns.
   b. Tabular summaries of existing, development, and combined vehicular volumes for the analysis periods.
   c. Documented warrant evaluations for:
      (1) Geometric needs including but not limited to right-turn lanes, left-turn lanes, radii, etc., in terms of 30th highest hour volumes.
      (2) Signal needs in terms of average weekday volumes.
   d. Traffic performance evaluations for all study locations in terms of 30th highest hour volumes for the selected analysis periods.
      (1) Numerical measures of capacity.
      (2) Level of service descriptions, delay and gap calculations.
   e. Study of proposed driveway(s) features
      (1) Sight distances
      (2) Non-interfering approach speeds on the intersecting street or road.
      (3) Acceptable spacing with respect to adjacent intersections and/or major driveways.
      (4) Recommend driveway configuration in terms of number and use of lanes, lane widths, and edge of pavement designs.
   f. Safety evaluation on main roadway or intersection at project driveway(s).
      (1) Summary of accident characteristics for the past five years by:
         a: Cause
         b: Type
         c: Severity
      (2) Comparison of actual and critical accident rates.
         a: Roadway - accidents per 1,000,000 vehicle miles.
         b: Intersection - accidents per 1,000,000 incoming

vehicles.

(3) Recommend improvements for any accident-prone locations.

(4) Evaluation of existing geometrics and alignment with respect to both vehicles and pedestrian safety and level of service.

4. Summary of any recommended geometric and/or control improvements to provide proper traffic performance and safety.
5. Miscellaneous items as requested by the Development Review Board including but not limited to.
   a. Facilities for pedestrians, bicyclists, and/or handicapped persons.
   b. Evaluation of internal circulation.
   c. Parking requirements.
   d. TDM Measures.
   e. Hours of Operation, number of employees, and time of shifts and number of employees per shift.

1.5 PROTECTION OF WORK PERSONNEL AND THE PUBLIC

Work personnel and the public shall be protected by the Contractor, from any and all hazards connected with the construction work. All construction activities, materials, or equipment within the working limits of the public right of way are to be guarded by the use of adequate barricades or flag persons. All barricades left in position overnight are to be properly lighted. When work narrows the useable pavement, flag persons shall be employed to aid the flow of traffic so that there will be no undue delays. The Contractor shall be held responsible for the safety of all work persons and the general public and all damages to property otherwise growing out of a failure on the part of the Contractor to protect persons or property from the hazard of construction activities, materials, or equipment at any time of the day or night within the working area. All work shall be in conformance to applicable VOSHA regulations.

1.6 PROTECTION AND REPAIR OF EXISTING UTILITIES

The Contractor shall notify Dig-Safe prior to any excavation in the public right of way or utility easement limits, and otherwise comply with all permit requirements as defined in Chapter 13 of the Town of Colchester ordinances entitled Streets and Sidewalks. Wherever culverts, sewers, drains, manholes, catch basin connections, water mains, valve chambers, electric conduits, telephone conduits, utility poles, overhead lines or other existing facilities are encountered they shall be protected and firmly supported by the Contractor at his/her own expense, by methods approved by the authority having control of the above or below ground structure, until excavation is backfilled and the existing structures are made secure. Injury to any such structures caused by or resulting from the

Contractor's operations shall be repaired at the Contractor's expense within a time period that will not place an unreasonable burden on the users. The authority having charge of any particular underground structure shall be notified promptly of injury to its structure.

The Town of Colchester and the Champlain Water District are not members of Dig-Safe and shall be contacted directly for field verification of their utility locations.

1.7 RECONSTRUCTION OF EXISTING UTILITIES

In case it shall become necessary to remove or reconstruct any water main, sewer main, storm sewer, electric conduit, telephone conduit, any connections thereto, or any appurtenant structures, approval for relocation shall be obtained from the appropriate party prior to relocation. The Contractor shall be responsible for the work and for providing notice to users before interrupting service. Unless specifically provided for by written agreement, reconstruction of the utilities shall be at the Contractor's expense. In no case shall the Contractor move, change or repair any water main, sewer main, storm drain, electric conduit, telephone conduit, or any underground cables, conduits or structures, without permission of the Municipality and the utility owner and until they are satisfied that adequate warning to the users has been provided.

1.8 PERMITS

It shall be the Developer and the Developer’s Contractor's responsibility to obtain all federal, state, regional, local or utility company permits necessary for the construction of the project prior to initiation of construction. The Contractor is also responsible for having copies of said permits on site at all times and for maintaining these permits in force during the length of the contract and for taking all required actions to comply with the content of the permits.

1.9 WORK OUTSIDE OWNED PROPERTY LIMITS OR WITHIN PUBLIC RIGHTS OF WAY

The Contractor shall not, without written consent of a property owner enter or occupy with persons, tools, materials, or equipment, any private land without written consent of the property owner. In a similar manner, no excavation shall take place within the public right of way without first obtaining authorization from the Municipality or State, as applicable.

1.10 SUPERVISORS ON THE JOB SITE

The Contractor shall be responsible for ensuring that there is a supervisor or responsible individual with the authority to make decisions for the Contractor under his/her direct employ on the job site at all times that construction is underway, whether or not the construction is being accomplished by a prime Contractor or subcontractors hired by a

prime Contractor.

1.11 MAINTENANCE AND PROTECTION OF TRAFFIC

The Contractor shall provide uniformed traffic officer or flag persons necessary to maintain safe and adequate traffic flow.

The Contractor shall, as conditions warrant, employ flag persons at any location on the project where his/her equipment or construction operations are such that they will in any manner interfere with the movement or safety of the traveling public within a public right-of-way.

All flaggers employed by the Contractor shall have completed a four-hour flagger training course given by a certified instructor within the last twenty-four months and shall have proof of said certification while conducting flagging operations.

The cost of uniformed traffic officer services deemed necessary by the Municipality, Town Engineer, Public Works Director, or Police Department shall be paid for by the Contractor.

The employment or presence of traffic flag persons or uniformed officer does not relieve the Contractor of responsibility or liability.

The Contractor shall obtain written approval from the Public Works Director or the Chief of Police, and notify same as well as Fire, Rescue, and School Departments at least 48 hours in advance of any need to close streets. The Contractor shall work with the Municipality to establish a suitable alternate route, and shall at his/her own expense, provide and maintain suitable marked and well-lighted detour signs.

Construction approach signs shall appear at each end of the construction site along the public highway and on all intersecting public highways. The exact placement of any sign will depend upon the alignment of the highway and the character of the roadside. The location, measurements, and minimum spacing shall comply with VTrans E Series Standard Drawings.

The design of the signs shall conform to the standards prescribed in the Manual on Uniform Traffic Control Devices prepared by the National Joint Committee on Uniform Traffic Control Devices.

The signs shall be in place at the time the project officially commences. Each sign shall be erected in a neat and workmanlike manner and shall be maintained by the Contractor.

On certain projects, the contractor/developer will be required to submit and maintain a Traffic Control Plan. The need for the project Traffic Control Plan will be determined by the

Town Engineer based on, but not limited to the following:

- Traffic Counts
- Accident History
- Location
- Project Duration
- Past Experience

When a Traffic Control Plan is determined to be required it shall be prepared and submitted to the Public Works Director two weeks prior to construction. The plans shall include an overall site plan indicating adjacent streets, anticipated truck routes, any weight limited roadways, hours of operation and emergency contact information. The Traffic Control Plan shall indicate all traffic diversions and methods used such as cones, barrels, etc. utilized to channel traffic. Refer to the Manual on Uniform Traffic Control Devices for appropriated methods and devices.

1.12 TESTING AND INSPECTION REQUIREMENTS

A. GENERAL

Proper construction requires accurate construction layout and control, field verification of materials and technique. All projects require inspection by an engineer or inspector experienced in the area of construction to be undertaken based upon the following minimum inspection efforts:

General site improvements	4 hours/week
Sewer line installation	2 hours/day
Water line installation	2 hours/day
Storm line/structure installation	2 hours/day
Embankment installation	2 hours/day
Roadway base installation	2 hours/day
Paving operations	Constant
Erosion Controls	Weekly and after each rain event and in accordance with the approved EC plan.

Field revisions necessitated by the conditions of the site must be approved by the Design/Project Engineer and the Town Engineer prior to acceptance of the completed work.

The sampling and testing of all materials to be used in the construction of the project is the responsibility of the project developer. The Design/Project Engineer must establish sufficient lead-time to review this information with the Building Inspector for conformance

with these specifications and standards and to acquire the necessary approvals of materials prior to placement.

Upon completion of the construction, the Design/Project Engineer shall certify that required testing and inspection has been conducted, that the improvements inspected are in full conformance with the approved plans and specifications, and that the entire project is in reasonable conformance with the approved plans and specifications. The certification shall include copies of all test reports as required in these specifications and standards. No inspection performed by the Town shall in any way, relieve the Design/Project Engineer of their responsibility to fulfill the inspection requirements as outlined in these specifications, and certify as required. A completed Project Certification Form (Appendix E) is required prior to the acceptance of the project by the Municipality.

A final walk-through inspection will be made of the project by the Developer, Contractor, Design/Project Engineer, Town Engineer and Building Inspector.

When the final walk-through inspection is complete, all deficiencies corrected, record drawings accepted, and the project certification is received, the Municipality will accept the construction and a warranty period will begin.

B. ROAD INSPECTION SCHEDULE

A sample of all subgrade, subbase and base materials will be tested by a testing lab approved by the Municipality in accordance with these Specifications. Sieve analyses and compaction tests (ASTM D1557 / AASHTO T180, Method A (Modified Proctor)) shall be performed on all materials. Sufficient time shall be allocated between submittal of material for testing and placement of the material.

Field density determinations for subgrade, subbase and base material placed will be made in accordance with AASHTO Standard Methods of Test, T-191 (sand cone method), T-238 (nuclear method). Field moisture determinations will be made in accordance with AASHTO Standard Method of Test T-180, or measured in accordance with AASHTO T-239 (nuclear method). Provide at least the following tests to the approval of the Design/Project Engineer; at paved areas, at least one field density test for every 10,000 sq. ft. of paved area, but not less than three (3) tests; in each compacted fill layer, one field density test for every 200 cubic yards of fill material placed, but not less than one per lift. The responsibility and payment for testing shall be the Developer's.

In addition to the above referenced AASHTO Standard Methods of Test, a fully loaded tandem dump truck with a total weight not less than 24 tons shall be driven over the compacted subgrade in the presence of the Design/Project Engineer and the depression left by the truck wheels shall be used to make a judgment on the acceptability or unacceptability of the subgrade.

If, in the Design/Project Engineer's opinion based on field investigations and reports from the testing laboratory, subgrade or fills, which have been placed, are below specified density, provide additional compacting and testing under the provisions of these specifications.

The Municipality will be notified 24 hours in advance of the construction of any and all roads at the following phases of construction. Failure to provide required notices may result in non-acceptance of the completed improvements.

- Preparation of subgrade;
- Installation of subbase and base material;
- Completion of finished grading;
- During the placement of the base coat of asphalt;
- During and after the placement of the topcoat of asphalt;
- Placement of curbs, sidewalks and driveway aprons.

A final inspection will be made after the completion of all roads, curbs, driveways, sidewalks, bicycle paths and setting of all pins and monuments for lots and street rights-of-way. The following roadway general checklist will be used at final inspection:

- Conformance with horizontal alignment and vertical grades as shown on the approved plan;
- Settlement, depression, or imperfections in finish surface;
- Seeding and erosion control on cut and fill slopes;
- Surface drainage (during rainstorm);
- General appearance;
- Material testing results, lab reports, and record drawing complete and on file.

C. UTILITY SYSTEMS

No backfilling of trenches shall occur until the installation of pipelines and structures have been inspected and approved by the Design/Project Engineer. The Municipality will be notified 24 hours in advance of any backfilling operations. Failure to provide required notices may result in non-acceptance of the completed improvements.

Field density determinations for all backfill material will be made in accordance with AASHTO Standard Methods of Test, T-191 (sand cone method), T-238 (nuclear method). Field moisture determinations will be made in accordance with AASHTO Standard Method of Test T-180, or measured in accordance with AASHTO T-239 (nuclear method). Provide at least the following tests to the approval of the Design/Project Engineer; at paved areas, at least three (3) field density tests for every 150 linear feet of trench or fraction thereof; at unpaved areas, at least three (3) field density tests for every 300 linear feet of trench or

fraction thereof. The responsibility and payment for testing shall be the Developer's.

All facilities will be inspected upon completion of the project using the following checklist:

- Catch basins, manholes, other structures and pipelines clean;
- Ditches and outlets clean;
- Erosion control measures completed;
- General appearance; and
- Material testing results, lab reports, manufacturer's certificates, and record drawings complete and on file.

The testing requirements for these facilities are included in their individual section of this document.

1.13 SUBMITTAL OF RECORD DRAWINGS

A. GENERAL

Record drawings shall be produced for all construction projects and should include the following information.

Roads

Accurate locations and elevations of all streets and storm drain lines, culverts, and other facilities; including:

- Width of pavement from curb to curb or shoulder to shoulder;
- Right of way dimensions for streets;
- Width of sidewalk and bike paths;
- Location of driveways;
- Location and size of planter islands, if any;
- Typical cross-section of streets as installed;
- Location of electric and telephone lines, structures and poles;
- Street monuments.

Water

Accurate locations of all water lines.

Measurement to within 1/2' from all valves and curb stops, from permanent fixtures such as telephone poles, hydrants, buildings, transformers, etc., along with depths of waterlines. Three point minimum tie measurements are required.

All curb boxes will be marked with stakes or PVC pipe so Contractors can easily locate them before building services are connected.

Sewer

Accurate locations of all sewer lines and clean-outs.

Accurate measurements to all service wyes for building connections (shown on tie drawings.)

Location of building connections at property line and depth and location of all manholes (shown on tie drawings).

Invert and manhole cover elevations, distances between manholes, size of pipe in manholes, and slope of pipe.

Storm Drainage

For storm drainage facilities, the following shall be shown:

- Depth, size, location and type of all storm drain lines and culverts, including under drains and services;
- Location and elevations of all catch basins;
- Location and details for all storm drainage facilities such as detention ponds;
- Location of all drainage ways, water courses, etc;

Traffic Signals and Street Lights

Accurate locations of all street lights, conduits, junction boxes, controller boxes, strain poles, mast arms, and power supply stanchions.

Information shall include material types, sizes, and approximate depths. Typical drawings may be used but must be supplemented with additional notes where changes from typical were required.

Field Inspection

After the initial set of record drawings have been submitted, there will be a field inspection by the Municipality to verify that all improvements have been installed in reasonable conformance with the approved Plans and these Specifications.

Final Drawings

Prior to final construction approval of the project by the Municipality, a final set of record drawings, including one set of Mylar reproducible prints (24”x36” or D-size) as well as copies in digital format (both AutoCAD drawing .dwg or transfer .dxf formats and raster image in .pdf format,) shall be submitted to the Municipality within 60 days of the completion of a project or project phase. The final set of the project record drawings shall be stamped by the Design/Project Engineer. The record drawings shall also contain a stamped and signed statement by a licensed Land Surveyor that all property corner makers have been set in accordance with the approved property plat.

1.14 TRAFFIC AND ENGINEERING STUDY (SPEED STUDY)

Prior to the acceptance of a street by the Town, the developer shall have a traffic and engineering study completed for the purpose of setting the posted speed limit and will also complete a stop sign warrant analysis. The developer shall present the prepared speed study and stop signal warrant analysis to the Town and allow for sufficient time to review the documents, appropriately warn the Select Board meeting and allow for the 60 day appeal process prior to acceptance of the road by the Town.

Characteristics of the roadway shall be evaluated to determine the safe operating speed. These factors are categorized into six areas of evaluation:

- Road surface characteristics, shoulder condition, grade, alignment, sight distance and identifying all required regulatory signage including a stop sign warrant analysis.
- The 85-percentile speed and pace speed.
- Roadside development and land use, and access characteristics.
- Safe speed for curves or hazardous locations within the zone.
- Parking practices and pedestrian activity.
- Reported accident experience for a recent 12-month period (if 12-month period has elapsed).

The type and characteristics of the road under study will be the basis for the expected safe operating speed on the road. Where speed studies to determine the 85-percentile speed are not feasible, then traffic-engineering literature will be the source material for satisfying evaluation under this section.

1.15 OTHER MISCELLANEOUS REQUIREMENTS

A. STUMP DISPOSAL

On any project in which site development requires the removal of the tree stumps, the disposal of the stumps may be accomplished on the site. On-site stump disposal plans shall be submitted to and approved by the Building Inspector.

Such plan(s) shall show that the on-site disposal can be safely and effectively accomplished and will meet the following minimum guidelines:

1. Disposal sites shall be located on nearly level to moderately sloping lands (slopes less than 12 percent).
2. Disposal sites will not be located in or within 100 feet of flowing watercourses or streams or in actively eroding gullies.
3. Disposal site shall not be located in flooded or flooding-prone lands, marshes, or other aquifer recharge areas.
4. Stumps will be placed on the site in a single lift prior to backfilling. When additional stumps are to be deposited on the same site, each successive layer or lift of stumps will be backfilled.
5. Stumps deposited in drainage ways or depressions shall be backfilled and bermed so as to divert overland flows from the disposal area.
6. A minimum of two feet (2') of overburden will be placed over all disposal sites.
7. Disposal sites shall be located outside any planned development area of structures, utilities, parking areas, streets, etc.
8. All disturbed surfaces shall be properly limed, fertilized, seeded, and mulched to provide for a stable, non-erosive, vegetated cover. Specific seeding recommendations and lime or nutrient requirements will be based upon soil tests and site conditions on that location.

1.16 OTHER REFERENCED STANDARDS

Standard Specifications for Construction, State of Vermont, Agency of Transportation
American Association of State Highway and Transportation Officials, (AASHTO)
Transportation and Traffic Engineering Handbook, ITE
American Society of Testing Materials Standards
American Water Works Association Standards
American Concrete Institute Standards
Water Pollution Control Federation Standards
American Society of Civil Engineer Standards and Manuals of Practice
American National Standards Institute
National Plumbing Code
National Electric Code

Portland Cement Association Standards
New England Water Works Association
Ten States Standards on Water and Sewage
American Public Works Association Standards
VOSHA Safety and Health Standards
New England Interstate Water Pollution Control Commission "Guides for the Design of Wastewater Treatment Works"
Public Water Supply Regulations of the State of Vermont
Vermont Storm Water Management Manual (Volumes I and II)
Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites

END OF SECTION

SECTION 2. EARTHWORK SPECIFICATIONS

2.1 GENERAL

This Section includes information regarding measures and materials for excavating, trenching, backfilling, and compacting as needed for the completion of grading and the installation of underground pipes, conduits, cables, wires or other utilities, manholes, catch basins, and appurtenances.

2.2 EXCAVATION, BACKFILLING, AND COMPACTING

A. DESCRIPTION

This work includes excavating and site grading, (including the removal of slides), borrow pits, waterways, channels, intersections, approaches, steps in side-hill embankment areas, excavation of surfaces and pavements, excavating selected material found in the construction area for specific use in the construction; the construction and removal of detours shown on the plans or authorized by the Municipality, trimming and shaping of slopes, and disposing of all excavated material in accordance with these specifications and in reasonably close conformity with the lines, grades and typical cross sections shown on the plans or established by the Design/Project Engineer. It shall include placing of material in embankments.

B. QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.

The Contractor shall comply with requirements of governmental agencies having jurisdiction over various phases of the work.

C. PRODUCTS

Soil Materials Fill and Backfill

Fill material is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soils free from roots and other deleterious matter.

Do not permit rocks having a dimension greater than 1" in the upper 12" of fill or embankment.

D. EXECUTION

Surface Conditions

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

Procedures

Prior to the beginning of excavation, grading and embankment operations in any area, all necessary clearing and grubbing in that area shall have been completed.

All slopes in cut and embankment sections, ditches and waterways, whether old or newly constructed, shall be satisfactorily cleaned and cleared of obstructions and left in a neat and trim condition. Excavation shall be made in reasonably close conformity with the lines, grades and requirements indicated on the plans.

The construction area shall be maintained so that it will be drained at all times. Where traffic is maintained, care shall be exercised to keep the portion open to traffic in a satisfactory condition.

All suitable material removed from excavation shall be used in the formation of embankments as indicated on the plans. Any excavation that cannot be incorporated in embankments shall be disposed of.

The Contractor shall be responsible for the stability of all constructed embankments and shall replace at his or her own expense any portions, which have become displaced.

Borrow material shall not be placed until all suitable material has been excavated and placed in the embankments except when Sand Borrow or Granular Borrow is called for on the plans under embankments or used with material from excavation in making embankments.

Excavation

Any loose material resulting from breakage and slides shall be removed and disposed of in approved locations.

Excavation shall be sorted so that only clean non-frost susceptible soils are placed in embankments beneath the traveled way.

Disposal of Surplus Material

All surplus excavation and waste material shall be used to the extent possible to uniformly flatten slopes, or be deposited in such places within the project confines as may be indicated on the plans or as directed by the Design/Project Engineer. Excavated material shall not be wasted except as shown on the plans. Compaction requirements for surplus or waste material used to flatten slopes outside the embankment limits shown on the plans may be waived; however, placement procedures shall insure a stable fill slope.

Embankments

Preparation of Embankment Area - When embankments are to be made on a hillside, the slope of the original ground on which the embankments are to be constructed shall be stepped and properly drained as the fill is constructed.

Use of Materials - The excavated rock, ledge, boulders and stone, except where required in the construction of other items or otherwise directed, shall be used in the construction of embankments to the extent of the project requirements and, generally, shall be placed so as to form the base of an embankment.

Frozen material shall not be used in the construction of embankments, nor shall the embankments or successive layers of the embankments be placed upon frozen material. Placement of material other than rock shall stop when the sustained air temperature, below 32°F, prohibits the obtaining of the required compaction. If the material is otherwise acceptable, it shall be stockpiled and reserved for future use when its condition is acceptable to the Design/Project Engineer for use in embankments.

The Design/Project Engineer or Building Inspector may require certain select material from excavation or borrow to be used adjacent to structures to obtain the required compaction or to protect them from damage.

When shown on the plans, certain portions of rock excavation may be reserved for special use such as rock fill, for embankment construction at locations below high water, or at locations susceptible to erosion.

Procedure for Placing and Spreading - When a road or an embankment is to be constructed across open water or across swampy, wet ground, the Contractor shall remove the full depth of any muck or other unsuitable soils and the first layer of the fill shall be rock or material meeting the requirements for Granular Borrow.

When trucks are used to place earth from excavation or borrow, the material shall be deposited on the layer of embankment being constructed, bladed or dozed into place, and shaped and compacted. Dumping directly onto previously constructed layers will not be permitted.

Embankments of either earth or rock material shall be placed in horizontal layers of uniform thickness and across the full section width. When it is impractical to construct a layer full width across an embankment, partial width layers may be authorized, providing the full width procedure is resumed as soon as practical. Logs, stumps, waste material and oversized cobblestones or boulders shall not be placed within the structural embankment area. They may be placed outside the structural embankment area at approved locations or when authorized, disposed of as surplus material. Initial layers shall begin at the deepest part of the fill. Except for the first layer of fill over swampy ground and cleared areas, the loose layer thickness shall be limited to 8 inches. When conditions necessitate, the Design/Project Engineer may authorize layers in excess of 8 inches but not more than 24 inches. The Contractor will, at his or her expense, make all necessary excavations up to two feet deep so that the Design/Project Engineer or Building Inspector can determine moisture, density and stability.

Effective spreading equipment shall be used on each layer to obtain uniform thickness. Cobblestones or boulders having a least dimension greater than the loose layer thickness being placed shall be removed prior to compaction. Each layer shall be compacted as specified, and, if necessary, stabilized prior to a successive layer being placed. Each layer shall be kept crowned to shed water. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density, a uniform and satisfactory moisture content, and acceptable stability. The last lift constructed each day shall be graded, crowned and rolled to insure adequate drainage.

When AASHTO Soil Classification A4, A5, A6 or A7 cohesive soils have excess moisture and cannot effectively be air dried or dried by manipulation, The Contractor may layer or mix the material with dry AASHTO Soil Classification A1, A2 or A3 granular soils in order to obtain acceptable compaction and stability. The Contractor is responsible for making prudent use of available granular excavation from the project prior to being authorized the use of Granular Borrow. The combined loose thickness of mixed or layered materials prior to compaction shall not exceed 16 inches.

If, during the construction of the embankments, serious bulging, cracking or unstable movement occurs, the placing of the fill material shall be stopped, retarded, or corrected to allow the material to stabilize. Generally, rutting, rolling, shoving or other displacement in excess of 6 inches under the action of construction equipment will be considered evidence of stability problems.

Each layer between the design embankment limits shown on the plans shall be uniformly

compacted by the use of compaction equipment. Each layer shall be compacted to not less than 95% of material's maximum dry density determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. Field density determination will be made in accordance with AASHTO Standard Methods of Test, T-191 (sand cone method), T-238 (nuclear method). Field moisture determination will be made in accordance with AASHTO Standard Method of Test T180, or measured in accordance with AASHTO T-239 (nuclear method). Locations within the embankment limits where waste materials have been placed shall be compacted to the extent that stability is assured.

Provide at least the following tests to the approval of the Design/Project Engineer; in each compacted embankment layer, one field density test for every 200 cubic yards of fill material placed, but not less than one per lift. The responsibility and payment for testing shall be the Developer's.

All fill material shall be compacted at, a moisture content suitable for obtaining the required density. In no case, shall the moisture content in each layer under construction be more than two percent above the optimum moisture content, and shall be less than that quantity that will cause the embankment to become unstable during compaction. Sponginess, shoving or other displacement under heavy equipment shall be considered evidence that an engineered solution is necessary within the area affected to stop or retard the instability and allow the material to stabilize.

When moisture content of the material in the layer under construction is less than the amount necessary to obtain satisfactory compaction by mechanical compaction methods, water shall be added by pressure distributors or other approved equipment; water may also be added in excavation or borrow pits. The water shall be uniformly and thoroughly incorporated into the soil by disking, harrowing, blading or by other approved methods. This manipulation may be omitted for sands and gravels. When the moisture content of the material is in excess of two percent above the optimum moisture content, dry material shall be thoroughly incorporated into the wet material, or the wet material shall be aerated by disking, harrowing, blading, rotary mixing, or by other approved methods; or compaction of the layer of wet material shall be deferred until the layer has dried to the required moisture content by evaporation.

The density requirements will not apply to those portions of embankments constructed of material so coarse that it cannot by satisfactorily tested with conventional density testing apparatus. Material having a gradation with more than 35 percent retained on the No. 4 sieve will, generally, be considered too coarse for conventional density testing.

In areas inaccessible to power rolling, the embankment material shall be placed in uniform horizontal layers of not more than six inches in depth and compacted by means of approved mechanical tampers to the density requirements herein specified. The use of hand tamps will not be permitted.

2.3 TRENCHING, BACKFILLING, AND COMPACTING

A. DESCRIPTION

Work included: Trench, backfill, and compact as specified herein and as needed for installation of underground pipes, conduits, cables, wires or other utilities, manholes, catch basins, associated with the Work.

B. QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

The Contractor shall comply with requirements of governmental agencies having jurisdiction.

C. PRODUCTS

Soil Materials Fill and Backfill

Provide soil materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with no more than 15% of the rocks or lumps larger than 2-3/8" in their greatest dimension.

Fill material is subject to approval and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soil free from roots and other deleterious matter.

Do not permit rocks having a dimension greater than 1" in the upper 12" of fill.

Cohesionless material used for backfill: Provide sand free from organic material and other foreign matter, and as approved by the Design/Project Engineer.

Other Materials

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Design/Project Engineer.

D. EXECUTION

Surface Conditions

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

Procedures

Utilities:

- The Contractor shall contact all utilities before excavating to verify the location of any underground lines. The Contractor shall notify "Dig Safe" prior to any excavation. The Town of Colchester and the Champlain Water District are not members of Dig Safe and shall be contacted directly for field verification of their utility locations.

- Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, the Contractor shall repair or replace at no cost to the Utility.

- If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

- If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility.

- If the existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Design/Project Engineer and Building Inspector.

- Do not proceed with permanent relocation of utilities until written approval is received from the Municipality.

Protection of persons and property:

- Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.

Dewatering:

- Remove all water, including rainwater, encountered during trench and sub-structure

work to an approved location by pumps, drains, and other approved methods. Dewatering water is not allowed to enter public sanitary or storm sewer lines or private sanitary or storm sewer lines that ultimately connect to public sanitary or storm sewer systems.

- Keep trenches and site construction area free from water.

Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

Maintain access to adjacent areas at all times.

Trenching

Comply with pertinent provisions of this Section.

Provide sheeting and shoring necessary for protecting of the Work and for the safety of personnel.

- Prior to backfilling, remove all sheeting.

- Do not permit sheeting to remain in the trenches except when, in the opinion of the Design/Project Engineer and Building Inspector, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, the Design/Project Engineer and Building Inspector may permit portions of sheeting to be cut off and remain in the trench.

Open Cut:

- Directional Drill or Jack and Bore for all new pipelines under existing paved Municipal roads or streets.

- If conditions at the site prevent directional drilling or jacking and boring operations, and if approved by the Public Works Director, trenching may be used.

- Short sections of a trench may be tunneled if, in the opinion of the Town Engineer, the pipe can be installed safely and backfill can be compacted properly into such tunnel.

- Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects as directed by the Design/Project Engineer.

- When the void is below the subgrade for the pipe or utility bedding, use suitable earth materials and compact to the relative density directed by the Design/Project Engineer, but in no case to a relative density less than 90%.

- When the void is in the side of the pipe or utility trench, use suitable earth or sand compacted or consolidated as approved by the Design/Project Engineer, but in no case to a relative density less than 80%.

- Remove boulders and other interfering objects, and backfill voids left by such removals.

- Excavating for appurtenances

    - Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.

    - Over depth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or high slump concrete as approved by the Design/Project Engineer.

Trench shall be kept to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.

Depressions:

- Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.

- Except where rock is encountered, do not excavate below the depth indicated or specified.

- Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified.

Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.

Cover:

- Provide minimum trench depth to maintain a minimum cover over the top of the installed utility item below the finish grade.

All areas
- Sanitary sewers: 66"
- Stormdrains: 48"
- Waterlines: 72"

Shallower depths may be permitted with the addition of trench insulation. See details.

Backfilling

General:

- Do not completely backfill trenches until required pressure and leakage tests have been performed, and until the utilities systems as installed conform to the requirements specified in the pertinent Sections of these Specifications.

- Except as otherwise specified or directed for special conditions, backfill trenches to the ground surface with selected material approved by the Design/Project Engineer.

- Reopen trenches, which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Design/Project Engineer.

- Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals.

- Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, refill and compact as specified, all at no cost to the Municipality.

Lower Portion of Trench:

- Deposit approved backfill and bedding material in layers of 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil, or grade as specified herein, until there is a cover of not less than 24" over sewers and 12" over other utility lines.

- Take special care in backfilling and bedding operations to not damage pipe and pipe coatings.

Remainder of Trench:

- Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is

smaller, in any dimension.

- Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density approved by the Design/Project Engineer.

Adjacent to Buildings:

- Mechanically compact backfill within ten feet of buildings.

Jetting:

- Consolidation of backfill by jetting with water may be permitted, when specifically approved by the Town Engineer, in areas other than building and pavement areas.

Pipe Jacking and Boring

The Contractor will install steel pipe casings, tongue-and-groove reinforced concrete pipes, and steel pipes under existing roads or pavements by jacking or boring into place using materials and procedures defined in the CWD Standards Sections 34.00 through 36.00, Appendix A.

Tunneling Operations

The Contractor may, at his or her option, tunnel pipes into position using procedures approved by the Town Engineer.

Field Quality Control

The Design/Project Engineer will inspect and approve open cuts, trenches, jacking, boring and tunneling before installation of utilities for the following:

- Assure that trenches are not backfilled until all tests have been completed;
- Check backfilling for proper layer thickness and compaction;
- Verify that test results conform to the specified requirements, and that sufficient tests are performed;
- Assure that defective work is removed and properly replaced.

2.4 CONTROLLED BLASTING, EARTH AND ROCK EXCAVATION

A. DESCRIPTION OF WORK

The work to be done under this section includes:

- Furnishing all labor, equipment, materials, and services, and performing operations required to excavate rock as specified utilizing controlled blasting techniques such that resulting ground vibrations are consistently maintained below the maximum levels specified in this Section.
- Protecting new and existing construction, workers, owner, and the general public from damage or injury from improper handling of explosives, flyrock, and excessive ground vibrations.
- Furnishing, installing, and implementing an audible warning system to indicate impending blasting and familiarizing workers, engineer, owner, and the general public with the system implemented.
- Conducting blasting monitoring as required to excavate rock utilizing the blast monitoring procedures and equipment specified in this Section.

B. DEFINITIONS

Controlled blasting: Shall be considered to mean excavation in rock in which the various elements of the blast, including hole size, position, alignment, depth, spacing, burden, charge size, distribution, and delay sequence are carefully controlled to excavate the rock to the desired lines with a relatively uniform surface and minimum overbreak and fracture of rock beyond the design excavation limits and to maintain resulting ground vibrations within specified limits.

Earth: All excavated materials not defined as rock.

Flyrock: Fractured rock propelled through the air resulting from blasting if not prevented by use of blasting mats.

Geophone or vibration transducer: A sensor used to monitor ground vibrations (particle velocity components).

Grades or elevations: The design vertical levels to which excavation shall be conducted and thereby define the design vertical limits of excavation. The actual vertical limits of excavation will be determined by the amount of overbreak below the design grades after removal of overbreak and cleaning of the resulting rock surface as specified.

Overbreak: The excess amount of rock removed by and/or resulting from blasting outside beyond the A-line or below the design excavation grades indicated on the drawings.

Peak particle velocity: The maximum of any one of the three mutually perpendicular ground motion velocity components of a vibration measured in directions vertical, radial, and perpendicular to the vibration source.

Rock: Material which is geologically classified as intact, untransported rock, and requires

systematic drilling and blasting for removal. Rock does not include boulders or loose rock fragments less than one (1) cubic yard in volume.

Seismograph: An instrument used to record the magnitude and frequency of ground vibrations sensed by a geophone.

C. QUALITY ASSURANCE

Qualifications

The Contractor shall refer, in this specification section, to a qualified professional licensed blasting Contractor with a minimum of 5 years experience in the design, review, evaluation, and actual field experience in blasting operations. The blasting Contractor shall design, supervise, and conduct test blasts until regular production controlled blast patterns are developed that produce the required performance specified hereinafter while meeting the requirements for vibrations control. The Contractor shall assign an experienced, qualified Superintendent to be on the job site at all times to review the blasting operations and direct such changes in the blasting operation meeting the requirements of these Specifications. The Superintendent shall have a minimum of 5 years of experience in field blasting work.

All blasting shall be conducted by persons qualified and experienced in drilling and controlled blasting procedures for rock excavation of the types required. Persons responsible for blasting shall be licensed blasters in the State of Vermont and shall have had acceptable experience in similar excavations in rock and controlled blasting techniques. The Contractor must submit a list of previous similar projects he or she and the field Superintendent have done. Drillers shall have demonstrated proficiency in collaring and drilling holes precisely.

Codes, Permits, and Regulations

The Contractor shall comply with all applicable laws, rules, ordinances, and regulations of the Federal Govt., the State of Vermont, and the municipality governing the transportation, storage, handling, and the use of explosives. The Contractor shall comply with the following regulations:

- Vermont Department of Labor and Industry and the Vermont Agency of Human Services as promulgated by the Occupational Safety and Health Administration, United States Department of Labor, VOSHA Safety and Health Standards for Construction: "Subpart U-Blasting and the Use of Explosives" with amendments as of March 1, 1979, with any current revisions.
- Code for the Manufacture, Transportation, Storage, and Use of Explosives and Blasting Agents (N.F.P.A. No. 495).

The Contractor shall obtain and pay for all permits and licenses required to complete the work of this Section.

In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable code, regulation, or Specifications.

D. BLASTING LIMIT CRITERIA

Peak Particle Velocity Limits

The Contractor shall conduct all blasting in such a manner that the resulting peak particle velocity does not exceed 2.0 inch per second at the ground line adjacent to existing structures in the vicinity of the project.

Blast Monitoring

The Contractor shall monitor peak particle velocity resulting from all blast rounds fired for the project as required.

The Contractor shall permit the Design/Project Engineer to utilize the Contractor's blast monitoring equipment to conduct a test calibration at any time during the blast monitoring.

Blast Monitoring Reports

Following each blast, a Blast Monitoring Report shall be submitted to the Design/Project Engineer within 24 hours of the blast as specified in this Section.

Blast Monitoring Instrumentation

All instrumentation proposed for use on the project shall have been calibrated within the previous six (6) months to a standard, which is traceable to the National Bureau of Standards.

The Contractor shall cooperate with the Design/Project Engineer in permitting observation of the Contractor's drilling and loading procedures, as well as in providing detailed information on blasting operations.

The Contractor shall be completely responsible for all damages resulting from the blasting operations and shall, as a minimum, take whatever measures are necessary to maintain peak particle velocities within the specified limits, and to minimize damage to rock left in place. Modifications to blasting and excavation methods required to meet these requirements shall be undertaken at no cost to the Municipality.

E. SUBMITTALS

Advance Submittals

The Contractor shall submit the following information to the Design/Project Engineer and Building Inspector at least three (3) weeks prior to commencing drilling and blasting operations.

Sequence of blasting rounds indicating the general method of developing excavations.

Specifics of the proposed blasting procedures for round design to be implemented in each individual project area including control blasting technique(s) to be utilized to form the excavation perimeter:

- Diameter, spacing, burden, depth, and orientation of each blast hole for each round design.
- Nomenclature and amount (in terms of weight and number cartridges) of explosives and distribution of charge to be used within each hole, on each delay, and the total for the blast.
- Nomenclature and type of detonators; delay pattern wiring diagram for the round: type and capacity of firing source, size, type, and location of safety switches and lightning gap.
- Type and location of stemming to be used in holes.
- Calculations of anticipated vibration levels at nearest adjacent structure.

Methods of matting or covering of the blast area in open excavations to prevent flyrock.

Written evidence of the licensing, experience, and qualifications of the blasters who will be directly responsible for the loading of each shot and for firing it.

Name and qualifications of the Superintendent responsible for directing the blasting. This submittal shall document by project, lists and samples of blasting round design calculations that the Contractor and his or her personnel have the required experience in production and control blasting required to adequately and safely perform this work.

Details of an audible advance signal system to be employed at the job site as a means of informing workers, engineer, owner and the general public that a blast is about to occur.

List of instrumentation that the Contractor proposes to use to monitor vibrations.

Recent calibration certificate(s) (within previous six (6) months) for the entire proposed blast monitoring instrumentation. Calibration shall be over the required frequency response ranges specified for blast monitoring instrumentation and to a standard traceable

to the National Bureau of Standards.

Submit a shop drawing indicating the location(s), limits, and details of initial test blast(s) proposed by the Contractor to define the relation between charge weight per delay and peak particle velocity level.

Progress Submittals

Within 24 hours following each blast, the Contractor shall submit to the Design/Project Engineer a Blast Monitoring Report. Each Blast Monitoring Report shall include all of the following applicable items:

- Report of Blast Monitoring including observer identification, location, time, date, charge weight per delay, total charge weight per blast, monitor instrumentation location and information, particle velocity readings.
- Blast Monitoring Location Plan.
- General Blast Round Design Data including blast pattern, charge weights, and distributions, other pertinent information, and location.
- Copy of strip chart with calibration and monitoring record marked with the date, time, and location of the blast as well as the monitoring location.

Prior to changing the approved blast round designs, the Design/Project Engineer and Building Inspector shall be informed in writing as to the nature of the change and the reasons therefore. Changes shall be subject to the approval of the Design/Project Engineer and Building Inspector. Allow sufficient time for review.

In the event that the Contractor's design round results in ground vibrations which exceed the blasting limit criteria specified in this Section, the Contractor shall immediately revise the round design appropriately and submit the revised round design to the Design/Project Engineer and Building Inspector for approval.

Review by the Design/Project Engineer and Building Inspector of blast designs and techniques shall not relieve the Contractor of responsibility for the accuracy, adequacy, and safety of the blasting, exercising proper supervision and field judgment, and producing the results within the blasting limits required by these Specifications.

The Contractor shall report to the Design/Project Engineer and Building Inspector in writing all blasting complaints received by the Contractor within 24 hours of receipt. Each blast complainant, time received, date, and time of blast complained about, and a description of the circumstances, which led to the complaint.

F. JOB CONDITIONS

Blasting

The Contractor shall comply fully with codes, permits, and regulations for the transportation, storage, handling, and use of explosives.

No blasting shall be permitted between the hours of 6:00 P.M. and 7:00 A.M., and all day Saturday, Sunday, and legal holidays. The Contractor shall provide advanced warning prior to detonating a blast. The means of warning shall be acceptable to the Design/Project Engineer and Building Inspector.

Prior to construction, the Contractor shall have prepared by an independent consultant satisfactory to the Municipality, a survey of all existing structures and utilities on the site and within 500 feet of the site. Said survey shall address the structural integrity of all existing structures and utilities. Upon completion of blasting operations, the Contractor shall have prepared by the same independent agency, a survey addressing the structural integrity of the same structures and utilities.

Vibration Control

The Contractor shall monitor blasting vibrations for blast(s) during the course of the work as required.

Blasting operations shall be controlled to conform with the requirements in this Section.

If the data indicates that these requirements are not being met, take whatever measures are necessary including reducing the size of the charge, reducing the length of advance, covering, or matting blasts to reduce vibrations to below the maximum permissible levels specified.

The Contractor shall install a signal system between the location of the blasting machine or switch and the monitoring instrument locations so instrument operators may be notified immediately prior to detonation. The signal system shall be relocated whenever the instruments are moved.

The Contractor shall be completely responsible for all damages resulting from the blasting operations and shall take whatever measures are necessary to maintain peak particle velocities within the specified limits, and to minimize damage to rock left in place. Modifications to blasting and excavation methods required to meet these requirements shall be undertaken at no additional cost to the Municipality.

G. SAFETY PRECAUTIONS

Special Hazards

The Contractor shall take all special precautions in handling, storage, and wiring necessary to prevent accidental detonation of charges by natural (e.g. thunder-storms) or manmade (e.g. power lines, transmitters) sources.

Clearing the Danger Area Before Blasting

No blasting shall be permitted until all personnel in the danger area have been removed to a place of safety. A loud, audible, warning system shall be sounded before each blast. The Contractor shall familiarize all personnel on the project, the Engineer, Town, and the general public with the implemented system. The danger area shall be patrolled before each blast to make certain that it has been completely cleared and guards shall be stationed to prevent entry until the area has been cleared by the blaster following the blast.

Explosives shall be stored, handled, and employed in accordance with federal, state, and local regulations and in accordance with N.F.P.A. No. 495 as referenced above.

No explosives, caps, detonators, or fuses shall be stored on the site during non-working hours until a permit has been obtained from the State and Municipality and submitted to the Design/Project Engineer.

The Contractor shall be responsible for determining any other safety requirements unique to blasting operations on this particular site so as not to endanger life, property, utility services, any existing or new construction, or any property adjacent to the site.

Immediately after each blast, the sidewalls of rock excavations shall be scaled by experienced scalers to dislodge loose or shattered rock liable to fall. Previously excavated portions shall also be routinely tested and scaled.

No requirement of, or omission to require, any precautions by the Municipality shall be deemed to limit or impair any responsibility or obligations assumed by the Contractor under or in connection with a project; and the Contractor shall at all times maintain adequate protection to safeguard the public and all persons engaged in the work, and shall take such precautions as will accomplish such end, without undue interference to the public. The Contractor shall be responsible for and pay for any damage to adjacent structures resulting from work executed under this Section.

H. MONITORING PROCEDURE

Mount, place, and locate instrumentation as specified in this Section.

Align the axis of vibration measurement:

- Axis 1: Vertical
- Axis 2: Horizontal, radial direction to the blast location.
- Axis 3: Horizontal, perpendicular to the radial direction.

Set the strip chart(s) speed in accordance with instrumentation manufacturer's recommendations.

Make a calibration strip chart before blast detonation in accordance with instrumentation manufacturer's recommendations.

Clearly label the strip chart with calibration levels, control settings, location, time, and date of blast.

Coordinate closely with the blaster such that the strip chart is advancing at the time the blast is detonated.

During the measurement period, observe instrumentation to ensure that recorded vibrations correspond to blasting and not some other source.

END OF SECTION

SECTION 3. ROADWAY SPECIFICATIONS

3.1 GENERAL

This Section includes information regarding measures and materials for the design and construction of roadways, multi-use paths and sidewalks, and other infrastructure within the public right-of-way.

3.2 SOIL TESTING

Prior to submittal of preliminary drawings for the construction of new roads or the reconstruction of existing roads, soil borings and/or test pits shall be made by the developer at his or her expense to a depth of six feet (6') below final road grade surface on the basis of at least one representative test every 500' and at every change in soil type. Soil tests shall be performed by a soils laboratory acceptable to the Town on samples taken and the test shall consist of:

1. Standard sieve analysis and grain size distribution curve for each representative soil in the cross-sections; and

2. Plasticity index and liquid limit for each representative soil in the cross-section.

3. The highest seasonal groundwater elevation shall be determined.

The Town Engineer may waive the necessity for soil borings altogether or modify the spacing or depth requirements depending upon the specific groundwater and soil characteristics at each proposed roadway.

3.3 SUBGRADE

The subgrade shall be constructed in close conformity with the lines, grades and cross section shown on the plans. After all drainage structures and piping have been installed and the subgrade has been shaped correctly, it shall be brought to a firm, unyielding surface compacted to attain not less than 95% of the maximum density as determined by ASTM D1557/AASHTO T-180 Method A (Modified Proctor) test.

A power roller or other approved equipment shall be used during the grading to obtain the specified cross section.

Areas of soft, yielding or other unsuitable material that will not compact readily shall be removed and replaced with a suitable material and properly compacted.

All loose rock or boulders encountered at subgrade in the earth excavation shall be removed or broken off to a depth not less than 12 inches below the subgrade. Within the area to be lined with fabric, no stones larger than 1/2" in diameter may be in the top 6" of subgrade material.

In excavation areas, the ground shall not be excavated or disturbed below the subgrade except as shown on the plans. All ditches and drains shall be constructed so they will effectively drain the construction area before the placement of any subbase or base course material. In handling materials, tools and equipment, the Contractor shall protect the subgrade from damage. Vehicles should not travel in a single track and form ruts. If ruts are formed, the subgrade shall be reshaped and compacted and any pockets of clay, sand or soft material that may have been left in the subgrade shall be removed and replaced with approved material and properly compacted at the Contractor's expense. The subgrade shall be kept in such condition that it will drain. Subbase, base or surface material shall not be deposited on the subgrade until the subgrade has been checked and approved. After the subgrade has been approved, hauling shall not be done nor equipment moved over the subgrade, which will distort the cross section.

If any in-place material becomes contaminated by the Contractor's operations so as to no longer meet specifications, the Design/Project Engineer or Building Inspector may order that material to be removed and replaced at the Contractor's expense.

A tolerance of 2 inch above or below the finished subgrade will be allowed provided that this 2-inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the required cross section is maintained. Where placement of the subbase is not part of the work, a tolerance of one inch above or below the finished subgrade will be allowed, provided that this one inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the road cross section is maintained.

Maintenance

Protection of newly graded areas:

- Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
- Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.4 DRAINAGE GEOTEXTILES

A. DESCRIPTION

This work includes furnishing and placing geotextiles for drainage applications.

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects, which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 3.1.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

1. Shipment and Storage

The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.

2. Geotextile Placement

Prior to placement of the geotextile the surface will be prepared to a smooth condition free of debris, depressions, or obstructions which may damage the geotextile. The geotextile shall be placed in the trench, followed by the aggregate which should be placed so as to prevent damage to the geotextile. The geotextile shall be overlapped twelve inches or the full width of the trench, whichever is less, at the top of the trench. Fill material will be placed over the fabric and compacted to hold the fabric in place. Successive pieces of geotextile shall be overlapped a minimum of twelve inches in the direction of flow. Any damage to the geotextile shall be repaired by placing a patch extending three feet in all directions beyond the damaged area.

TABLE 3.1
PHYSICAL REQ0UIREMENTS[1]
DRAINAGE GEOTEXTILES[2]

Property[3]	Class A[4]	Class B[5]	Test Method
Tensile Strength - lbs.	180	90	ASTM D 4632
Elongation - %	50	50	ASTM D 4632
Puncture Strength - lbs.	105	55	ASTM D 4833
Burst Strength - psi.	330	175	ASTM 3786
Trapezoidal Tear – lbs.	75	40	ASTM D 4533
Apparent Opening Size – U.S. Sieve	#80 min.	#60 min.	ASTM D 4751
Flow Rate, gal/min/ft^2	105	145	ASTM D 4491
Ultraviolet Degradation[6] - %	70	70	ASTM D 4355

1. Acceptance of geotextile material shall be determined according to ASTM D 4759.

2. Municipality may require a letter from the manufacturer certifying that its geotextile meets specification requirements.

3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe applications. Lots sampled according to ASTM D 4354.

4. Class A drainage applications are for fabrics where installation stresses are more severe than Class B applications, i.e., very coarse sharp angular aggregate is used, a heavy degree of compaction (95% ASTM D1557 / AASHTO T180 Method A, Modified Proctor, test) is specified or depth of trench is greater than 10 feet.

5. Class B Drainage applications are those where fabric is used with smooth graded surfaces having no sharp angular projections, no sharp angular aggregate is used; compaction requirements are light, (<95% ASTM D1557 / AASHTO T180 Method A, Modified Proctor, test), and trenches are less than 10 feet in depth.

6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM-D-4355 for 150 hrs.

3.5 STONE FILL OR RIPRAP CONTROL GEOTEXTILES

A. DESCRIPTION

This work includes furnishing and placing geotextiles for separating stone fill or riprap.

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects, which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 3.2.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

1. Shipment and Storage:

The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.

2. Placement of Geotextile:

Unless otherwise specified, the geotextile shall be overlapped a minimum of two feet at all longitudinal and traverse joints, or the geotextile shall be sewn. If overlapped, the geotextile shall be placed so that the upstream sheet overlaps the downstream sheet. For placement on slopes, each strip shall overlap the next downhill strip. The geotextile shall be anchored using key trenches or aprons at the crest and toe of the slope. Pins, usually eighteen inches in length, may be helpful in securing the geotextile during installation.

3. Placement of Riprap or Aggregate:

Placement of riprap will begin at the toe of the slope and proceed up the slope. The riprap shall be placed so as to avoid damage to the geotextile, as approved by the Design/Project Engineer. Stones weighing in excess of 100 pounds shall not be allowed to roll downslope. Lower drop heights may be required, as approved by the Design/Project Engineer, if damage to the geotextile is evident.

TABLE 3.2
PHYSICAL REQUIREMENTS[1]
STONE FILL OR RIPRAP CONTROL GEOTEXTILES[2]

Property[3]	Unprotected[4]	Protected[5]	Test Method
Tensile Strength - lbs.	315	90	ASTM D 4632
Elongation - %	-	-	ASTM D 4632
Puncture Strength - lbs.	110	80	ASTM D 4833
Burst Strength - lbs.	510	250	ASTM 3786
Trapezoidal Tear – lbs.	110	80	ASTM D 4533
Apparent Opening Size – U.S. Sieve	> #100 [7]	> #70 [7]	ASTM D 4751
Permittivity, sec^{-1}	.4	.4	ASTM D 4491
Ultraviolet Degradation[6] - %	50	50	ASTM D 4355
Seam Strength - lbs.	-	-	ASTM D 4632

1. Acceptance of geotextile material is to be determined according to ASTM-D-4759.

2. Municipality may require a letter from the manufacturer certifying that its geotextile meets specification requirements.

3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM D 4354.

4. Unprotected stone-fill or riprap control applications are those where fabrics are used under conditions where installation stresses are more severe than class B, i.e., stone placement height should be less than 3 feet and stone weights should not exceed 250 pounds.

5. Protected stone-fill or riprap control applications are those where fabrics are used in structures or under conditions where the fabric is protected by a sand cushion or by "zero drop height" placement of stone.

6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM 4355 for 500 hours.

7. Apparent Opening Size

   a. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)
   b. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

3.6 SUBGRADE GEOTEXTILES

A. DESCRIPTION

This work includes furnishing and placing a geotextile to prevent mixing of base and subgrade materials in roadways and in other applications where it is necessary to prevent mixing of dissimilar materials.

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the requirements of Table 3.5. The choice of a geotextile for this application is determined by the ability of the geotextile to survive installation stresses. These stresses include subgrade strength, wheel loads, and lift thickness as shown in Table 3.4.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

1. Shipment/Storage:

The geotextile shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days. The fabric shall be labeled as per ASTM-D-4873.

2. Site Preparation:

The area should be cleared and any debris or obstructions which may damage the geotextile shall be removed. Trees and large bushes should be cut at ground level, and native vegetation and roots should be left in place.

3. Fabric Placement:

The geotextile shall be unrolled on the subgrade and laid smooth without excessive wrinkles. The geotextile shall not be dragged across the subgrade. The geotextile shall be overlapped or sewn depending upon subgrade conditions as shown in Table 3.3.

4. Placement of Aggregate:

Aggregate base shall be placed on the geotextile in lifts of not less than six inches. The aggregate shall be placed by back dumping and spreading of the aggregate material on the geotextile. Traffic shall not be permitted directly on the geotextile, and sudden stops or turns by equipment operating on aggregate placed over the geotextile shall be avoided. Pins or piles of fill can be used to hold the geotextile in place while being covered. End dumping or tailgate dumping of aggregate on the geotextile will not be permitted. Backfill shall be compacted as specified on the plans.

Any damage occurring during placement of the aggregate must be repaired immediately. The backfill shall be removed over the damaged area so as to allow placement of a patch extending three feet on all sides beyond the damaged area, followed by replacement of the fill material.

Table 3.3
OVERLAP REQUIRED

CALIFORNIA BEARING RATIO (CBR)	<0.5	0.5-1	1-2	>2
MINIMUM OVERLAP	Field Sew	3 ft.	2 ft.	1.5 ft.

Table 3.4
CONSTRUCTION SURVIVABILITY RATINGS

SUBGRADE CBR	1		1-2		>2	
TIRE PRESSURE (PSI)	<50	>50	<50	>50	<50	>50
COVER THICKNESS (IN)						
6	NR		H		M	
12	NR	H	M		M	
18	H	M	M		M	

H = High M = Medium NR = Not Recommended

TABLE 3.5
PHYSICAL REQUIREMENTS[1]
SUBGRADE GEOTEXTILES[2]

Property[3]	Survivability Medium[5]	Survivability High[5]	High Flow/ Groundwater[6]	Test Method
Tensile Strength - lbs.	200	315	315	ASTM D 4632
Elongation - %	15	15	15	ASTM D 4632
Puncture Strength - lbs.	75	120	120	ASTM D 4833
Burst Strength - lbs.	400	600	600	ASTM D 3786
Trapezoidal Tear – lbs.	75	120	120	ASTM D 4533
Apparent Opening Size – U.S. Sieve	> #50 [7]	> #4 [7]	min #40	ASTM D 4751
Permittivity, sec^{-1}	.05	.05	.05	ASTM D 4491
Ultraviolet Degradation[4] - %	70	70	70	ASTM D 4355

1. Acceptance of geotextile material is to be determined according to ASTM-D-4873.

2. Municipality may require a letter from the manufacturer certifying that its geotextile meets specification requirements.

3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM-D-4354.

4. Percent of tensile strength retained (ASTM-D-4632) after conditioning for 500 hours per ASTM 4355.

5. Construction survivability as defined in Table 3.4.

6. High flow/high groundwater properties refers to those site conditions were groundwater flow through the fabric exceeds that which can be managed with conventional stabilization (separation) fabrics. These conditions are usually evaluated on a qualitative basis, with the condition that the flow rate through the fabric should generally be an order of magnitude greater than that of the soil or base material being filtered.

7. Apparent Opening Size

   a. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)

   b. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

3.7 UNDERDRAINS

A. DESCRIPTION

This item includes constructing underdrains using pipe, stone, filter fabric, underdrain outlets, clean outs, and risers in accordance with these specifications and as shown on the approved drawings. The depth of the road underdrain shall be as required to effectively maintain the road subbase in a dry condition. The underdrain depth required in the Special Section is site specific and shall be determined based on site-specific design considerations as determined by the Project/Design Engineer and as approved by the Public Works Director.

B. MATERIALS

Perforated Polyvinyl Chloride (PVC): PVC SDR35 pipe shall conform to AASHTO M278 and ASTM F75B. Perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees.

Stone: Stone fill shall be clean, durable, three-fourths inch to one and one-half inch (3/4" to 1 1/2") stone.

Drainage Fabric: The fabric shall meet the requirement of the Drainage Geotextiles Section.

C. CONSTRUCTION METHODS

Trenches for underdrain shall be excavated to the dimensions and grade shown on the plans. Stone fill shall be placed to a depth of six inches (6") below the bottom of the pipe in conformity with the lines and grades shown on the plans.

Underdrain shall be placed in the center of the trench and firmly embedded in the material. The underdrain trench shall be backfilled to the gravel road base with three-fourths inch to one and one-half inch (3/4" to 1 1/2") clean stone. Placing shall begin at the outlet end and shall proceed toward the upper end. The under-drain shall be placed with perforations down.

The joints between sections shall be made by fitting the ends as tightly as practicable. PVC plastic underdrain shall be suitably joined with approved fittings by the same manufacturer. Upgrade ends of all underdrain pipe installations shall be closed with suitable plugs to prevent entry of soil material.

Underdrain cleanouts and cast iron covers shall be installed at locations shown on the plans. Unless other-wise directed, non-perforated pipe shall be used.

Backfill material shall not be placed directly in the trench by dumping from haul vehicles or by pushing material into trenches by bulldozers, graders, or other equipment. Placing shall be limited to the use of hand shovels, backhoes, front-end loaders, or other similar types of equipment.

3.8 SAND

A. DESCRIPTION

This item shall consist of a subbase course of sand in accordance with these specifications.

B. MATERIALS

Sand shall consist of material free from silt, loam, clay, or organic matter. It shall conform to the Vermont Standard Specifications for Construction for Sand Cushion, # 703.03. It shall be obtained from approved sources and shall meet the requirements set forth in this table:

TABLE 3.6
SAND CUSHION

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
2"	100
1 1/2"	90 – 100
1/2"	70 – 100
#4	60 – 100
#100	0 – 20
#200	0 – 8

3.9 GRAVEL BASE - BOTTOM COURSE

A. DESCRIPTION

This item shall consist of a base course composed of bank run gravel and filler constructed on a prepared subgrade in accordance with these specifications. The depth of gravel base required for the Special Section is site specific and shall be determined based on site-specific design considerations as determined by the Project/Design Engineer and as approved by the Public Works Director.

B. MATERIALS

All materials shall be secured from approved sources. Such gravel shall consist of hard, durable stones, which show uniform resistance to abrasion and which are intermixed with sand or other approved binding material in accordance with these specifications. It shall meet the requirements of Vermont Standard Specification for Construction, # 704.05 Coarse, Crushed Gravel for Subbase, or as periodically amended. The gravel shall be uniformly graded from coarse to fine and shall meet the grading requirements set forth in this table:

TABLE 3.7
GRAVEL FOR SUBBASE

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
4 inch	95 – 100
#4	25 – 50
#100	0 - 12
#200	0 – 6

All bottom course material shall be deposited and spread so as to distribute the material in uniform layers, compacted at optimum moisture content; and the maximum size stone particles shall not exceed two-thirds (2/3) of the thickness of the layer being placed.

C. PREPARATION OF SUBBASE

The subbase material shall be placed on a prepared surface with an approved spreader

box or by use of some other approved mechanical spreading equipment. The material shall be deposited so as to meet the requirements of the Vermont Standard Specifications for Construction, Section 301, or as periodically amended, and compacted to a 95 percent dry density by the ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. Where there is high groundwater or frost susceptible soils, subbase fabric and underdrains shall be installed beneath the roadway as required on the street details found in Appendix C of these specifications.

Protection of newly graded areas:

- Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
- Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.10 GRAVEL BASE - TOP COURSE

A. DESCRIPTION

This item shall consist of an upper course of crusher run gravel to be placed over the bottom course of bank run gravel, which will have been prepared in accordance with these specifications. This upper course shall conform to the following specifications and be placed in accordance with the lines, grades, and typical cross-sections as shown in the accepted drawings. Material shall meet Vermont Standard Specifications for Construction, Item # 704.05 Fine, Crushed Gravel for Subbase, or as periodically amended.

B. MATERIALS

All materials shall be secured from approved sources. This gravel shall consist of angular and round fragments of hard durable rock of uniform quality throughout, reasonably free from thin elongated pieces, soft or disintegrated stone, dirt, or other unsuitable material. The grading requirements shall conform to the following table:

TABLE 3.8
CRUSHED GRAVEL FOR BASE

Sieve Opening	Percentage By Weight Passing Square Mesh Sieve
2"	100
1 1/2"	90 – 100
#4	30 – 60
#100	0 – 12
#200	0 – 6

This upper course of crushed gravel shall be deposited and spread in a uniform layer and compacted to 95 percent dry density as determined by the ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test.

Secure the Design/Project Engineer's inspection and approval of subbase before subsequent construction is permitted thereon.

Protection of newly graded areas:

- Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
- Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.11 BITUMINOUS CONCRETE (ASPHALT) PAVEMENT

A. GENERAL

SUMMARY

The work of this section includes furnishing all labor, materials, tools and equipment necessary to construct all temporary and permanent bituminous bases and surfaces to the dimensions and in the areas shown on the Drawings. The Contractor shall maintain all temporary surfaces until the permanent surface is constructed.

Roadway, driveways and parking area subgrade excavation, embankment and fill shall be in accordance with the appropriate portions of the Earthwork Section of these Specifications.

REFERENCE STANDARDS

Reference is made in this section to the following standard specifications:

a. VTrans Spec. - "Standard Specifications for Highway and Bridge Construction", Department of Highways of the State of Vermont, as adopted 2011 or later.
b. ASTM - "Standard Specifications for Materials and Testing of the American Society of Testing Materials."

WEATHER LIMITATIONS ON PAVING OPERATIONS

Bituminous material shall not be applied between November 1 and May 1. The courses shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is below 40°F. Placing shall not begin until the air temperature is at least 40°F and rising. The Town Engineer may authorize in writing construction of bituminous concrete pavements at lower atmospheric temperatures than those specified or may extend the dates of the paving season. No pavement shall be laid in the rain and the underlying course shall be dry during paving operations.

Each load shall be covered with canvas or other suitable material of ample size to protect it from the weather. Deliveries shall be made so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight. The mixture shall be delivered to the area to be paved in such a manner that the temperature at the time of dumping into the spreader will not be less than that specified. Hauling over freshly laid material will not be permitted.

B. PRODUCTS

MATERIALS

Aggregate for Base and Surface Courses
Aggregate for base and surface courses shall consist of clean, hard, durable particles of crushed stone, gravel, sand and fine mineral particles conforming to "VTRANS" Spec. Section 704 as follows:

Base course - Section 704.05 Coarse, Table 704.05A or 704.06 Dense Graded, Table 704.06A – Crushed Gravel for Sub-Base.
Surface Course - Section 704.05 Fine, Table 704.05A - Crushed Gravel for Sub-Base.

AGGREGATES FOR BITUMINOUS CONCRETE PAVEMENT

The aggregates for bituminous concrete pavement shall be crushed stone, crushed gravel and/or sand uniformly graded.
Coarse aggregate shall conform to Standard Specification for Coarse Aggregate for Bituminous Paving Mixture, ASTM D692-69.
Fine aggregate shall conform to Standard Specification for Fine Aggregate for Bituminous Paving Mixture, ASTM D1073-69.
Mineral filler shall conform to Standard Specifications for Mineral Filler for Bituminous Paving Mixture, ASTM D242-64.

ASPHALT CEMENT FOR BITUMINOUS CONCRETE PAVEMENT

Asphalt cement for use in the construction of bituminous concrete pavements shall be prepared by refining crude petroleum by suitable methods and shall conform to Standard Specification for Asphalt Cement for Use in Pavement Construction, ASTM D946-69. The grade of asphalt shall be AC5, AC10, or AC20 as directed by the Design/Project Engineer.

EMULSIFIED ASPHALT

Emulsified asphalt shall be used as specified herein or on the Drawings and shall conform to Standard Specifications for Emulsified Asphalt, ASTM D977-69.

BITUMINOUS CONCRETE

The materials for all bituminous concrete shall be as specified herein and as shown on the Drawings. All bituminous Concrete shall be prepared in accordance with standard specifications for Hot-Mixed, Hot-Laid Asphalt Paving Mixtures ASTM D2629-60 which have been prepared in a plant which conforms to ASTM D995-67.

GRADATION

The materials shall be combined and graded to the following composition limits by weight:

TABLE 3.9
COMPOSITION OF MIXTURE

Sieve Designation	**Percentage By Mass (Weight) Passing Square Mesh Sieves**			
Sieve Size	Type I	Type II	Type III	Type IV
1 ½"	100			
1"	95-100	100		
3/4"	74-86	95-100	100	
1/2"	60-80	64-88	95-100	100
3/8"	-	50-82	70-90	95-100
#4	35-60	32-62	42-75	48-78
#8	25-45	22-45	28-56	28-56
#16	-	13-35	14-41	14-41
#30	10-25	8-27	7-31	7-31
#50	-	3-20	3-22	3-22
#200	2-6	2-6	2-6	2-6
Total Agg.	94-97	93-97	92-97	92-95
Bitumen (% of Total Mix)	3-6	3-7	3-8	5-8

a. These gradations taken from Section 406 of the State of Vermont Department of Highways Standards Specifications.
b. The class and thickness of pavements shall be as shown on the Drawings.

C. WORK

BASE AND SURFACE COURSES

Before any base course material is laid, the subgrade shall be prepared in a proper manner. All embankments shall be constructed as specified in the Earthwork Section of these Specifications and in all cases the top 6 inch layer of subgrade material shall be compacted in such a manner as to secure not less than 95% of the maximum density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test.

All materials used for the construction of the subgrade, base and surface shall be unfrozen and free from organic or other deleterious matter. No subgrade, base or surface construction shall take place at temperatures below 40°F.

Mineral aggregate base and surface courses shall be placed in layers not to exceed 8 inches loose depth and 6 inches compacted depth. Materials for each layer shall be distributed from moving dump trucks, spreader boxes of self-propelled spreaders. Material may also be spread by depositing it in one of two windrows and then spreading it with a blade grader.

After each layer is placed it shall be compacted with an approved roller weighing not less than 8 tons, or a rubber tired roller approved by the Engineer. Rolling of each layer shall be continued until a firm, solid and unyielding base is established before the next layer is begun. During compaction, the surface shall be graded to obtain a true even surface.

PLACING BITUMINOUS CONCRETE PAVEMENT

Placing Equipment

The bituminous concrete paver shall be a self-propelled unit with an activated screed or strike-off assembly, capable of being heated if necessary, and capable of spreading the mixture without segregation for the widths and thicknesses required.

The screed shall be adjustable to provide the desired cross-sectional shape.

The finished surface shall be of uniform texture and evenness and shall not show tearing, shoving, or pulling of the mixture.

The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.

Surface Preparation

Prior to laying the surface course, the underlying course shall be cleaned of all foreign or unsuitable material.

If the bottom course of bituminous concrete pavement is left over 30 days, the existing surface shall be cleaned. All longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the finish coat. Any large cracks in a bituminous surface shall be thoroughly cleaned and filled with a bituminous material or mixture approved by the Town Engineer. Emulsified asphalt shall then be applied to the existing pavement in a manner approved by the Town Engineer.

Contact surfaces such as curbing, gutters and manholes shall be painted with a thin, uniform coat of Emulsified Asphalt, immediately before the bituminous concrete mixture is placed against them.

If there are deficiencies in the base course that require corrective action, a bituminous concrete mix which meets the approval of the Town Engineer shall be used to bring the base course to the designed grade and contour.

Delivery

The range of acceptable temperatures of mixture delivered to the spreader shall be not less than 225°F nor more than 325°F. Material not within this temperature range shall be rejected.

Placing and Finishing

The mechanical spreader shall be adjusted and speed regulated so that the surface of the course will be smooth and of such depth that, when compacted, it will conform to the cross section, grade, and contour shown on the Drawings.

Unless otherwise directed, the placing shall begin along the centerline of areas to be paved on a crowned section and on the high side of section with a one-way slope.

The mixture shall be placed in strips having a minimum width of 10 feet, and the 6-inch strip adjacent to the area on which additional material is to be laid shall not be rolled until such additional material is placed, except when the work is to be discontinued.

After the first strips have been placed and rolled, the second strips and succeeding strips shall be placed and rolling shall be extended to include the 6-inches of the first strips not previously rolled. The succeeding strips shall be placed while the unrolled 6-inch section of the adjoining strip is hot and in a readily compatible condition.

Placing of the mixture shall be as continuous as possible.

A sufficient number of experienced shovelers and rakers shall follow the spreading machine, adding hot mixture and raking the mixture as required to produce a course that, when completed, will conform to all requirements specified. In areas where the use of machine spreading is impractical, the mixture may be spread by hand.

The mixture shall be dumped on approved dump boards outside the area to be paved. The mixture shall be distributed into place from the dump boards by means of hot shovels and then spread with hot rakes in a uniformly loose layer of such thickness. The loads shall not be dumped any faster than they can properly be handled by the shovelers and rakers.

COMPACTION OF BITUMINOUS CONCRETE PAVEMENT

Compaction shall be done by three wheel rollers or tandem rollers having a gross weight of not less than 8 tons and capable of providing a minimum compactive effect of 250 pounds per inch of width of drive roller. The rollers shall also be equipped with tanks and sprinkler bars for wetting the rollers.

Rolling of the bituminous concrete pavement shall begin as soon after placing as the mixture will bear the roller without undue displacement.

Rolling will start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, over-lapping successive trips by at least 1/2 the width of the rear wheel of the roller. Alternate trips of the roller shall be of slightly different lengths. The initial longitudinal rolling shall be effected by the use of 3 wheel rollers. Tests for conformity with the specified crown, grade and smoothness shall be made by the Contractor under the supervision of the Design/Project Engineer immediately after initial compression. Before continuing the rolling, any variations shall be corrected by removing or adding materials as directed. The course shall also be subjected to diagonal rolling using the tandem rollers crossing the lines of the first rolling while the mixture is hot and in a compatible condition. The speed of the rollers shall not exceed 3 miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture. Any displacement of the mixture occurring, as the result of reversing the direction of the roller, or from any other cause shall be corrected at once by the use of rakes and fresh mixture applied or mixture removed as required. Rolling shall be continued until all roller marks are eliminated and a density of at least 93 percent of the density of a laboratory specimen of the same mixture, subjected to 50 blows of a standard Marshall hammer, has been obtained for both courses.
Provide at least the following tests to the approval of the Design/Project Engineer:

- At paved areas, at least one field density test for every 10,000 sq ft of paved area, but

not less than three tests;

If, in the Design/Project Engineer's opinion based on reports of the testing laboratory, bituminous concrete pavement, which has been placed, is below specified density, provide additional compacting and testing under the provisions of these Specifications.

In all places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers. Hand tampers shall weigh not less than 25 pounds and shall have a tamping face of not more than 50 square inches. Skin patching of an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or in any way defective shall be removed replaced with fresh mixture and compacted to the density of the surrounding area. The roller shall pass over the unprotected edge of the course only when the laying of the course is to be discontinued for such length of time as to permit the mixture to become cold.

JOINTS IN PAVEMENT

Joints between old and new pavements or between successive day's work shall be made so as to insure a thorough and continuous bond between the old and the new pavement. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed and a joint constructed.

Butt joints shall be formed by rutting the pavement in a vertical plane at right angles to the centerline. The butt joint shall be thoroughly coated with Emulsified Asphalt just prior to depositing the paving mixture.

Longitudinal joints that have become cold shall be coated with Emulsified Asphalt before the adjacent mat is placed. If they have been exposed to traffic, they shall be cut back to a clean vertical edge prior to painting with the emulsion.

PAVEMENT SURFACE TOLERANCES

The surface will be tested by the Design/Project Engineer and Building Inspector using a 16-foot straightedge at selected locations parallel with the centerline. Any variations exceeding 3/16 of an inch between any two contacts shall be satisfactorily eliminated. A 10-foot straight-edge may be used on a vertical curve. The straight edges shall be provided by the Contractor.

CLEANING

Remove all bitumen from exposed surfaces of concrete curbs.

Remove all excess bituminous material from the project site.

3.12 PAINTED PAVEMENT MARKINGS

A. DESCRIPTION

Plain solid lines where indicated on the Drawings in the manner hereinafter specified.

B. MATERIALS

Markings shall be in accordance with 646.06 of the Vermont Standard Specifications. Durable Pavement Markings shall not be required.

C. CONSTRUCTION METHODS

Paint lines immediately after all aspects of the paving operations have been completed and before dirt or moisture can accumulate on pavement surfaces.

Carefully layout and define all painted lines on the surface of the pavement, by means of chalk markings, before painting, and accurately paint all lines within the limits and to the dimensions indicated on the Drawings. All surfaces must be thoroughly cleaned before lines are painted.

All lines shall be clear and distinct with sharply defined edges. Paint shall be applied at the rate of 70.0 - 73.15 square feet per gallon with glass beads applied at a rate of 8 pounds per gallon of paint for painted pavement markings.

Reflectorized paint pavement markings shall be applied by a method in which the liquid paint is applied to the road surface and the glass beads are immediately applied on the paint and firmly embedded therein, and which shall provide a retroreflective marking, with a night visibility satisfactory to the Municipality. The material shall have a minimum wet film thickness of 22±1 mil for paint, unless otherwise specified, and shall be applied in a smooth uniform coat, free from thin places or films of excessive thickness.

Protection - Install adequate barricades at, points where trespassing may occur, immediately after paving is completed so as to prevent vehicles or pedestrians from impeding the painting operation.

Removal of Equipment - Upon completion of the painting operation and once the paint has dried, remove all barricades and other debris, which has resulted from this operation.

3.13 CEMENT CONCRETE CURB

A. DESCRIPTION

This item includes a Portland cement concrete curb constructed on a prepared subgrade in accordance with these specifications and the cross-section shown in Figure 3.8.

B. MATERIALS

All concrete used in the construction of roadway curbs shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Design/Project Engineer. This concrete shall have a 28-day compressive strength of 3,500 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

Preparation of subgrade: All boulders, organic material, soft clay, spongy material, and any other objectionable material shall be removed and replaced with approved material. The concrete curbing shall be built to the required line and grade on a bed of fully compacted gravel a minimum of six inches (6") in depth.

Forms for concrete: The forms shall be of metal or of acceptable planed and matched lumber and of such construction that a smooth surface will be produced. All forms shall be oiled.

Placing and finishing concrete: Just prior to placing the concrete, the subgrade shall be moistened. After being mixed to the proper consistency, the concrete shall be placed in the forms and thoroughly tamped in place so that all honeycombs will be eliminated and sufficient mortar will be brought to the surface. The use of vibrators or other compaction equipment to move the concrete within the forms is not approved.

Immediately upon removal of the forms, the curbing shall be rubbed down to a smooth and uniform finish. No plastering or patching will be allowed. After the forms have been removed, the trench shall be backfilled with approved gravel and fill as needed and thoroughly tamped, care being taken not to affect the alignment or grade of the curbing.

Placement of the concrete by a curb-forming machine shall be allowed.

Expansion and contraction joints: Half-inch (1/2") expansion joints shall be placed at intervals of 20 feet. Expansion joint material shall confirm to AASHTO Designation M-135. At intervals not greater than 10 feet, nor less than five feet, the concrete shall be scored for a depth equal to one-third the total depth of the concrete.

Curing the concrete: When completed, the concrete shall be kept moist for a period of not less than three days or longer if the Design/Project Engineer or Building Inspector deems necessary and shall be protected from the elements in an approved manner. The Contractor shall apply Lin-Seal White curing and anti-spalling compound to the concrete according to directions of the manufacturer.

Seasonal limits: No concrete shall be poured on a frozen or thawing subgrade during unseasonable weather conditions or when the temperature is 38°F and falling. The Contractor shall record the temperature daily as outlined in the Proposed Recommended Practice - Cold Weather Concreting, ACI 306. In hot weather, the temperature of freshly placed concrete shall not be allowed to exceed 85°F, conforming to ACI 305.

Anti-Spalling Compound: Spray on in one even coat with a hand or power sprayer as soon as the surface water disappears from horizontal concrete surfaces at a rate of 200 sq. ft./gal. in accordance with manufacturer's instructions. Lin-Seal White curing and anti-spalling compound or Design/Project Engineer approved equal shall be used.

Curb cuts: Each house or business shall be allowed one curb cut unless otherwise approved by the Public Works Director. Curb cuts within existing curbs shall be performed in accordance with these specifications as well as the requirements within the Colchester Code of Ordinances Chapter 13 Streets and Sidewalks.

3.14 CEMENT CONCRETE SIDEWALK

A. DESCRIPTION

This item includes a sidewalk made of one course Portland cement concrete not less than five inches (5") thick and with a width of not less than five feet (5'). Where the sidewalk crosses a driveway, the depth of concrete shall not be less than six inches (6") for residential driveways and eight inches (8") for commercial and industrial driveways for the full width of the driveway. The sidewalk shall be constructed in accordance with these specifications and the cross-sections shown on the accepted drawings.

B. MATERIALS

All concrete used in the construction of cement concrete sidewalks shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 3,500 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

Preparation of subgrade: All boulders, organic material, soft clay, spongy material, and any other unsuitable material shall be removed and replaced with approved material. The sub- grade shall be properly shaped, rolled, and uniformly compacted to conform with the accepted cross-sections and grades.

Base: A minimum base depth of six inches (6") of compacted crusher run gravel (704.05) or sand (704.03) shall be constructed on the subgrade to accepted cross-sections and grades.

Forms for concrete: The forms for the concrete shall be of wood or metal, well-oiled, straight, free from warps or kinks, and of sufficient strength. They shall be staked securely enough to resist the pressure of the concrete without spring. When ready for the concrete to be deposited, they shall not vary from the approved line and grade and shall be kept so until the concrete has set.

Placing and finishing concrete: Just prior to placing the concrete, the subgrade shall be moistened. After being mixed to the proper consistency, the concrete shall be placed in the forms and thoroughly tamped in place so that all honeycombs will be eliminated and sufficient mortar will be brought to the surface. After this, the surface shall be brought to a smooth, even finish by means of a float. The surface shall be broom finished. All faces adjacent to the forms shall be spaded so that after the forms are stripped the surface of the faces will be smooth, even, and free of honeycombs. All edges shall be tool-rounded with an edge having a quarter inch (1/4") radius.

Expansion joints and scoring concrete: Half-inch (1/2") transverse expansion joints shall be placed at intervals not exceeding twenty feet (20'). Sidewalks shall be scored to a depth of one inch (1") every five feet (5'). Curb and sidewalk sections shall be separated by an expansion joint constructed of material conforming to AASHTO Designation M-135.

Curing / Anti-Spalling Compound: Same as for Cement Concrete Curb.

Backfilling: Backfill shall be of suitable bank run gravel and shall be placed and tamped until firm and solid. Backfilling shall follow immediately after the concrete forms have been removed.

Seasonal limits: No concrete shall be poured on a frozen or thawing subgrade during unseasonable weather conditions or when the temperature is 38°F and falling. The Contractor shall record the temperature daily as outlined in the Proposed Recommended Practice - Cold Weather Concreting, ACI 306. In hot weather, the temperature of freshly placed concrete shall not be allowed to exceed 85°F, conforming to ACI 305.

Detectible Warning Surfaces: Detectable Warning Surfaces shall be a pattern of truncated domes that is furnished and installed in conformance with ADA Accessibility Guidelines. The Detectable Warning Surface shall be supplied by East Jordan Iron Works, Inc., of East Jordan, MI, or Neenah Foundry, Neenah, Wisconsin, and installed in accordance with manufacturer requirements and recommendations for environmental conditions, surface preparation, installation and curing procedures, and materials compatibility.

3.15 TRAFFIC CONTROL DEVICES

All traffic control devices necessitated by the construction of the roadway shall be included on the design drawings and subject to Town review. The Developer shall be solely responsible for purchasing and erecting the signs or signals at his or her own expense. The Manual of Uniform Traffic Control Devices (MUTCD) shall be the controlling document for the installation of all signs or signals.

The minimum standards for traffic controls shall meet or exceed the requirements listed in Vermont Standard Specifications for Construction, Section 752 and at a minimum shall include the following:

1. Minimum 12-phase controller in ground mounted box.

2. Exclusive left turn signals for each approach (or per engineers design).

3. Accessible Pedestrian Signal on each corner including the following features:
   a. Pushbutton locator tones
   b. Audible and vibrotactile walk indications
   c. Tactile arrows
   d. Automatic volume control
   e. Countdown Timer with R10-3e Sign

4. Video detection cameras – at least one for each approach.

5. Fire pre-empt devise mounted on arm (Tomar, no substitutions).

6. Metal pole & arm (design approved by Town Engineer).

7. All visible items: color dark green or black.

8. Signal heads: Lightweight plastic with flat black glare reduction shields.

9. Proper signage: All signage to use symbols rather than letters.

10. Street lights mounted on metal or fiberglass poles.

11. Auxiliary power connection for traffic control devices.

The pavement markings, traffic signs, sign supports and signals shall conform to sections 646, 675, 677 and 678 of the Vermont Standard Specifications for construction, as required in these Specifications and as required by the Town Engineer.

The most current version of the Manual on Uniform Traffic Control Devices (MUTCD) shall be used for determining all roadway sign dimensions, colors, wording, placements, etc.

All signage shall be retro-reflective meeting ASTM D-4956 Type XI. Approved retro-reflective material shall be either 3M Diamond Grade DG^3 Reflective Sign Faces or Avery Dennison Omni-View Prismatic Grade Reflective Sheeting or approved equal. All signage shall be constructed of aluminum sheeting.

Street name signs shall be provided by the Developer and shall be in accordance with MUTCD Section 2D-43. Sign dimensions and lettering shall also be in accordance with the Standard Highway Sign 2012 Supplement, or latest revision, for Guide Sign Designation D3-1 with Green background, White border, and descending strokes, where applicable. Signs for private streets shall also bear the letters “PVT” after the Rd, St, Ave, or similar road type designation.

Road striping such as crosswalks, stop bars, median striping, lettering and arrows shall be installed by the Developer at his or her own expense. Placement of all pavement markings shall follow the VTrans E Series Drawings. All markings shall be Painted Pavement Markings in accordance with 646.06 of the Vermont Standard Specifications. Durable Pavement Markings shall not be required.

3.16 STREET LIGHTING

Street lighting shall be designed for all public streets and installed at the cost of the Developer. Streetlights shall be located for safety and security protection, generally at street intersections, crosswalks, bus stops, curves and installed on the sidewalk side of the street. The design of streetlights shall include the type of pole, type of luminaries, mounting base, wiring, wire conduit, junction boxes and electrical meter.

To ensure separation of Street Lighting to be maintained by the Town from private systems or primary and secondary electrical distribution systems, a complete electrical layout shall be required for all projects which include installation of public street or pedestrian lighting.

Design/Installation standards shall be in accordance with requirements of the Utility

Provider as well as all local, state and national electric codes. Posts, poles, brackets, and lights for overhead or decorative post top street lighting shall be approved as to size, type, and location by the Municipality. All luminaires shall be new, installed complete and fully energized prior to acceptance of the street by the Municipality. The street light disconnect shall be located outside of the public ROW or extended easement; sufficient easement area shall be given to the Utility Provider for the placement and maintenance of the street light disconnect; sufficient evergreen screening shrubs shall be provided such that the street light disconnect is not visible from the street and the screening shall in no way interfere with necessary minimum sight distances. The streetlights shall be owned by the Town upon acceptance of the street.

All luminaires shall be of the type as specified below and as indicated within Table 3.10 (Street Lighting Requirements by Zoning District):

- LED Overhead Type I (See Table 3.10)
    - IES Distribution: Type 2 Medium
    - Backlight Uplight Glare (BUG) Rating: U = 0%, others not to exceed 1%
    - Color: 4,000-4,300 K (Min. 70 CRI)
    - Wattage and Initial Lumen Output: 50 Watt Max. and 3,680 Lumens Min.
    - Universal voltage 120-277v, or 347-480v if required
    - Color options: Gray or Black (with matching pole and bracket arm)
    - Maximum Effective Projecting Area (EPA): 1.0 sq. ft.
    - Provided with NEMA photocell receptacle
    - Other Ratings or Certifications
        - UL Listed
        - Design Lights Consortium Qualified
        - 10K Surge Protection
        - 3G Vibration Rated
        - Warranty: 5 Year Min.
    - Acceptable Manufacturer / Model:
        - CREE / LEDway - STR-LWY-2M-HT-02-E-UL-SV-700-R-40K
        - Philips / RoadView - RVS-35W32LED4K-LE2-UNIV-RC-GY3

- LED Overhead Type II (See Table 3.10)
    - IES Distribution: Type 2 Medium
    - Backlight Uplight Glare (BUG) Rating: U = 0%, others not to exceed 2%
    - Color: 4,000-4,300 K (Min. 70 CRI)
    - Wattage and Initial Lumen Output: 70 Watt Max. and 5,400 Lumens Min.
    - Universal voltage 120-277v, or 347-480v if required
    - Color options: Gray or Black (with matching pole and bracket arm)
    - Maximum Effective Projecting Area (EPA): 1.0 sq. ft.
    - Provided with NEMA photocell receptacle
    - Other Ratings or Certifications

        - UL Listed
        - Design Lights Consortium Qualified
        - 10K Surge Protection
        - 3G Vibration Rated
        - Warranty: 5 Year Min.
    - Acceptable Manufacturer / Model:
        - CREE / LEDway - STR-LWY-2M-HT-04-E-UL-SV-525-R-40K
        - Philips / RoadView - RVS-55W48LED4K-LE2-UNIV-RC-GY3
        - Eaton / Ventus – VST-E02-LED-E-U-T2-AP-4-U

- LED Decorative Post Top
    - IES Distribution: Type 5 (0% Max. Uplight BUG Score)
    - Post Top Wattage: 35 or 55 Watts (See Table 3.10)
    - Finish Color: Black Textured (BKTX)
    - Maximum EPA: 2.75 sq. ft.
    - Acceptable Manufacturer / Model:
        - Philips (Lumec) / Metroscape (35 Watt) - MPTR-35W32LED4K-T-LE5-VOLT-PH8-BKTX
        - Philips (Lumec) / Metroscape (55 Watt) - MPTR-55W48LED4K-T-LE5-VOLT-PH8-BKTX

- Fiberglass Roadway Overhead Pole with Single 6’ bracket arm
    - Nominal luminaire mounting height: 20’-0” or 25’-0” (See Table 3.10)
    - Shaft length: 18’-9” or 23’-9”
    - Hand hole access (4” x 6” Min.) with aluminum door and vandleproof screws in color to match pole
    - Bolt Covers or Shroud in color to match pole
    - Color: Gray or Black to match Streetlight
    - Minimum EPA rating at 100 mph: 7 sq. ft.
    - 20’ Nom. Height - Acceptable Manufacturer / Models:
        - PLP Composite Technologies / 700 Series A720-M1/6
    - 25’ Nom. Height - Acceptable Manufacturer / Models:
        - PLP Composite Technologies / 700 Series A725-M1/6

- Aluminum Decorative Post
    - Shaft length: 12’ or 14’, as determined by luminaire wattage and location
    - Color: Black Textured (BKTX) to match post top luminaire
    - Minimum EPA rating at 100 mph: 8.7 sq. ft. (12’) and 4.7 sq. ft. (14’)
    - 12’ Post Acceptable Manufacturer / Model:
        - Philips (Lumec) - AM6F-12-BAS20-FS1-BKTX
    - 14’ Post Acceptable Manufacturer / Model:
        - Philips (Lumec) - AM6F-14-BAS20-FS1-BKTX

Note: Refer to Table 3.10 below for selection and spacing requirements. For installations along proposed or existing multi-lane streets (wider than two lanes,) adjustments for spacing, distribution, driver settings, and wattage may be necessary to meet IENSA roadway lighting requirements.

Photoelectric Control Device

- Twist-lock type, electronic solid-state photoelectric control device shall comply with ANSI C136.10, 2010 or latest revision and must meet IP 65 or more stringent requirement for sealed enclosure.
- Photo sensors shall be factory set to:
    - Turn on at 1.0 fc (1.5:1 Off/On ratio)
- Location of photo sensor shall not be affected by any output from luminaire or by any other lighting fixtures or building or reflected façade lighting.
- The relay shall have a time delay to avoid operation due to transient lighting.
- In the event of a failure, the relay shall fail safe to an open circuit condition, meaning the lights are left on in the event of a failure.
- Photocell shall be provided with a minimum 510 joule MOV lightning/surge protection
- Warranty Period shall be for a minimum of twelve (12) years
- Acceptable Manufacturer / Model:
    - Precision / EXDV-AP-TD
    - Intermatic / LED4536SC

Junction/Pull Boxes

- For junction or pull boxes located within vehicular travelways including emergency or maintenance access points, boxes shall comply with “Concrete Pullbox Standard” as shown on VTrans Standard Drawing E-173.
- For all locations outside of vehicular travelways but within pedestrian walkways or within three (3) feet of any vehicular or pedestrian travelway, boxes shall be constructed of polymer concrete or fiberglass/polymer concrete as indicated below.
- For all other areas, HDPE or “Plastic” boxes may be used.
- Polymer concrete or fiberglass/polymer combination boxes shall have exposed rings and covers consisting of polymer reinforced concrete having a minimum compressive strength of 11,000 psi and shall be provided with skid resistant top surface, stainless steel hex bolt down cover, cast labeling according to application (SIGNAL or LIGHTING,) and minimum load rating of Tier 15 (22,500 lb test load) per ANSI/SCTE 77, 2007. Acceptable Manufacturers / Models:
    - CDR 13”x24”x18”D Flared Wall Assembly (Base Model – B12132418A and Cover Model – C12132402A)

  - Quazite 13”x24”x18”D Flared or Straight Wall Assembly (Base Model PD1324BA18 and Cover Model PD1324BA18 or Base Model PT1324BA18 and Cover Model PT1324HA00)
- HDPE or “Plastic” boxes shall be made of injection molded polyolefin or polyethylene blend of plastic with ultra-violet additives per ASTM-D-V1248. Boxes shall be suitable for pedestrian traffic loadings and provided with green color, skid resistant surface, and stainless steel hex bolts. Acceptable Manufacturer / Model:
  - Carson L Series Model 1324-3B Bolt Down

Conduit

- For underground and above ground installations, conduit shall be rigid, non-metallic Schedule 40 or Schedule 80 Polyvinyl Chloride (PVC) manufactured in accordance with ANSI/UL 652 and meeting or exceeding requirements of NEMA TC-2.
- Maximum length of conduit runs between light bases, junctions, or connection to power supply stanchion shall not exceed three hundred (300) feet.
- Minimum cover shall be twenty-four (24) inch.
- Minimum conduit diameter shall be sized per NEC requirements but shall not have a nominal diameter smaller than one (1) inch.
- All conduits shall be overlain by warning tape labeled for underground electrical installations in ANSI red color at a height of twelve (12) inches above the conduit.

TABLE 3.10
STREET LIGHTING REQUIREMENTS BY ZONING DISTRICT

ZONING DISTRICT	REQUIRED LIGHTING	EXCEPTIONS
R3 Residential – high density residential	LED Decorative Post Top – 55w on 14' post, 400' o.c., at roadway intersections, pedestrian crosswalks, and turnarounds	Modify spacing to 100' o.c. adjacent to and within 100' of school property
R2 Residential – medium density residential	LED Decorative Post Top - 35w on 12' post, 400' o.c., at roadway intersections, pedestrian crosswalks, and turnarounds	Modify spacing to 100' o.c. adjacent to and within 100' of school property
R1 Residential – low density single family residential	LED Overhead Type I - roadway lighting luminaire mounted on 20' pole, 600' o.c., at roadway intersections, marked pedestrian crossings and turnarounds.	Modify spacing to 100' o.c. adjacent to and within 100' of school property
R5 & R10 Residential – low density in rural and agricultural area	LED Overhead Type I - roadway lighting luminaire mounted on 20' pole, at roadway intersections and marked pedestrian crossings.	
GD – General Development LS - Lakeshore	LED Decorative Post Top – 55w on 14' post, 100' o.c. on the sidewalk side of the street; at intersections, and turnarounds.	When sidewalks are on both sides of the street, stagger light poles at 140' o.c. (70' o.c. from center line of street)
COM – Commercial District BD – Business District	LED Overhead Type II - roadway lighting luminaire mounted on 20' pole and bracket arm at 140' o.c. on the sidewalk side of the street; at intersections, and turnarounds.	When sidewalks are on both sides of the street, stagger light poles at 280' o.c. (140' from centerline of street). For streets wider than 2 lanes, increase pole height to 25' and meet IESNA roadway average horizontal fc, higher wattage may be required.
IND – Industrial District	LED Overhead Type II - roadway lighting luminaire mounted on 20' pole and	For streets wider than 2 lanes, increase pole height to 25' and meet IESNA

	bracket arm at 300' o.c. on sidewalk side of the street, at intersections and turnarounds.	roadway average horizontal fc, higher wattage may be required.
AGR, AMU, FP, and all other similar districts	No street lighting	Where land use is for PRD or other Multi-Family uses or where new drives intersect with existing developments, use LED Overhead Type I roadway lighting luminaire mounted on 20' pole, 600' o.c., at roadway intersections, marked pedestrian crossings and turn-arounds.

3.17 PLANTING OF TREES

The Municipality shall require the planting of new trees in areas where no trees presently exist, within the area disturbed by new construction, or in an area which substantial loss of trees has or will occur in the process of the road construction.

Such trees shall be of a type specified in the **"Colchester Street Tree Master Plan"** (see Appendix D). Such trees shall be planted in fertile or fertilized ground and shall be watered and nurtured after planting until growth is assured.

Refer to the Colchester Street Tree Master Plan for min diameter size, placement of, spacing of and clearance to all trees. All new trees shall be planted inside of the street right-of-way and utility, drainage, or other public easements. Plantings shall be guaranteed for two years. Any plantings, which do not survive, shall be replaced prior to acceptance by the Town.

3.18 STREET GUARD RAIL OR BARRIER

This item includes the construction of twelve gauge standard steel beam-and-post guard rail, conforming to the design indicated on the accepted drawings, Sections 621 and 728 of the Vermont Standard Specifications for Construction as periodically amended, and pages G-1 and G-1d of the Vermont Design Standards.

This item may also consist of roadside barriers of other types, which shall conform to the latest edition of the AASHTO Roadside Design Guide and shall be approved by the Town Engineer.

3.19 STREET SIDELINE MONUMENTS

A. DESCRIPTION

This item shall consist of installing street property sideline monuments at all street intersections and at all points of curve and/or tangency of other critical points in the street lines as will enable a land surveyor to reconstruct the street geometry.

B. MATERIALS

Reinforced concrete monuments shall be those as manufactured by S.T. Griswold, or equivalent, and shall be 4”x4”x36”. The top shall have a marked center, which shall be the point of reference.

C. CONSTRUCTION METHODS

The monuments shall be set vertically and to a depth so that the top of the monument will project one-half inch (1/2”) above the surrounding finished ground surface. The monuments shall be set in place after all other street improvements are completed. The monument’s location shall be established by a surveyor licensed in the State of Vermont.

END OF SECTION

SECTION 4. STORM DRAINAGE SPECIFICATIONS

4.1 GENERAL

This Section includes information regarding measures and materials for the design and the construction of infrastructure used to treat, collect, and convey stormwater runoff.

4.2 PROJECT REQUIREMENTS

A. COMPLIANCE

The Developer shall be responsible for complying with the latest revisions of Vermont Water Quality Standards and protection of adjacent properties from degradation due to stormwater runoff. In addition, the Contractor shall comply with relevant local and state regulations governing the control of stormwater, which may include Chapter 18, Article VI of the Town of Colchester Ordinances and the State of Vermont's Stormwater Management Rule.

B. STORMWATER MANAGEMENT PLAN

For projects that disturb greater than 1 acre and create between one-half and one acre of impervious surfaces, a Stormwater Management Plan shall be submitted to the Town Engineer for review and approval prior to the issuance of a Building Permit and/or Septic Permit. See Chapter 18; Section 18-37 of the Town of Colchester Ordinances for specific Plan requirements.

4.3 STANDARD TREATMENT PRACTICES

A. COMPLIANCE

The standard treatment practices (STP) to be used for the purpose of providing the necessary water quality, channel protection, groundwater recharge, and/or flood control for a given project shall comply with the STP measures contained within the latest edition of the Vermont Storm Water Management Manual (Volumes I and II). These measures may include ponds, wetlands, infiltration practices, filters, and open channels.

B. ANALYSIS AND SIZING

The storm water collection system shall be properly sized to convey storm water flows in an efficient and effective manner to the required STP measures.

In addition to the 10-yr, 25-yr, and 100-yr storm events analyzed for flood control, a downstream analysis (as described in Section 2.5 of the Vermont Storm Water Management Manual Vol. 1) of the project site may be required by the Town Engineer on a case-by-case basis depending on the magnitude of the project, the level of risk to downstream public and private infrastructure, or other issues such as past drainage or flooding problems.

All new developments which include construction or upgrade of a public roadway as outlined in these Specifications shall be required to design associated stormwater treatment facilities to handle, at a minimum, the 25-year event.

Any culvert with a drainage area greater than 0.25 sq. miles (160 acres) will require a hydraulic engineering study. Culverts and bridges (structures with spans greater than 6 feet) shall be designed to convey the minimum design storm event as stipulated in the VTrans Hydraulics Manual based on roadway classification. In the case of perennial streams, designs shall also conform to Vermont Statewide Stream Alteration Standards. All bridges and open bottom structures will require a hydraulic engineering study and shall be designed to allow for passage of ice and debris.
The following minimum pipe diameters shall apply to new construction and replacement of existing structures:

- Driveway culvert – 15-inch diameter
- Roadway culvert – 18-inch diameter
- Combination Infiltration Trench/Storm Drain – 8-inch diameter
- Underdrain– 6-inch diameter (closed system receiving no surface drainage)

4.4 MATERIALS AND PRODUCTS

A. TYPES OF PIPE

Types of pipe which may be used for storm drain lines are Reinforced Concrete Pipe (RCP), Corrugated Polyethylene Pipe (PE), Corrugated Polypropylene Pipe (PP) and Polyvinyl Chloride Pipe (PVC). Types of pipe which may be used for culverts are Reinforced Concrete Pipe (RCP), Corrugated Polyethylene Pipe (PE), and Corrugated Polypropylene Pipe (PP).

REINFORCED CONCRETE PIPE (RCP)

Pipe shall conform to the Vermont Standard Specifications for Construction, Section 710, and AASHTO, M170. RCP shall be used where there is not sufficient cover for other pipe materials to structurally support the loads of passing traffic.

CORRUGATED POLYETHYLENE PIPE (PE)

Pipe shall conform to AASHTO M294-90, Type S.

CORRUGATED POLYPROPYLENE PIPE (PP)

Pipe shall conform to AASHTO M330, ASTM F2764, and ASTM F2881.

POLYVINYL CHLORIDE PIPE (PVC)

Pipe shall conform to ASTM Specification D-3034 or F679, (PVC) Sewer Pipe and Fittings, SDR35, or Perma-Loc sewer pipe and fittings in compliance with ASTM F794.

PVC pipe shall not be installed when the temperature drops below 32°F or goes above 100°F. During cold weather, the flexibility and impact resistance of PVC pipe is reduced.

Extra care is required when handling PVC pipe during cold weather. PVC pipe shall not be stored outside and exposed to prolonged periods of sunlight as pipe discoloration and reduction in pipe impact strength will occur. Canvas or other opaque material shall be used to cover PVC pipe stored onsite.

CORRUGATED GALVANIZED METAL PIPE (CGM)

This pipe material is not allowed for construction under municipally owned roadways, rights-of-way, or easements.

B. MANHOLES

Where indicated on the plans, the Contractor shall furnish and install manholes, which meet the requirements of the sanitary sewer manholes of these specifications. Precast sections shall be coated with dampproofing or shall be cast with a waterproofing concrete admixture. Frame and covers shall say “STORM” or “DRAIN” on the cover and otherwise meet the requirements of frames and covers as described in the Sewer section of these specifications.

C. CATCH BASINS

Catch basins shall be constructed of reinforced concrete and provided with cast ductile or gray iron frames and grates rated to carry a minimum design load of AASHTO H-20.

For paved areas, acceptable models include Models R-3210-A and R-3210-L as manufactured by Neenah Foundry of Neenah, WI and the Model 5520 (VTrans Model)

Frame with Type A, D, or E Grates as manufactured by EJ (formerly East Jordan Iron Works) of East Jordan, MI. Frames in curbed areas shall be provided with three flanged sides rather than four. In curbed areas, frames shall also be set to final grade only after the curbs have been completed.

For inlets in vegetated or unpaved areas, above models may be used and “liftmate” hinged arm or captive hinge models such as the Rexus Grating as manufactured by Certainteed Corp. of Valley Forge, PA, both R-3210-ALM and R-3210-LLM as manufactured by Neenah Foundry, and 5624 Heavy Duty Hinged Grate by EJ of East Jordan, MI are also acceptable.

Precast risers and base sections shall conform to the Vermont Standard Specifications for Construction, Section 604, or as periodically amended. Frames shall be brought to grade with rubber grade rings by Infra-Riser or approved equal. Precast risers and bases for manholes shall conform to ASTM Specifications C-361. Precast sections shall be coated with dampproofing or shall be cast with a waterproofing concrete admixture.

The pipe opening in the precast manhole riser shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Town Engineer. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

Catch basins shall have a minimum 24-inch sump.

D. DRAINAGE SWALES

Drainage swales and ditches that are being used to convey (but not provide treatment of) stormwater shall conform to Figures 4.5 and 4.6.

E. UNDERDRAINS

Perforated Polyvinyl Chloride (PVC): PVC SDR35 pipe shall conform to AASHTO M278 and ASTM F75B. For pipe sizes 6" and 8", perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

Cleanouts for underdrains shall be provided at upstream ends and at bends, where permitted. No bends will be permitted for combined drain/underdrain lines receiving surface waters. Cleanout frames and covers shall be cast iron. Castings shall be true to pattern and free from flaws. Bearing surfaces for cleanout frames and covers shall be machined to give continuous contact throughout their circumference. All iron castings shall be thoroughly cleaned and then coated with hot coal tar before being delivered.

Cleanout frames and covers shall not bear directly on the cleanout pipe. Cleanouts installed in yard areas or other areas outside of the traveled-way, may be installed with a valve box style riser. Cleanouts installed in the traveled way shall have a minimum 2-foot diameter, 2-foot high Precast concrete riser, open bottom, with minimum 8-inch wide, 6-inch high annular Precast footing. Frame and cover shall be cast-iron and marked "STORM" or "DRAIN" with a 20-inch minimum clear opening and HS-20 load rating.

4.5 CONSTRUCTION METHODS

A. LAYING PIPE

Storm drains and culverts shall be constructed in accordance with the Vermont Standard Specifications for Construction, Section 601, or as periodically amended; and on a trench bottom, they shall be prepared and bedded as shown on Figure 4.3. Each pipe shall be checked just prior to laying to ensure that it is clear of all dirt and debris. It shall be laid true to line and grade as indicated on the contract drawings. All joints shall be tight, and inverts shall be continuous.

PE pipe shall be firmly joined as recommended by the manufacturer, concrete pipe joints shall be a rubber-gasket type, and PVC pipe shall be joined with standard push-on type using elastomeric gaskets.

Storm drains and culverts shall be designed to have a minimum slope of 0.5%, a maximum slope of 20%, and designed based on project-specific requirements and as accepted by the Town Engineer.

B. PIPE BEDDING

Reinforced concrete pipe shall be bedded with material excavated from the trench having no stones larger than one and a half inches (1 ½") in the longest dimension. Should no excavated material be suitable, sand or gravel shall be used. Sand and Gravel shall meet the current Vermont Agency of Transportation Standard Specifications for Construction for these items.

PVC and PE pipe shall be bedded with fine graded crushed stone. Fine graded crushed stone shall meet the current Vermont Agency of Transportation Standard Specifications for Construction for this item and then backfilled with material excavated from the trench having no stones larger than one and a half inches (1 ½") in the longest dimension. Sand or gravel shall be used if no excavated material is suitable.

C. BACKFILL

Trenches shall be backfilled to subgrade with, wherever possible, material excavated from the trench, and shall be done only after the approval of the Design/Project Engineer. Material for backfilling shall be free of roots, stumps, and frost. Backfill shall not be placed on frozen material. Materials used for backfilling trenches shall be free of stones weighing more than thirty (30) pounds. No stones measuring over three inches (3”) in the longest dimension shall be placed within one foot (1’) of the pipeline being backfilled. Stones found in the trench shall be removed for a depth of at least six inches (6”) below the bottom of the pipe. Use of blasted rock, as trench backfill will not be permitted.

Backfill material shall be tamped in layers around the pipe to a sufficient height above the pipe to adequately support and protect the pipe. Backfill for pipelines under roadways shall be placed in six inch (6”) lifts, each lift being compacted to not less than 95% of maximum dry density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. Pipelines outside of roadways or in cross country routes shall be compacted to 90% maximum density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. If conditions warrant, the backfilling of trenches shall be done with mechanical equipment. Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe, pipe coating or structure. Backfilling in all public roadways shall be so compacted as to leave no depression in the road. Additional backfill requirements may apply within State Highway Right-Of-Ways. All public road surfaces shall be restored to a condition at least equal to that, which existed prior to the start of construction. Precautions shall be taken against undue damage to existing surface materials.

No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction.

Surplus excavated materials shall be disposed of in a satisfactory manner. Surplus material or spoil shall be removed promptly and disposed of in accordance with applicable State and local permits.

Trenches that have been improperly backfilled, enclosed or covered before inspection of fittings and joints shall be reopened and re-backfilled at the Contractor’s expense.

D. HEADWALLS

The Contractor shall construct pipe headwalls at the outfall end of all storm lines as shown on the plans. Headwalls shall be specifically designed Polyethylene end sections, concrete, or rubble masonry construction.

If constructed of concrete or masonry rubble, headwalls shall conform to the Vermont

Agency of Transportation Standard Specifications for Construction, Section 602. All concrete utilized for the purpose shall meet the requirements for Class B concrete as per the Vermont Standard Specifications for Construction, Section 501. End sections shall conform to the Vermont Agency of Transportation Standard Specifications for Construction, Section 711, or as periodically amended.

E. PIPE OUTFALLS

Stormwater outfall pipes shall be constructed to minimize the discharge velocity. The last 20' of pipe slope shall not exceed 2 %. This may require the use of drop manholes in the outfall. All outfalls will be properly lined with heavy stone appropriately sized to withstand the velocity of water when the pipe is running full. See Figure 4.4.

F. CATCH BASINS

Catch basins shall be installed on a compacted base of sand or fine graded crushed stone. The base material shall be covered with one layer of subgrade geotextile before placement of the structure. See Figure 4.1.

G. ACCESS ROAD

All necessary access routes shall have at least a fourteen foot (14') wide improved travel way capable of supporting the weight of a two-axle, forty thousand (40,000) pound vehicle and have an adequate turnaround at the end. See Figure 4.7.

H. CHAIN LINK FENCE

Stormwater ponds shall either be fenced to protect against hazards or the contours of the pond shall be benched to eliminate drop-offs or other safety hazards.

- Fabric – Chain link, 2" mesh, #9 gauge (0.148" diameter) wire. Top selvage shall be knuckled and bottom selvage shall be barbed.
- Line Posts – 1.9" diameter, nominal pipe, schedule 40.
- Terminal Posts – End, Corner and Pull Posts to be 2.375" diameter, nominal pipe, schedule 40.
- Post Spacing – Posts shall be spaced equidistant on a maximum of 8 feet center to center, except gate posts which shall be spaced according to the required gate opening.
- Post Footings – All posts shall be set to a depth of 34" in a 10" cylindrical shaped hole 42" deep filled with concrete.
- Tension Wire – A tension wire (0.192" diameter) shall be attached 1" below the top selvage and 2" above the bottom selvage of fabric with hog ring fasteners.

- Fabric Ties – Fabric to be fastened to posts and gate frames with (0.148” diameter) wire or tie bands.
- Truss Rods – To be 3/8” diameter (diagonal) bars with turnbuckle.
- Stretcher Bars – ¼” x ¾” flat bars with square edges.
- Gates – Gate frames to be 1.9” diameter nominal pipe, schedule 40, assembled by welding, riveting, or bolting, and shall be furnished complete with fittings. Gate posts shall be 2.875” diameter, nominal pipe, schedule 40. See Figure 4.8.

Refer to the Vermont Stormwater Treatment Standards for pond design information regarding pond benches (2.7.1.E Pond Landscaping).

END OF SECTION

SECTION 5. WATER DISTRIBUTION SPECIFICATIONS

5.1 GENERAL

This Section includes information regarding measures and materials for the design and the construction of water mains, valves, services, hydrants, and other infrastructure pertaining to municipal water transmission and distribution.

5.2 WATER DISTRIBUTION STANDARDS

The Town of Colchester adopts the Champlain Water Districts (CWD) Standards (Appendix A) for the materials, installation, and uses of water distribution systems with the following exceptions and clarifications:

MUNICIPAL NOTIFICATION & APPROVAL (GENERAL TO ENTIRE CWD)

Exception: Where the CWD Standards reference notification or inspection by the local water district or CWD, the Town of Colchester Building Inspector shall also be notified. Where CWD Standards reference review by the local water district or CWD, review is also required by the Department of Public Works, or other appropriate municipal officials.

STORM DRAIN SEPARATION (CWD 1.25)

Clarification and Exception: Separation between storm drain pipes, sanitary sewer pipes and water pipes shall be in accordance with the Vermont Water Supply Rule. Where the minimum separation distances cannot be met refer to the CWD documents.

RECORD DRAWINGS (CWD 1.26.02)

Clarification: Both the requirements of CWD Standards for record drawing information and submittal; and the requirements of these Standards shall be required to satisfy record drawing requirements on projects involving water system improvements.

ACCEPTANCE AND TRANSFER OF OWNERSHIP (CWD 1.26.04)

Clarification: Both the requirements of CWD Standards for procedures for acceptance and transfer of ownership; and the requirements of these Standards shall be required to satisfy requirements on projects involving water system improvements.

WATER MAIN SIZING STANDARDS (CWD 2.02)

Clarification: CWD lists the minimum pipe size as 8-inch diameter for all water mains and states that deviation from the minimum to a larger pipe size requires the submittal of sizing

calculations. Sizing calculations shall be submitted on ALL water mains, unless waived by the Town Engineer.

POLYVINYL CHLORIDE (PVC) PIPE (CWD 3.00)

Exception: No plastic (PVC or other plastic) water distribution or service lines are allowed in the Town of Colchester, unless they are required to withstand unusual soil acidity. Data measuring soil pH must be submitted to the Town prior to authorization to use these materials. Procedures, standards, etc. for use of PVC water pipe are detailed in the CWD Standards.

FIRE HYDRANTS AND HYDRANT BRANCHES (CWD 12.00)

Clarification: A four-inch (4”) Storz Connection on the pumper nozzle shall be required in place of the 4 ½” NST nozzle for All Water Districts within the Town.

Clarification: Where hydrants are being installed within the Fire District 2 service area, the acceptable color shall be Yellow as opposed to Red as listed in 12.09.

Clarification: Where design and construction of hydrant spacing is concerned, both the CWD Standards and the Colchester Town Ordinance Chapter 7 shall apply. Where conflicts occur, the more stringent standard shall apply.

SERVICE CONNECTIONS (CWD 15.00)

Clarification: Copper tubing shall by type "K", soft-temper, conforming to ASTM B88. The name or trademark of the manufacturer and type shall be stamped at regular intervals along the pipe. Copper service pipe shall be one piece from the corporation to the curb stop. The minimum service for a single-family residence shall be three-quarter inch (¾”). The minimum service for a duplex shall be one inch (1”).

Exception: Service sizes for homes with more than two bathrooms and non-residential uses shall be designed in accordance with applicable plumbing codes based on the number of fixture units in the building and/or any fire protection flow needs. Additionally, if the service line is to be longer than the minimum zoning setback, then the frictional headloss at the instantaneous peak demand shall be calculated and shall be additionally used in the size design. Service lines are required to have pressure calculations performed in the event that a home or building requires water service at a substantially different elevation than the water main to which the service connects in order to prove that

minimum pressure requirements are met in accordance with the Vermont Water Supply Rule and other applicable building codes.

ROCK EXCAVATION (CWD 17.00)

Exception: This section is superceded by pertinent portions of these Standards.

WATER MANHOLES AND VAULTS (CWD 24.00)

Exception: In addition to conformance with ASTM C478, all precast concrete manholes and appurtenances shall meet or exceed AASHTO HS-20 rating minimum. Buoyancy calculations are required on water manhole structures and vaults and must be submitted for review with the design.

Clarification: Drainage from any water manhole or vault shall have outlet protection and insect screening.

Exception: Precast concrete manhole and vault manufacturers shall use link seal products to produce a watertight wall penetration. Where appropriate double link seals shall be used. All link seal bolts shall be stainless steel. Flexible pipe sleeves are not allowed for pipe connections under pressure.

MANHOLE AND VAULT FRAME AND LID (CWD 25.00)

Exception: All manholes shall be provided with ductile iron manhole frames and covers. Frames and covers shall be in accordance with the Sewer section of the Colchester Standards, except that the covers on water structures shall be marked “WATER” in lieu of “SEWER.”

Exception: Where no traffic is possible or anticipated, water structures may be accessed via an aluminum hatch by Bilco or equal. Aluminum hatches shall be rated for 300 psf minimum and have a minimum clear opening of 30-inches. Aluminum hatches shall have a diamond plate skid pattern on them to provide traction; a locking mechanism to hold the hatch open; and be lockable for security purposes.

BACKFILLING (CWD 32.01)

Clarification: Material shall be considered “too wet” if the material is sufficiently above the optimum water content for the material properties to reduce the ability to achieve proper compaction. Additionally, the material shall also be considered “too wet” if the compaction equipment creates a safety hazard to the workers performing the compaction.

COMPACTION (CWD 32.02)

Exception: Where the CWD Standards reference standard methods for compaction, the acceptable method shall be AASHTO-180: Modified Proctor. The percent compaction that is acceptable does not change. AASHTO-99: Standard Proctor testing is not acceptable.

WATER/SEWER SEPARATION (CWD 33.02)

Clarification: When it is impossible to obtain horizontal and vertical separation on new installation, the sewer pipe material shall be installed as waterworks material with watertight joints and that material shall be PVC C900. Where possible this material shall be included in the design to allow for properly sized manhole boots.

END OF SECTION

SECTION 6. SANITARY SEWER SPECIFICATIONS

6.1 GENERAL

This Section includes information regarding measures and materials for the design and the construction of infrastructure to collect and convey sanitary sewer flows including manholes, pipes, services, and other appurtenances.

6.2 MATERIALS

A. TYPES OF PIPE

Types of pipe which shall be used for the various parts of work are as follows:

Gravity sewers shall be SDR 35 PVC solid wall pipe meeting ASTM Specifications D-3034 or F679, or ductile iron pipe.

Force mains shall be ductile iron with push-on joints, PVC SDR21, PVC CL150 DR18, or HDPE SDR 17 (minimum 100 psi pressure class) with butt-fused joints.

B. PVC SEWER PIPE

Gravity PVC Pipe

Gravity PVC sewer pipe shall conform in all respects to the latest revision of ASTM Specifications D-3034 or F679, Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, SDR35. Wall thickness of all Gravity PVC sewer shall meet ASTM Specifications for SDR35 pipe, or better. All pipe and fittings shall be clearly marked as follows:

Manufacturer's Name and Trademark
Nominal Pipe Size
Material Designation 12454C PVC
Legend "Type PSM SDR35 PVC Sewer Pipe" or
"PS 46 PVC Sewer Pipe"
Designation ASTM D-3034 or F679

Joints shall be push-on type using elastomeric gaskets and shall conform to ASTM D-3212. The gaskets shall be factory installed.

The pipe shall be furnished in nominal 14-foot, or 20-foot lengths. Sufficient numbers of short lengths and full machine fittings shall be provided for use at manholes, chimneys,

and connections. All connections will require the use of manufactured fittings. Field fabricated, saddle-type connections will not be considered acceptable.

Pressure PVC Pipe

Pressure PVC sewer pipe shall conform in all respects to the latest revision of ASTM D-2241, SDR 21. Wall thickness of all Pressure PVC sewer shall meet ASTM Specifications for SDR 21 pipe, or better. All pipe and fittings shall conform to ASTM D-2241.

Any pipe or fitting having a crack or other defect or which has received a severe blow shall be marked rejected and removed at once from the work site. All field cuts are to be made with saw and 90 degree miter box. Bevel the cut end to the same as the factory bevel and remove all interior burrs. Measure and place a homing mark on the pipe before assembling.

General PVC

The Contractor will submit certification that the materials of construction have been sampled, tested, and inspected, and that they meet all the requirements--including wall thickness--in accordance with ASTM D-3034 or ASTM F679 for all pipe and fittings to be included in the project work.

PVC pipe shall not be installed when the temperature drops below 32°F or goes above 100°F. During cold weather, the flexibility and impact resistance of PVC pipe is reduced.

Extra care is required when handling PVC pipe during cold weather. PVC pipe shall not be stored outside and exposed to prolonged periods of sunlight as pipe discoloration and reduction in pipe impact strength will occur. Canvas or other opaque material shall be used to cover PVC pipe stored onsite.

PVC pipe shall not be installed in locations where there is a likelihood of low molecular weight petroleum products or organic solvents or their vapors are present.

PVC pipe shall be installed with an approved tracing wire accessible in a Buffalo Box at approved locations. Tracing wire shall be placed at the top of the bedding material over the pipe. The wire shall have a one-inch (1”) PVC conduit under roadway and sidewalk crossings. Tracing wire may be Kris-Tech Wire Company #12 Solid PE 45 Blue, direct bury.

C. DUCTILE IRON PIPE

Ductile iron pipe shall be the thickness class designated in accordance with the manufacturer’s recommendations. All ductile iron pipe shall be centrifugally cast in molds

and shall conform to the latest revision of ANSI Standard A21.51 (AWWA C151); ANSI Standard A21.11 (AWWA C111), Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings; and ANSI Standard A21.10 (AWWA C110), Gray Iron and Ductile Iron Fittings 2" Through 48" for Water and Other Liquids.

All ductile iron pipe shall be cement lined and shall conform to ANSI Standard A21.4 (AWWA C104), Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water.

All fittings shall be push-on joint fittings unless noted otherwise on the plans with body thickness and radii in accordance with Sections 11-2 through 11-5 and 11-7 through 11-8 of ANSI A21.11.

Mechanical joint, ductile iron pipe shall be the thickness class designated in accordance with Manufacturer's recommendations and shall be installed at locations in accordance with Manufacturer's recommendations.

Mechanical joint ductile iron pipe shall conform to the specifications of ductile iron pipe, except for fittings which shall be mechanical joint with body thickness and radius of curvature conforming to ANSI A21.10 and mechanical joints which shall be in accordance with Sections 11-2 through 11-6 of ANSI A21.11.

D. POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE

Polyethylene pipe encasement shall be required in areas of corrosive soils and shall conform to the current AWWA C105/ANSI A21.5 standard**.** Minimum material requirements for the polyethylene film shall be high density; cross-laminated virgin polyethylene 4 mil film sleeves. In lieu of installing polyethylene encasement in known or suspected corrosive soils, the Town Engineer may approve the installation of other pipe materials including HDPE and/or C-900 PVC pipe.

E. MANHOLES

Manholes shall be placed at all changes in slope, size, alignment of pipe, at the ends of each line, at all intersections, and at least every 300 feet. The Contractor shall construct reinforced concrete manholes and drop manholes to the dimensions at the locations shown on the approved drawings. Drop connections shall be designed at manholes where the entering sewer invert is 2-feet or more above the manhole invert, in accordance with the standard detail (Figure 6.6). When a smaller sewer joins a large one, the inverts shall be aligned such that the larger sewer should be sufficiently lower to maintain the same energy gradient. On slopes exceeding 20%, follow Ten States Standards and submit hydraulic grade line calculations with plans for approval.

Manhole Excavation and Subbase

Manholes subbase shall be a compacted base of ¾" stone and underlain with a layer of subgrade geotextile fabric.

Precast Concrete Structure

All manholes shall be precast reinforced concrete manhole sections with tongue-and-groove joints with rubber composite grade rings, covers, anchorage, and accessories. All manholes shall be a minimum of 48-inches inside diameter. All precast concrete shall be rated for AASHTO HS-20 loading requirements and be made with 3000 psi concrete. All precast reinforced concrete manhole sections shall conform to the latest version of the ASTM Specifications C478. Precast risers and bases for manholes shall conform to ASTM Specifications C-361.

Dampproofing and Sealing

All exterior surfaces of the manhole shall be coated with two-coats of a waterproof sealant. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

Pipe Penetrations

The pipe openings in new precast manholes shall have cast-in-place flexible gaskets. Pipe openings for newly cored connections shall have a Kor-N-Seal connection. All flexible gaskets shall conform to the latest version of the ASTM Specifications C 923 (Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals).

Where force main discharge enters a manhole structure, a Link-Seal shall be used. Link-Seal connectors shall be resistant to wastewater and have stainless steel nuts and bolts.

Shelves & Inverts

Shelves shall be constructed with Class B concrete as defined in Section 501 of the VTrans Standard Specifications for Construction. Shelves shall slope at a minimum rate of ½-inch per foot toward the invert. No lateral sewer, service connection, drop manhole pipe, or force main shall discharge onto the surface of the shelf.

Inverts shall be designed and constructed to conform as closely as possible in shape and slope to that of the connecting sewers. The channel walls shall be constructed to the full height of the crown of the outlet sewer. Inverts shall be constructed with Class B concrete or, for straight runs, segments of pipe cut in half longitudinally. Inverts shall have the exact shape of the sewer to which they are connected, and any change in size or direction shall

be gradual and even. The minimum differential elevation across an invert shall be 0.1 feet. Additional differential elevation should be used when there is a bend in the invert or where there is a lateral confluence with unequal flow.

Steps

All manholes are to be precast with copolymer polypropylene plastic rungs with steel reinforcement twelve inches (12") on center.

Frames and Covers

All manholes shall be provided with heavy-duty frames and covers rated to carry a minimum design load of AASHTO HS-20. All frames shall be circular and shall be non-rocking designs provided with self-sealing gaskets. Manhole frames and covers shall be either gray cast iron, meeting ASTM A48 Class 35B and AASHTO M306, or ductile iron, conforming to the latest version of the ASTM Specification A536 grade 80-55-06. Frames and covers shall have a minimum 30-inch diameter clear opening and a minimum frame depth of 5-inches except frostproof models which shall have a minimum 28-inch diameter clear opening. Frames and covers shall be badged or labeled according to intended use with 3-inch minimum height letters reading “WATER”, “SEWER”, “STORM”, or other as approved by Engineer. Frames and covers shall also be provided with non-skid surfaces and coated to provide corrosion resistance.

The following makes and models are approved for use in both paved and un-paved areas, Model R-1743 as manufactured by Neenah Foundry of Neenah, WI or Model 2006 as manufactured by EJ (formerly East Jordan Iron Works) of East Jordan, MI. For watertight installations, use Neenah Model R-1916-H1 or EJIW 2006ZPT 2006A1PT Assembly. For frostproof installations with inner cover, use Neenah Model R-1758-G or EJ 1323G 2006A1 2009Z Assembly. Note: interior locking bar mechanism not required for frostproof or frost resistant installations.

For non-paved areas only, additional acceptable models shall also include the following: Pamrex 32-inch covers as manufactured by CertainTeed Corporation of Valley Forge, PA, Model R-1743-LM “Lift Mate” as manufactured by Neenah Foundry and EJ Model ERGO XL . Frames and covers shall be hinged and open to a minimum 100 degrees with a hold open mechanism at 90 degrees that will prevent accidental closure. The frames and covers shall be supplied with Penta Nut and Wrench locking devices. All covers shall be supplied with an infiltration plug. An elastomeric gasket shall be provided between with frame and cover to seat the closed cover.

Risers

Manholes shall be constructed to grade with at least one grade ring. Manhole risers shall be constructed with rubber composite grade rings. All grade rings shall have a minimum

outside diameter of 42-inches with a 30-inch diameter clear opening. The minimum thickness for a rubber composite grade ring shall be 0.5 inches and the maximum height of stacked rubber composite grade rings shall not exceed 3-inches. Tapered rubber composite grade rings shall be used to adjust covers to sloping finished grades. All grade rings shall be rated for H-20 loading. Rubber composite grade rings shall be Infra-Riser.

Manhole Patching Compound

Compound will be specifically designed for patching/sealing manhole surfaces. Material shall be non-shrink, fiber reinforced, suitable for horizontal or vertical installation, hydrogen sulfide resistant, freeze-thaw resistant, and suitable for installation under wet conditions.

Testing & Quality Assurance

All construction of sewer manholes must be carried out to ensure watertight work. Any leaks in manholes shall be caulked and completely repaired to the satisfaction of the Design/Project Engineer or the entire structure shall be removed and rebuilt. Repairs shall only be allowed to the exterior of the manhole.

Inspect dampproofing prior to installation to insure that it is continuous over all exterior surfaces.

Verify items provided by other sections of Work are properly sized and located. Verify that built-in items are in proper location, and ready for roughing into Work. (Steps are aligned, access is located in the correct location, inverts are aligned properly.)

The manhole water stop gasket and stainless steel clamp assembly must be approved by the Design Engineer prior to the installation of any pipe.

F. MASONRY

The brick for ordinary brickwork shall be common hard-burned clay brick. All brick shall be regular and uniform in shape and size with plane, parallel beds, and faces. Ordinary brick shall conform to ASTM Specification C-32, latest version, and shall be SS for invert and benches, first quality, sound, clay or shale hard brick.

Brick masonry shall be laid in Portland Cement mortar. All mortar shall meet ASTM C270 and shall be Types, S, M, or N. (Where below grade masonry may be subject to high water table conditions, Type S Mortar shall be required)

The sand for mortar for brick masonry shall be uniformly graded, clean, sharp, and contain no grades larger than will pass a one-eighth inch (1/8") mesh screen.

6.3 CONSTRUCTION METHODS

A. EXCAVATION

Excavations shall be made to a point at least six inches (6") below the pipe invert to accommodate the bedding material. All excavations are to be kept dry while pipe is being laid and until each joint and pipe has been inspected by the Design/Project Engineer and approval given, to commence backfilling operations.

B. LAYING SEWER PIPE

The bell end of the pipe shall face upgrade at all times and be placed in such a position as to make the invert even when the succeeding section is inserted. Where required by adverse grading conditions, the Contractor shall backfill any gully to make a suitable bedding for the sewer pipe. The backfill material shall be pneumatically compacted to a 95 percent dry density by the AASHTO-T-180, Modified Proctor test, upon which the six inches (6") of bedding material shall be placed.

Any pipe which is not laid to grade and alignment shall be reinstalled to the satisfaction of the Design/Project Engineer. The bedding material shall be placed and compacted on each side of the pipe to a height equal to one-half the pipe diameter and for the full width of the excavated trench in accordance with Figure 6.4.

C. PIPE BEDDING

Pipe shall be bedded with fine graded crushed stone. Fine graded crushed stone meeting the current Vermont Agency of Transportation Standard Specifications for Construction for this item shall be placed and tamped around the pipe to the point of initial backfill at six inches above the crown of the pipe as shown on Figure 6.4.

D. BACKFILL

Trenches shall be backfilled to subgrade with, wherever possible, material excavated from the trench, and shall be done only after the approval of the Design/Project Engineer. Material for backfilling shall be free of roots, stumps, and frost. Backfill shall not be placed on frozen material. Materials used for backfilling trenches shall be free of stones weighing more than thirty (30) pounds. No stones measuring over three inches (3”) in the longest dimension shall be placed within one foot (1’) of the pipeline being backfilled. Stones found in the trench shall be removed for a depth of at least six inches (6”) below the bottom of the pipe. Use of blasted rock, as trench backfill will not be permitted.

Backfill material shall be tamped in layers around the pipe to a sufficient height above the pipe to adequately support and protect the pipe. Backfill for pipelines under roadways shall be placed in six inch (6”) lifts, each lift being compacted to not less than 95% of maximum

dry density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. Pipelines outside of roadways or in cross country routes shall be compacted to 90% maximum density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. If conditions warrant, the backfilling of trenches shall be done with mechanical equipment. Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe, pipe coating or structure. Backfilling in all public roadways shall be so compacted as to leave no depression in the road. Additional backfill requirements may apply within State Highway Right-Of-Ways. All public road surfaces shall be restored to a condition at least equal to that, which existed prior to the start of construction. Precautions shall be taken against undue damage to existing surface materials.

No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction.

Surplus excavated materials shall be disposed of in a satisfactory manner. Surplus material or spoil shall be removed promptly and disposed of in accordance with applicable State and local permits.

Trenches that have been improperly backfilled, enclosed or covered before inspection of fittings and joints shall be reopened and re-backfilled at the Contractor's expense.

E. CONCRETE CRADLE AND ENCASEMENT FOR PIPE

Where required on the plans, in these standards, or as approved by the Town Engineer, a concrete cradle shall be used to bolster and strengthen pipe. Where required on the plans, in these standards, or as directed by the Engineer or Building Inspector to meet this standard or a State standard, concrete encasement for sewer pipes will be made to protect nearby wells or waterlines for stream crossings or for similar purposes. All concrete will be Class B as defined in the Vermont Standard Specifications for Construction, Section 501, and will meet the requirements of that section.

F. FROST PROTECTION FOR SHALLOW SEWERS

Sewers with less than five and one-half feet (5 1/2') of cover over the crown or sewers crossing culverts or other storm drains shall be protected against freezing by installation of two inch (2") thick Styrofoam SM insulating sheets with a total width of four feet (4') or twice the pipe diameter, whichever is greater. The sheets shall be placed six inches (6") above the crown of the sewer after compaction of the six-inch lift immediately above the crown. Care shall be exercised by the Contractor during backfill, and compaction over the insulation. Insulation shall be styrofoam SM sheets. The styrofoam SM sheets shall meet the compressive strength requirements of ASTM D1621-73; and shall be as manufactured

by Dow Chemical Company, Midland, Michigan, or equal. In no case shall the sewer lines have less than four (4') feet of cover over the top of the pipe.

G. MANHOLE EXCAVATION AND SUBBASE

Manholes shall be set on a compacted base of ¾" stone. The base material shall be covered with a layer of subgrade geotextile fabric before setting the manhole. The manhole cover frames shall be set to final grade only after the base course paving has been completed.

H. MANHOLE CONSTRUCTION

Manhole sections shall be plumb and level. Joints shall be thoroughly cleaned prior to installation of joining material in accordance with manufacturer's recommendations. All manhole lift holes shall be grouted inside and out with expandable grout.

I. MASONRY

Each brick shall be wetted and completely bedded in mortar at its bottom, sides, and ends in one operation with care being taken to fill every joint. Brickwork shall be well-bonded, and joints shall be as close as practicable. No brick masonry shall be laid in water nor shall any water be allowed to rise on or around any brick masonry until it has set at least 24 hours. No masonry shall be laid in freezing weather.

Cold Weather Requirements: Comply with recommendations of IMIAWC (CW). IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

Maintain materials and surrounding air temperature to minimum 50 degrees F (10 degrees C) prior to, during, and 48 hours after completion of masonry work.

J. DEFLECTION TESTING FOR GRAVITY SEWERS

The pipe installed under this specification shall be installed so that the initial deflection, measured as described below, shall be less than five percent (5%).

Deflection tests shall be performed on all flexible pipes after the final backfill has been in place for at least 30 days. The deflection test shall be run using a rigid ball or mandrel having a diameter equal to 95 percent of the inside diameter of the pipe. No mechanical pulling devices shall be used during the deflection tests. All pipes not meeting the deflection test shall be re-excavated and replaced at the Developer's expense.

K. LEAKAGE TESTS AND ALLOWANCES FOR GRAVITY SEWERS

The low-pressure air test will be used to simulate infiltration or exfiltration rates into or out of all gravity sewers. The Contractor will furnish all facilities and personnel for conducting the test.

Final acceptance of the sewer shall depend upon the satisfactory performance of the sewer under test conditions. The test shall be performed on pipe between adjacent manholes after backfilling has been completed and compacted.

All wyes, tees, laterals, or end-of-side sewer stubs shall be plugged with flexible-joint caps, or an acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible-jointed lateral connection or extension.

Prior to testing for acceptance, the pipe should be cleaned by passing through the pipe a full gauge squeegee. It shall be the responsibility of the Contractor to have the pipe cleaned. Immediately following the pipe cleaning, the pipe installation shall be tested with low-pressure air.

Air shall be slowly supplied to the plugged air installation until the internal air pressure reaches four pounds per square inch (4.0 psi) greater than the average backpressure of any groundwater that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

The pipeline shall be considered acceptable when tested at an average pressure of three pounds per square inch (3.0 psi) greater than the average back pressure of any groundwater that may submerge the pipe if:

- The total rate of air loss from any section tested in its entirety between manhole and cleanout structures does not exceed 2.0 cubic feet per minute; or
- The section under test does not lose air at a rate greater than 0.0030 cubic feet per minute per square foot of internal pipe surface.

The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 or 2.5 psi greater than the average back pressure of any groundwater that may submerge the pipe is not less than that computed according to the following table:

TABLE 6.1
MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

Diameter (Inches)	Time (sec/100')	Diameter (inches)	Time (sec/100')
3	10	21	485
4	18	24	634
6	40	27	765
8	70	30	851
10	110	33	935
12	158	36	1,020
15	248	39	1,105
18	356	42	1,190

The table gives the required test time in seconds per 100-foot lengths of pipe for a given diameter. If there is more than one pipe size in the section of line being tested, compute the time for each diameter; and sum the times to find the total required test time.

If the pipe installation fails to meet these requirements, the Contractor shall determine at his or her own expense the source or sources of leakage and shall repair (if the extent and type of repairs proposed by the Contractor appear reasonable to the Engineer) or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of this test before being considered acceptable.

Since this test does not determine the tightness of manholes, they shall be tested separately.

It is noted that all existing sanitary sewers shall be kept operational until new work has been tested and approved by the Design/Project Engineer. At such time, existing sewers and sewer services shall be connected to the new sewers.

L. MANHOLE LEAKAGE TESTING

Perform vacuum tests on all manholes. Exfiltration tests on manholes shall be performed in case of vacuum test failure or may be submitted as a substitution with approval of Engineer.

The Design/Project Engineer shall observe all tests.

Repairs to manholes found to leak by any test method shall be performed both inside and outside the structure by a method approved by Design/Project Engineer.

Preparation

After manholes have been assembled in place, fill and point all lifting holes with non-shrink grout. Do not place non-shrink grout between precast sections until after successfully testing the manhole.

All manholes shall be tested prior to backfilling to allow for compression of the mastic joint sealant.

Test all manholes with pipes and/or stubs installed. Testing with through pipes to be removed and replaced is not acceptable.

Any situation in which the pipe to manhole connection is disassembled after testing shall be re-tested at the Contractor's expense.

Make the tests prior to placing the shelves and inverts and before filling and pointing the horizontal joints below the 6-foot depth line.

Suitably plug all pipes and other openings into manhole.

Test Procedure: Vacuum

Use only an approved testing machine. The equipment shall be in good working order. Gauges shall be suitably sized such that the test vacuum pressure is at the mid-point of the span of the gauge. Equipment and testing shall only be conducted by trained personnel that are familiar with the equipment and methods utilized.

Securely brace all piping plugs.

Check cone section to insure a good seal with the testing equipment bladder.

Testing Requirements:

- Bring test vacuum to 10 inches Hg gauge.
- Test duration for manholes 0 to 10 feet shall be 2 minutes.
- Test duration for manholes 10 to 15 feet shall be 2.5 minutes.
- Test duration for manholes greater than 15 feet shall be 3 minutes.
- Allowable leakage is 1" Hg or less over the test duration given. If pressure drop exceeds this limit, the manhole shall be repaired and retested.
- If the manhole fails after being repaired, the manhole shall be Water Exfiltration tested as specified herein.

Test Procedure: Water Exfiltration Test

Lower the groundwater below the bottom of the manhole for the duration of the testing.

If the excavation has not been backfilled and observations indicates no visible leakage, the manhole may be considered to be satisfactorily watertight.

Fill the manhole with water to the top of the cone section. During testing, no allowances are made for absorption. If Contractor wishes, a period of time may be allowed to allow absorption to occur and then the water level may be adjusted prior to beginning the test.

At the end of the absorption period, refill the manhole to the top of the cone and begin measuring over an eight-hour period.

At the end of the test period, refill the manhole to the top of the cone and measure the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage shall be determined on the basis of depth. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period.

If the test fails the leakage rate noted above but does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as approved by the Engineer to bring the leakage within the allowable rate.

Leakage due to a defective section or joint exceeding the 3-gallon per vertical foot per day shall be cause for the rejection of the manhole.

Manholes may be water tested simultaneously with non-pressure pipes. If the allowable leakage is exceeded, separately test each manhole and each run of pipe in the failed section.

A combined exfiltration test of piping and manholes can be accomplished by lowering the groundwater table to below the bottom of the manhole (and pipe). Install a watertight plug in the pipe at the downstream manhole and another watertight plug in the incoming pipe(s) in the upstream manhole. Fill the upstream manhole until water reaches its highest point without overflowing.

More than one manhole may be included in a test section provided that when the lowest manhole is filled, the water level in the other manholes is at least two feet above the highest manhole joint, and the interconnecting piping is subjected to at least a four feet differential hydrostatic pressure.

Allow at least four hours for stabilization. Conduct the test for a minimum of six hours. Allowable exfiltration is 50 gallons per inch of internal pipe diameter per mile per day plus the allowable manhole exfiltration specified above.

M. LEAKAGE AND PRESSURE TESTING FOR FORCE MAIN

All pipelines shall be tested in accordance with the Vermont Department of Water Resources Environmental Protection Rules, latest edition. A leakage and pressure test shall be performed concurrently.

The hydrostatic test pressure shall be a minimum of 50 psi at the highest point along the test section and shall not vary by more than five psi during the entire two-hour test. If and when during the test the pressure drops by five psi, the quantity of water required to restore the test pressure shall be measured.

At the end of the two-hour test, the pressure shall be returned to the test pressure and the additional volume of water measured. The total amount of water used during and at the end of the test shall constitute the actual leakage. The maximum allowable leakage shall be determined by the following formula:

$$L=\frac{ND\sqrt{P}}{7400}$$

Where:
- L = leakage in gallons per hour
- N = number of joints in the tested area
- D = diameter of pipe in inches
- P = average test pressure in psi

N. CLEANING PIPELINES AND APPURTENANCES

Upon completion of construction, all dirt and other foreign material shall be removed from pipelines and their appurtenant constructions. No materials shall be left in the pipelines to impede normal flow through them.

O. SEWER SERVICE CONNECTIONS

The minimum sewer service connection for a single-family residence shall be four-inch (4") diameter pipe of the type material specified under this section. Commercial buildings or multi-family residences shall be sized in accordance with the State of Vermont Plumbing Code. The pipe shall be laid and its joints made as required for sewer construction in this specification.

Open ends of pipes shall be properly sealed to prevent damage and intrusion of foreign matter where hookup to the building sewer is not coincident with sewer main construction. Additionally, the Contractor will provide a PVC pipe temporary marker approved by the

Building Inspector from the sewer service invert up to twenty-four inches (24") above the finished grade. The marker shall be seated securely into the ground for ease in relocating the end of sewer service connection for hooking up the building sewer.

In the case of reconnection of existing services, such reconnections will be made only after the new sewer main has been completed, tested, and accepted. The excavation, bedding material, installation, and backfill for service connections shall be the same as for sewer mains.

P. CLEANOUTS FOR SEWERS

Cleanouts for gravity sewers and force mains shall be provided at locations as indicated on the plans.

Cleanouts for 4-6” gravity sewers (individual building or service laterals) are required at bend locations and 100’ maximum spacing. The Town reserves the right to require a cleanout at the right of way for 4-6” service lines as determined by the Director or designee on a case by case basis. For 8” or larger private service laterals or collection mains, manholes shall be required at connection to public main, bends and 300’ maximum spacing. Where vertical separation between connecting mains is equal to or greater than 2’, a drop structure shall be provided.

Cleanouts for force mains shall be provided at low points when such low points cannot be avoided and at 1,000’ maximum spacing. Air and Vacuum Relief Valves shall be provided on force mains at high points and at all locations where vertical grade changes are in excess of 20’. Force main cleanouts shall be installed with a check valve or other valve prior to the end cap to protect workers from opening a pressurized line. Valves must be operable without excavation of the cleanout. All cleanouts shall have a threaded PVC end cap that can be opened without excavation of the cleanout.

Cleanout frames and covers shall be of tough gray cast iron. Castings shall be true to pattern and free from flaws. The bearing surface of cleanout frames and covers against each other shall be machined to give continuous contact throughout their circumference. All iron castings shall be thoroughly cleaned and then coated with hot coal tar before being delivered.

Cleanout frames and covers shall not bear directly on the cleanout pipe. Cleanouts installed in yard areas or other areas outside of the traveled-way, may be installed with a valve box style riser. Cleanouts installed in the traveled way shall have a minimum 2-foot diameter, 2-foot high Precast concrete riser, open bottom, with minimum 8-inch wide, 6-inch high annular Precast footing. Frame and cover shall be cast-iron and marked “SEWER” with a 20-inch minimum clear opening and HS-20 load rating.

Q. CHIMNEYS

Chimneys shall be built of six-inch (6") pipe, minimum. Each chimney shall be plugged or capped at the end until ready to connect to existing services. Chimneys are required where the vertical drop between the finished grade surface and the main sewer line exceeds 15 feet at the wye for a service connection.

R. THRUST BLOCKS AND ANCHORS

Concrete thrust blocks or anchors shall be placed at bends, tees, fittings, and other locations on the force main as shown on the contract drawings or as directed by the Town Engineer or Building Inspector. Concrete for thrust blocks and anchors shall be 3,500 psi concrete. Steel rods and clamps as required shall be galvanized and rust proofed or painted.

Thrust blocks and anchors shall be placed between the fitting and the trench wall with bearing on undisturbed earth. The bearing area shall be as shown on Figure 5.1.

S. AIR RELEASE VALVES AND MANHOLES

Air release valves shall be provided in all sewer force mains where there is a high point, low point, or other point requiring air release from the forcemain as defined by the Design Engineer. Air release valves for sewer applications shall be the ARI valves. See CWD Standard (Figure 5.2) for additional detail of a typical air release manhole.

END OF SECTION

SECTION 7. WASTEWATER PUMPING STATIONS SPECIFICATIONS

7.1 GENERAL

This Section includes information regarding measures and materials for the design and the construction of municipally owned and operated pump stations and appurtenances.

7.2 PROJECT REQUIREMENTS

Wherever feasible, gravity sewers shall be utilized rather than wastewater pumping stations. Gravity sewers shall be considered economically feasible for all installations where buried sewers can be constructed at depths of less than 20 feet, unless the Developer can demonstrate that pressure sewers would result in long-term cost benefits to

the Town. Cost effectiveness must be documented in an equivalent annual cost analysis which considers both capital and operation/maintenance costs using an assumed useful life of 20 years.

The following Pump Station Standard applies primarily to pump stations whose ownership will be transferred to the Town of Colchester. Other styles of pump stations fall under the Standards established through the Vermont Environmental Protection Rules, Chapter 1 and any local codes and ordinances, including applicable portions of this Standard. A single owner or Home Owner's Association shall maintain ownership of submersible grinder pump stations. The Town shall not take over ownership of a submersible grinder pump station.

The following table summarizes the allowed uses for pump stations that have met the above engineering economics analysis.

TABLE 7.1

ALLOWABLE PUMPSTATION TYPES

Type of Pump Station	Flow Range (gpd)		
Municipally Owned Pump Stations Not Allowed	0	to	1,900
Surface WWMPS with Aeration	1,901	to	14,399
Surface or Recessed WWMPS	14,400	to	22,499
Recessed WWMPS	22,500		Plus

The Town's pressure sewer system has been standardized on the basis of factory-built pumping stations of similar quality to those manufactured by Smith & Loveless Inc. of Lenexa, Kansas. Wet well-mounted pump station (WWMPS) enclosures (both Recessed and Surface Mounted) designs are required to maintain separate dry wells and wet wells. For maintenance reasons, pump stations that have a design flow of 1900 gpd or less are not permitted to have ownership transferred to the Town. Pump Stations with flows between 1901 gpd and 14,399 gpd are to be surface wet-well mounted pump station with aeration, or privately owned. Surface wet well-mounted systems will be considered for installations which will serve less than fifty (50) dwelling units (less than 22,500 gpd at full build-out). Wet well/drywell or recessed wet well-mounted designs will be considered for installations which will serve between fifty (50) and one hundred (100) dwelling units (between 22,500 gpd and 45,000 gpd at full build-out). Wetwell/Drywell designs will be considered for wastewater pumping stations which are projected to serve the equivalent of one hundred (100) or more dwelling units (greater than 45,000 gpd). Wet well designs (with submersible pumps on slide rails) are unacceptable and will only be approved for situations where ownership and maintenance responsibilities remain with the Applicant.

The design of all pumping stations must be reviewed and approved by the Department of Public Works prior to construction.

Prior to completion of a preliminary design for any new pumping station, the designer shall submit a basis of design report for approval by the Town Public Works Department. The report shall include as a minimum:

1. Service area map.

2. Design flow including average daily flow, maximum daily flow, and peak hourly flow for the initial year, 10-year and 20-year design conditions. The basis for the projected flows must be clearly defined along with associated peaking factors. If the pump station will service commercial and industrial uses, provide information for any equipment that will contribute additional flows, including domestic and industrial cooling towers.

3. The design flows for the operating point of the specified pumps in gpm, the total dynamic head in feet of water, and the efficiency of the pump in percent.

4. A description and detail of the proposed wet well including minimum volume requirements, configuration and depth.

5. Force main design parameters including pipe material, diameter, estimated length, and minimum flow velocity to achieve solids scouring.

6. Computations to establish the emergency storage volume requirements.

7. Results of preliminary soils investigations including test pit logs, soil borings, or ledge soundings.

7.3 FACTORY BUILT WASTEWATER PUMPING STATIONS

A. GENERAL

Multiple pumps shall be provided with each raw wastewater pumping station. For duplex stations, each pumping unit shall be identical, and with sufficient capacity to handle the design peak hour influent flow with one pump off-line. For triplex or quadraplex stations, pumping units shall have capacity such that, with any one unit out of service, the remaining units will have capacity to handle the design peak hourly flow.

Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage as the result of a flood of 100-year recurrence interval. All pumping stations shall be constructed with top of wet well elevations above the FEMA mapped 100-year flood level and designed to be fully operational and accessible during a

flood of 25-year recurrence.

All pumping station sites shall be fully accessible by maintenance vehicles during all weather conditions. Gravel access roads and associated easements must be conveyed with the pumping station.

Dry wells, including the associated superstructure, shall be completely separated from the wet well. Common walls and pipe penetrations shall be gas tight.

Secondary pump H-O-A switches, run lights and alarm silencer shall be located in an auxiliary panel located near the top of the dry well. The panel shall be located to allow access by maintenance personnel without entering the dry well.

Water supply for wash down and maintenance shall be provided at a yard hydrant to be located within 10 feet of the wet well access hatch.

B. FOUNDATION

A reinforced concrete foundation shall be provided for the wet well and pump chamber, designed by a structural engineer licensed in the State of Vermont.

The foundation and structure shall be designed to prevent flotation of the dry well and wet well under worst case conditions: fully saturated soils outside of floodplains and floodways; and to the 100-year flood elevation. Buoyancy computations shall be submitted as part of the design for review by the Town.

C. WET WELLS

The effective volume of the wet well shall be established such that the filling time shall not exceed 30 minutes under design average flow conditions (unless equalization is incorporated in the design). When the anticipated initial flow tributary to the pumping station is less than the design average flow, provisions shall be made such that a 30 minute fill time is not exceeded for initial flows or provisions shall be made to provide equipment to prevent odor such as aeration, mixing, or chemical addition. Suitable and safe means of access for persons wearing self-contained breathing apparatus shall be provided to both the dry well and to the wet well.

Pre-cast concrete wet wells shall be of steel reinforced design with a documented compressive strength of 4000 psi at 28 days. Butyl rubber gaskets shall be specified at all joints.

All pipe penetrations shall be pre-cast openings with flexible rubber boots or compression fittings to create watertight connections.

The top of the wet well shall be designed with an appropriately sized wet well access hatch of diamond plate aluminum suitable for concrete embedment and rated for a load of 300 psf or H-20 loading. The hatch shall include a lockable latching device. The pre-cast concrete wet well shall be dampproofed with an external coating of two coats of asphaltic sealant and tested for water tightness using an approved vacuum or water testing procedure.

The wet well suction inlets shall be designed with a bellmouth inlet to reduce solids accumulation. The bottom of the wetwell shall be sloped a 1:1 ratio away from the suction inlet at a horizontal distance of D/2 from the outside edge of the bell; and a vertical distance of D/2 from the bottom of the wetwell to the outside of the bell. The spacing between the suction inlet lines shall be 4D from outside of pipe to outside of pipe. Where D is the diameter of the bellmouth. Deviations from this requirement must be in accordance with *ASCE Manual #37, Design and Construction of Sanitary and Storm Sewers*.

Electrical systems and components (i.e. motors, lights, conduits, switchboxes, control circuits, etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present, shall comply with the National Electric Code requirements for Class I Group D, Division 1 locations and shall be corrosion resistant. Each flexible cable shall be provided with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for the main power feed for all pumping stations. When such equipment is exposed to weather, it shall meet the requirements of weatherproof equipment NEMA 4X. A 110-volt power receptacle to facilitate maintenance shall be provided inside the control panel for lift stations that have control panels outdoors. Ground fault interruption protection shall be provided for all outdoor outlets.

D. ENCLOSURE

The station shall be prefabricated and factory-built in one complete assembly. The pumping chamber shall be designed to mount directly on top of the pre-cast concrete wet well with a watertight seal. The supporting floor plate shall be minimum 3/8" thick steel plate with reinforcing as required to prevent deflection and to ensure rigidity. The station shell shall be a minimum of 1/4 inch or heavier, ASTM A-36 steel plate. All outside surfaces shall be ground smooth, blasted with steel grit, and coated with two coats of coal tar epoxy. Inside surfaces shall be cleaned, primed, and coated with a 6 mil or greater thickness of an epoxy polyamide coating.

The equipment chamber shall be physically separated from the wet well. Wet well access shall be provided via a 30"x30" or larger hatch which is located outside the equipment chamber. A separate, screened wet well vent shall be provided in the pump station cover.

The equipment chamber shall be provided with a split fiberglass cover hinged at the

partition wall separating the equipment chamber from the access manway to the wet well. Both the equipment chamber and wet well access covers shall be designed with lockable latching devices. The fiberglass cover shall be formed with a drip-lip around the edge to prevent rainwater from entering the equipment chamber or wet well. Brackets shall be provided to support the cover in the open position and to restrain it under load. An aluminum ladder shall be located in the equipment chamber to provide ready access from the surface.

Two 17-pound magnesium anodes shall be provided as cathodic protection and shall include 30' long insulated copper leads. Copper lugs shall be provided by the Manufacturer on opposite sides of the station for anode connections.

A heavy synthetic rubber mat shall be cemented to the station floor in the walkway area after the final coat of paint has been applied.

The station shall be shipped complete with a minimum of two vertical, close coupled motor driven, non-clog sewage pumps, electric motors with 3 phase power (for pump motors over 5 HP in size), valves, internal piping, duplex vacuum priming pumping system, control panel with circuit breakers, motor starters and automatic level controls, lighting, sump pump, ventilator, heater with adjustable thermostat, wiring, elapsed time hour meter for each pump and a remote alarm system tied into the Town's radio telemetry system. The pumping system shall be designed to pass 3" solids without clogging.

E. SEWAGE PUMPS

The sewage pumps shall be designed such that, with any one pump out of service, the remaining unit(s) will have capacity to handle the design peak hourly flow.

The pumps shall be vertical, non-clog type specifically designed for raw sewage applications. The pumps shall be 4", 6" or 8" non-clog solids handling pumps designed specifically for handling sanitary sewage.

Each pump shall be of heavy cast iron construction specifically designed for vacuum priming and use of mechanical seals. The shaft shall be of solid stainless steel construction through the mechanical seal for corrosion and abrasion resistance.

Impellers shall be of the enclosed type made of close-grained cast iron. All impellers less than full diameter shall be trimmed, to prevent the buildup of foreign particles.
The pump shall be designed such that the rotating element can be easily removed from the volute, without disconnecting the seal system, electrical wiring or removal of the motor from the backhead and seal.

The pump shall be supported via a floor-mounted cast iron base with four legs to provide rigidity and balance.

Pump motors shall be squirrel-cage induction type of vertical, solid shaft, P-base construction especially designed for sewage pump service. The motors shall be rated per the design specification and shall be suitable for 3 phase, 60 cycle service with a 1.15 service factor. They shall not be overloaded at full speed at the minimum head condition specified in the design. The motors shall have Class F insulation, suitable for temperatures up to 104 degrees C. The motor insulation temperature shall not exceed 80 degrees C. The motor shall be NEMA design B having normal starting torque and low starting current. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

Pumping sequence shall be arranged in an alternating "lead" / "lag" configuration. When liquid level reaches the predetermined "lead pump on" elevation, the designated lead pump shall start automatically. This pump shall continue to operate until such time as the liquid level falls below the designated "pump off" elevation. If flow into the wet well exceeds the capacity of the lead pump, and liquid level rises to the "lag pump on" elevation, then the designated lag pump shall be automatically activated. Both the lag pump and the lead pump shall continue to operate until liquid level falls to the "pump off" elevation. A "high level alarm" condition shall occur if liquid level rises above the predetermined alarm level (typically established at an elevation 6" above the "lag pump on" elevation). The alarm condition shall remain in affect until manually reset from the control panel.

F. VACUUM PRIMING SYSTEM

A separate and independent priming system shall be furnished for each main pump, providing complete standby operation.

Each priming system shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe, and a float operated check valve installed in the system to prevent liquid entry into the vacuum pump head.

Vacuum pumps shall be constructed of corrosion resistant components and shall be capable of priming the main pump and suction piping in not greater than 60 seconds under rated static lift conditions.

Vacuum pumps shall have corrosion-resistant internal components. The vacuum priming system shall be complete with large port vacuum control solenoid valves, vapor filters to protect the solenoid valves, Sonic Start™ prime level sensor, float-operated check valves to protect the vacuum pumps, and all necessary shut-off valves as shown on the piping schematic. The float-operated check valves shall have a transparent body for visual inspection. All hoses and tubing used in the priming system shall be at least 3/8” nominal diameter.

The solenoid valves used in the vacuum priming system shall be of the high flow, direct

acting brass body type, with threaded ports, NBR seals and 300 Series stainless steel plunger, rod, plate and springs. The minimum orifice diameter shall be 5/16". The solenoid valves shall be UL Listed, with Class F coil rating and of suitable voltage and thermal capacity for the application.

A vapor filter, installed in the vacuum line between the valve and the priming dome, shall protect each solenoid valve. The vapor filter shall be constructed of corrosion resistant materials and shall have a minimum filtration area of 2.74 square inches and be suitable for operation from 10 to 100 PSI. They shall be readily replaceable without the use of special tools.

Liquid level in the pump-priming chamber shall be monitored by a Sonic Start™ resonant frequency liquid level probe. The probe shall be equipped with a piezoelectric drive and sensitive circuits to detect frequency shifts when the probe is covered by liquid. The probe shall be completely sealed and have a 316L stainless steel housing for corrosion resistance. It shall be provided with a wiring connector molded of PolyPhenylSulfone, an amorphous high performance thermoplastic for impact and chemical resistance. The probe shall have a plug-in connector to facilitate easy removal.

The Sonic Start™ probe shall be provided with light emitting diodes. This diagnostic tool shall indicate connectivity, prime status or a fault condition. Systems utilizing an electrode, mechanical means such as a float, or that require any type of electrical or moving parts inside the priming chamber, which may accumulate debris, short out, bind or fail will not be acceptable.

The priming system shall automatically provide positive lubrication of the mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped liquid must pass shall be smaller than the equivalent of a 2-1/2" opening.

G. INTERIOR PIPING

Pump suction and discharge piping shall be drilled and tapped for 125 pound American Standard flanges. All flanged ductile iron pipe shall meet the requirements of ANSI A21.51 (AWWA C151) latest version.

Pump suction lines protruding through the equipment chamber wall shall be welded to create a gas-tight seal.

H. VALVES

Suction and discharge valves shall be non-lubricated eccentric type plug valves with resilient facings and hand-wheel operators. All valves shall be supplied with ANSI 125 pound flange end connections.

Check valves shall be placed on the discharge lines between the pumps and the plug valves. Check valves shall be non-slamming, bronze mounted swing type valves with bolted covers and outside levers. Check valves shall have ANSI 125 pound flanged ends.

I. EMERGENCY STORAGE AND PUMPING REQUIREMENTS

All wastewater pumping stations shall include provision for either emergency storage or emergency power to prevent flooding in the event of a power outage or mechanical malfunction.

Emergency Storage

Emergency storage consists of available volume above the high water alarm in the wet well, and may include an adjacent storage tank or available volume in the gravity sewer system (provided sewage does not back-up into building basements or overtop sewer manholes). The designer shall insure that either a minimum emergency storage volume of 25% of the design average daily flow (or 4 hours storage based on a 16 hour operating day) is provided for each pumping station; or that an emergency storage volume is provided that is adequate to store flow over the longest recorded power outage for the service area.

Emergency storage tanks shall have at least one manhole access to grade with copolymer plastic ladder rungs at 8" on center. The manhole access shall have a ductile iron frame and cover (in accordance with the sewer section of this standard) or a 30" x 30" hinged, diamond plate hatch rated for 300 psf (Bilco or equal).

The emergency storage system shall be free draining toward the wet well with the fill/drain pipe invert elevation above the high water alarm level.

The emergency storage tanks shall not be used as part of the normal pump dose volume.

Emergency Power Generation

The emergency power generation design shall be designed by a Professional Engineer with an Electrical Engineering specialty registered in the State of Vermont and shall meet the National Electric Code and other applicable codes.

Emergency power generators shall use diesel fuel. Fuel tanks must meet applicable code standards for fuel tanks and must be protected from spilling, flooding, and other applicable damage and hazards.

Emergency generators shall automatically run on a weekly basis.

Emergency generators shall be provided with a block heater to facilitate cold weather starts.

Emergency power generators shall have an automatic transfer switch. Sizing and design of the ATS shall be by an Electrical Engineer licensed as a professional engineer in the State of Vermont.

Acceptable generator manufacturers are:

Generac Generators by Generac Power Systems, Inc. of Waukesha, Wisconsin;

Katolite Generators, by Katolight Corporation, of Mankato, Minnesota;

Kohler Power Generators, by Kohler Company of Kohler, Wisconsin; and

Onan Electrical Power Generators, by Cummins Power Generation, of Columbus, Indiana.

J. EMERGENCY BACK-UP MEASURE

In addition to emergency storage or emergency power, each pump station shall be provided with one back-up emergency measure.

By-Pass Pumping Features

The pump station shall include a Portacon pump coupler system as manufactured by Precision Systems of Calumet, IL. The purpose of the Portacon is to facilitate the connection of an emergency pump to a fixed suction and fixed by-pass force-main connection at a sewage lift station. The model of the Portacon pump coupler is PC104.

The Portacon pump coupler shall be completely constructed of aluminum with non-corrosive hardware. The assembly shall include the frame and coupling plate with integral male camlock fitting. The lid shall be fully removable from the frame structure but be permanently secured to the frame at all times. The lid shall be firmly fixed within the frame when closed with a locking assembly integral to the lid. Pin and hole lock assemblies shall not be considered equal. The lock shall have a waterproof cover to prevent icing of the lock assembly. The diameter of the camlock fitting shall be as shown on the plan drawings.

The Portacon pump coupler shall be encased within the wet well lid casting along side of the access hatch. A fixed PVC Schedule 80 suction line of the same diameter as the Portacon shall be connected to the pipe coupling on the underside of the Portacon. The suction line shall be supplied and installed by the installing Contractor. The suction line shall extend down to the bottom of the wet well and be permanently mounted. A foot valve shall not be used on the bottom of the suction line. If it is deemed necessary to have bracing on the suction line it shall be supplied and installed by the installing Contractor.

K. CONTROLS

The main equipment control system shall be mounted internally within the pump station in a NEMA 4 panel, complete with suitable latching devices. All circuit breakers, motor starter reset buttons, and pump control switches shall be mounted so that they are operable without opening the cabinet. The low voltage, automatic pump control section shall be separate from the high voltage circuit breaker motor starter section and shall be provided with a hinged access door and latch. The control switches shall be mounted on the face of the automatic pump control section door. A grounding-type convenience duplex outlet shall be provided for operation of 115-volt AC devices.

An auxiliary control panel shall be provided immediately under the access hatch in the drywell and shall contain: pump control switches for each pump, run time meters, and pump run lights.

Thermal magnetic circuit breakers shall be provided for branch disconnect service and over-current protection of all motor, control and auxiliary circuits. Magnetic across-the-line starters with under voltage release and overload coils for each phase shall be provided for each pump motor to give protection against single phasing. Each single-phase auxiliary motor shall be equipped with an over-current protection device, in addition to its branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

An automatic alternator with manual "ON-OFF" switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle. Provisions shall also be made for the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for a low-level pump. The panel shall include a time delay to prevent the simultaneous start-up of both pumps.

A running time meter shall be supplied for each pump to record the hours of operation. The meter shall be enclosed in a dust and moisture proof molded plastic case. The flush mounted dial shall register in hours and tenths of hours up to 99999.9 hours before repeating. The meter shall be suitable for operation from a 115 volt, 60 cycle supply and shall be mounted on the surface of the control cabinet.

All pump stations shall be provided with a local alarm panel with an onsite flashing light and sonic alarm.

L. WIRING

The pump station shall be completely pre-wired at the factory, except for the power feeder lines. All wires shall meet the requirements of the National Electrical Code and shall be color-coded as indicated on the wiring diagram. All wiring outside the panel shall be in

conduit, except for the 115-volt accessory items, which are provided with insulated service cord. Conduit shall be provided from the control panel across the ceiling, and up the entrance tube to receive the feeder lines, and shall terminate in a threaded conduit connection through the wall of the entrance tube. All receptacles shall be of the ground fault type.

Accessory items such as the sump pump, dehumidifier and air compressor shall be plugged into polarized grounded convenience outlets located close to their installed position so that such items can be readily removed and serviced if necessary.

M. ACCESSORY EQUIPMENT

The following equipment shall be provided:

The design shall have provision for a sump pump with minimum 1000 gph capacity operating off a float switch in the dry pit sump. Two check valves and a gate valve shall be installed on the discharge line. The pipe shall enter the wet well at an elevation of 6 feet or more below final grade and above alarm level.

A dehumidifier assembly with a hermetically sealed freon compressor, expansion coil, fan, and condenser coil shall be furnished which shall maintain the relative humidity of the air in the pump chamber low enough to prevent condensation on the walls. The dehumidifier shall be controlled automatically by an adjustable humidistat and low air temperature cutout. The condensate shall be drained to the sump.

A ventilating blower shall provide air circulation to the floor of the pump chamber. The exhaust outlet shall be screened to prevent the entrance of foreign matter and insects and shall have a suitable cover to prevent the entrance of rain and snow. Fresh air to the pump chamber shall be drawn from the surface. The air inlet shall be screened to prevent the entrance of foreign matter and insects and shall have a suitable cover to prevent the entrance of rain and snow. The blower shall be sized to exchange the air in the station once every two minutes or to deliver 250 CFM at 0.1” static water pressure in order to remove the heat generated by continuous motor operation. The ventilating blower and station lights shall be turned on automatically when the entrance cover is raised and shall have a manual switch located on the inside of the entrance. Additionally, the ventilating blower shall be turned on and off automatically by a preset thermostat. A heavy extruded aluminum louvered grille with adjustable openings shall cover the discharge of the blower. A similar grille shall be provided in the other end of the station enclosure for air intake.

Light fixture(s) shall be installed in the pump chamber to provide adequate illumination for the control panel and other areas. Lights shall be turned on automatically when the entrance lid is raised, and a manual switch shall be provided to maintain the lighting when the lid is closed.

A 500 watt dual range thermostatically controlled electric heater shall be rigidly mounted within the pump station to keep the temperature within the pump chamber above freezing. The heater will be provided with an automatic circulating fan, thermostatic control and an "ON-OFF" switch. The heater will be operated by connection to the convenience receptacle located on the control panel.

A non-mercury float switch shall be provided in the dry well, which will create an alarm condition if infiltration, leakage or condensation were to reach a predetermined "high liquid level". Float switches shall each have two normally open and two normally closed contacts.

Float switches will be wired to the local alarm system, which will automatically activate the alarm at the Hercules Drive Pumping Station via a radio telemetry system.

Aeration equipment, where required, shall be Aera-Vent, Model WWA-1000 or approved equal. Aeration equipment shall be located within a fiberglass enclosure. Aeration equipment shall be controlled to run both on an adjustable timer and when manually activated.

N. SPARE PARTS

A complete replacement pump shaft seal assembly shall be furnished with each lift station. The spare seal shall be securely fastened to the control panel and shall include complete installation instructions.

A spare volute gasket and a spare impeller shall be provided.

A spare filter cone for the seal filter shall be provided in the same container as the pump shaft seal.

Provide 100% spare lamps for control panel.

Provide all lubricants required for initial operation.

Provide epoxy-paint touch-up kit to repair scratches in the surface of the factory- built pumping station.

7.4 FACTORY TESTS

All pump stations shall be given an operational test of all equipment at the factory to check for excessive vibration for leaks in all piping or seals and for correct operation of the automatic control system and all auxiliary equipment. The pump suction and discharge line shall be coupled to a reservoir and the pumps shall recirculate water for at least one hour under simulated service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating. Factory test instrumentation must

include flow measurement with indicator, compound suction gage, bourdon tube type discharge pressure gage, electric meters to measure amperes, volts, kilowatts and power factor; speed indicator and a vibrometer capable of measuring both amplitude and frequency.

7.5 SERVICES OF MANUFACTURERS REPRESENTATIVE

After installation has been completed, but before the system is placed into operation, the manufacturer's representative shall inspect, lubricate, operate, test, adjust and assure that the equipment is in proper working condition for the specified installation. The service representative shall then submit a written report to the Design/Project Engineer with a copy to the Building Inspector stating the results of the inspection. The report shall include the Manufacturer's Certification that the equipment conforms to the requirements of the contract and is ready for permanent operation. He shall also certify that the installation meets the manufacturers warranty requirements.

The manufacturer's representative shall be present during start-up and field acceptance testing.

7.6 PUMP - FIELD TESTING

Upon completion of the installation, each sewage pump station shall be given a running test during which the pumps shall demonstrate their ability to deliver rated capacity at specified heads and to operate satisfactorily under automatic control, without overheating or excessive vibration. Any corrections and adjustments necessary to enable the equipment to meet the specified requirements shall be made by the manufacturer's representative at the time of the tests or within five (5) calendar days at no expense to the Town. All testing must be witnessed by the Town's Authorized Representative.

7.7 OPERATING INSTRUCTIONS

Installation of all mechanical equipment shall be done in accordance with written instructions provided by the manufacturer. Installation instructions shall be delivered with the station.

A convenient maintenance and operating instruction chart and daily maintenance and inspection record chart with ample room for recording daily inspections of the pump station, shall be securely mounted on the interior wall of the main pumping chamber. In addition to the maintenance and operating chart, the manufacturer shall further provide 5 copies of a complete and detailed operating and maintenance manual. This manual shall provide general operating procedures, maintenance and servicing procedures for all major components, and as-built drawings of the contributory gravity sewer system, the pumping station and forcemain. All instructions and parts lists shall be prepared for the specific

equipment furnished and shall not refer to similar equipment. Operating manuals must be submitted to the Town prior to final acceptance of the station.

7.8 REMOTE ACCESS AND PUMP CONTROL SYSTEM

A remote access and pump control system shall be provided for all Municipal Stations and shall include the following components and/or features:

- Pump controller shall be furnished with a user friendly "View-At-A-Glance™" operator interface allowing adjustment and viewing of all system parameters and status. The operator interface shall be NEMA 4 rated suitable for front door mounting including locations requiring wash-down and moisture protection.
- The process variable signal, Pump 1, 2, & 3 On/Off and High & Low Setpoints, shall be displayed simultaneously via front panel mounted long lasting Ultra Bright LED bar graphs. These bar graphs shall be vertically mounted in parallel fashion to provide relational viewing of all setpoints vs. segments of resolution. Each setpoint column shall have a status LED mounted on top of the associated setpoint providing indication of setpoint activation status. Units that require operator action to view the above parameters are not acceptable.
- To assure the highest resolution and accuracy, the process display shall be configured to display the full range of the actual measured process. Range can also be offset allowing display of a pressure or level range that does not start at zero. The display ranges shall be field configurable.
- System pump on/off and alarm setpoint parameters shall be easily adjustable via individual up and down pushbutton arrows located next to the associated setpoint display column (s).
- The unit shall have a built in process simulation capability allowing the operator to verify system operation by forcing the process variable up or down via pushbutton arrows located next to the process display. To prevent accidentally leaving the unit in simulation mode, the pump controller shall be configured to automatically restore monitored process display within 2 minutes after last keypad usage or immediately upon operator initiated restore.
- The display unit shall incorporate a high contrast LCD panel allowing for viewing of higher level functions including the following:
    - Process display to XX.X of the full scale process range
    - Time and date stamped alarms & events
    - Pump statistics (including run time, number of starts, daily average number of starts)
    - System diagnostics
    - Controller security
    - Unauthorized station entry detection
- Auxiliary pump control system shall be Model LC150 with A1000 Level Transmitter (0-5 psi) as manufactured by Primex.

7.9 ALARM TELEMETRY SYSTEM

An alarm telemetry system shall be provided for all Municipal Stations and shall include the following components and/or features:

-
- Monitoring RTU – The monitoring RTU shall be enclosed in either a NEMA 4X (exterior locations) or NEMA 1 (interior locations) and integrated into the pump control panel. The RTU shall be powered by 12 volts AC and have a built-in battery backup capable of keeping the unit powered for 40 hours in case of AC failure. All terminations inside the RTU enclosure shall be low voltage AC or DC (28 volts or less.) The RTU shall have two (2) analog, 10-bit resolution, 4-20 mA or 0-5 Vdc inputs, with four (4) alarm thresholds per input. RTU shall have built-in AC failure and low battery detection. RTU shall have eight (8) digital inputs of which up to three (3) shall be capable of recording pump run times in one (1) minute resolution. RTU shall have at least three (3) remotely controllable relay outputs. RTU shall have up to two (2) optional pulse counting totalizers of which one can be programmed to report every 15 minutes. RTU shall have a built-in electronic key reader, which can be used to securely put the RTU in/out of alarm reporting mode and/or to accept active alarms. RTU shall produce an audible noise to indicate to the operator that the electronic key has been successfully read.
- Customer Web Site or OPC Compliant HMI Software – RTU shall be capable of reporting alarms and all supervisory information to the password protected Missions Communications web site for the Town of Colchester, VT. The web site shall be capable of displaying all RTU alarms and supervisory data, including alarms, individuals accepting alarms, RTU electronic key reads with user names and time of read, pump run times with historical graphs, individual pump flow estimates, automatic daily analysis of pump runtimes for abnormalities with automatic customer notification of such abnormalities, pump starts, daily radio health checks with automatic notification of non-reporting or poorly reporting RTUs, scaled and labeled pulse totalizations and if rainfall gauges are used, inter-day rainfall graphs. The web site shall be capable of reporting alarms via phone dialup, numeric pager dialup, alpha numeric pager, fax or email or any combination of the above. The customer web site shall produce weekly reports which summarize alarms and responses, pump run times and flow estimates and all electronic key use at the RTU sites.
- Any upgrades in hardware or software of the existing equipment to allow for the new equipment to be fully functional shall be the responsibility of the installer of the pump station.
- As a minimum, the alarm telemetry system shall be capable of transmitting the following alarms/status signals
    - Wet well high-level alarm transducer;
    - Wet well high-level alarm float backup;
    - Flooded dry well alarm (excluding surface-mounted stations);
    - Power failure alarm; and
    - Pump run signals

- Alarm telemetry controller system shall be a Model 110 or 113 RTU (as appropriate for location) and as manufactured by Mission Communications of Norcross, GA. .

7.10 LEVEL TRANSMITTER

The liquid level of the wet well shall be sensed by a submersible level transducer. The transducer shall be a 3-wire type to operate from the level controller's power supply and produce an instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to 5 psi. The submersible level transducer shall be Model A1000 as manufactured by Siemens Water Technologies Control Systems.

The transducer shall be of the solid-state head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with the manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed approximately 6 inches above the wet well floor. The sensor shall be mounted using a stainless steel cable suspension system in a location and as shown on the project plans.

The transducer housing shall be fabricated of type 316 stainless steel with a bottom diaphragm 2-5/8" diameter of heavy-duty, limp, foul-free, molded Teflon™ bonded to a synthetic rubber back/seal.

7.11 ELECTRICAL SYSTEM

All material and equipment necessary for a complete and workable electrical system shall be furnished and installed including: conduit and fittings, wire and cable, service panel, grounding, alarm system, connections to pump station, power company connection fees, telephone service fees.

Packaged pump station will be furnished completely wired including controls and will require only power wiring from the service panel to the control panel in the pump station and signal wiring for the high level signal from the pump station control to the service panel. The above grade panel and signal communicator shall be provided by the pump station manufacturer.

All materials and equipment shall meet the standards of the National Electrical Manufacturer's Association and Underwriters Laboratories, Inc., and shall bear their label wherever standards have been established and label service is available.

Installation of electric systems and controls shall be in conformance with the latest edition of the National Electric Code, local ordinances and regulations prescribed by the local Power Company.

Completed electric work performed shall comply with the latest edition of the National Electric Code Underwriters Laboratories regulations and all Municipal, State and other public or private authorities having jurisdiction. The developer is responsible for acquiring all necessary permits.

All equipment and workmanship shall be guaranteed to be free from mechanical and electrical defects for a period of one year from the day of final acceptance. Any replacement of parts or adjustments, including labor made necessary by such defects and adjustments, shall be rectified without cost to the Town.

Required Testing

All mechanical, control and alarm functions shall be tested in the presence of the Town representative to demonstrate that all equipment is fully operational.

Any grounds, opens, shorts or other defects shall be rectified at no cost to the Town before acceptance.

END OF SECTION

SECTION 8. EROSION, SEDIMENT AND DUST CONTROL

8.1 GENERAL

This Section includes information regarding materials and applications for the design and construction of protective measures used to control soil erosion, sedimentation, dust, and water pollution during construction.

8.2 PROJECT REQUIREMENTS

A. COMPLIANCE WITH LOCAL & STATE REGULATIONS

The Contractor shall be responsible for complying with the Vermont Water Quality Standards and protecting adjacent properties from degradation due to erosion or sedimentation during the course of construction activities. In addition, the Contractor shall comply with relevant local and state regulations governing the control of erosion and sedimentation, which may include Chapter 18, Article V of the Town of Colchester Ordinances, the Town of Colchester Stormwater Management Plan (MS4 General Permit 3-9014, VTR040000), and the State of Vermont's Construction General Permit 3-9020.

B. EROSION PREVENTION & SEDIMENT CONTROL PLAN

The Contractor shall develop a plan to prevent erosion and control sediment that at a minimum, implements the practices required by the State of Vermont's Low Risk Site Handbook for Erosion Prevention and Sediment Control.

For projects disturbing more than 10,000 square feet (SF) but less than 1 acre, the Erosion Prevention and Sediment Control Plan shall be submitted to the Town Engineer for review and approval prior to the issuance of a Building Permit and/or Septic Permit. For projects smaller than 10,000 SF, the disturbance may be eligible for a waiver of plan submittal subject to approval by the Director. Waivers will not be issued for sites which are located within a shore land district; discharge directly to open waters, wetlands or other protected areas; or are otherwise found to be inconsistent with Chapter 18 of the Code of Ordinances. See Section 18-24 of the Town of Colchester Ordinances for specific Plan requirements.

C. DUST CONTROL

The Contractor shall be responsible for ensuring that the dust created as a result of construction activities does not create a nuisance or a safety hazard. Where and when deemed necessary by the Municipality, the Contractor will be required to wet sections of the construction area with water, or apply calcium chloride, or sweep the roadway with a wetted power broom as dust control measures.

D. PROTECTION OF WATER COURSES

The Contractor shall carry out his or her operations in such a manner as to give adequate protection of watercourses and minimize soil erosion. The Town Engineer, Building Inspector and Design/Project Engineer have the authority to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to order the Contractor to implement immediate erosion control measures to prevent contamination of adjacent streams or other watercourses, and areas of water impoundments. These measures shall include but not be limited to, dumped stone check dams, straw/mulch matting, silt fencing, and temporary construction entrances.

Unless otherwise approved in writing, mechanized equipment shall not be operated in live streams except as may be required to construct changes in channel and permanent or temporary structures. Rivers, streams and impoundments shall, as soon as construction will allow, be cleared of all falsework, piling and debris caused by the construction operations.

E. LIMIT DISTURBANCE AREA AND/OR TIME OF EXPOSURE

The applicant or their agent shall limit the amount of soil exposed at any one time to reduce the potential for erosion or sedimentation. Where possible, the applicant or their agent shall also plan out necessary construction activities by phasing or limiting exposure to those areas needed for pending construction. Once construction activities have been completed for specific areas, permanent stabilization measures shall follow. Where disturbed areas are going to remain inactive for extended periods of time, temporary stabilization measures should be used to reduce the need for regrading activities, additional sediment storage, and/or additional maintenance of protective measures.

F. INSPECTIONS AND MAINTENANCE

The applicant or their agent shall make regular inspections of all control measures in accordance with the inspection schedule outlined on the approved Erosion and Sediment Control Plan and as outlined in Section 18-27 of the Town of Colchester Ordinances. At a minimum, inspections and any necessary maintenance activities shall be performed on all active construction sites where permanent stabilization has not been achieved on a weekly basis and after measurable rainfall or snowmelt events.

8.3 MATERIALS, PRODUCTS & BMPS

Unless specified otherwise, the Contractor shall use Erosion Prevention and Sediment Control practices, including materials, products, and Best Management Practices (BMPs), that comply with The Vermont Standards & Specifications for Erosion Prevention & Sediment Control (VSSEPSC).

Some of the most commonly used practices are as follows:

A. PERIMETER FENCE

Safety/Barrier fence shall be machine produced plastic or fabric, high visibility, break resistant fence used for crowd control, tree protection, and work limits definition. The openings shall be rectangular or diamond pattern and the stakes shall be hardwood or metal. The height shall be a minimum of 36 inches.

B. STABILIZED CONSTRUCTION ENTRANCES

A stabilized pad of aggregate underlain with geotextile located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto the public right-of-way. See Figure 8.1 and the VSSEPSC for specific guidelines on the size, geometry, and materials required for stabilized construction entrances.

C. MULCH

Mulch includes the application of coarse plant residue or chips, or other suitable materials, to cover the soil surface. The primary purpose is to provide initial erosion control while a seeding or shrub planting is establishing. See Figure 8.2 and the VSSEPSC for guidelines on the appropriate materials and application rates for various mulching methods.

Use of mulch in combination with tacking or crimping shall only be permissible on graded slopes and fills where the slope is not steeper than three horizontal to one vertical (3:1.) For slopes steeper than 3:1, erosion control blankets, turf reinforcement matting, or stone armoring shall be used.

D. EROSION CONTROL BLANKETS

Erosion control blankets (also referred to as Rolled Erosion Control Products or RECP) shall be machine produced, 100% degradable mats with a matrix composed of extruded roving, netting, or jute mesh with straw and/or coconut fiber or coir filler. The specific blanket type (including netting, thread, anchor staples, and degradation rates) shall be selected based on manufacturer's recommendations for the given application. The purpose of this practice is to protect the soil surface from raindrop impacts and overland flow during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation.

E. STONE CHECK DAMS

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable

material across a drainage way. The purpose of stone check dams are to reduce erosion in a drainage channel by restricting the velocity of flow in the channel. See Figure 8.3 and the VSSEPSC for specific requirements for stone check dams.

Check dams must be provided with a properly designed overflow or weir at a lower elevation than the adjacent ditch bank to prevent bypass and failure of the measure. Permanent installations must also be keyed into the slope. Where large stones for dams do not adequately filter sediment from discharged water, additional smaller stones (similar to AASHTO Mix No. 57) shall be applied to upstream side of dam.

F. SILT FENCE

Silt fences shall be a commercially produced product, composed of 3 ft. minimum length hardwood or metal posts supporting a geotextile fabric designed to filter water and trap sediment. All fencing materials shall be properly keyed into the slope to prevent bypass. Where preassembled fence and post materials are used, the ends shall be properly lapped and securely bound together as recommended by the manufacturer.

Please note that filtering capabilities for silt fence fabric are limited and silt fencing is not to be used in areas of concentrated flow and should only have small upstream tributary areas in accordance with VSSEPSC. Allowable tributary areas will vary depending on upstream slope. In many cases, silt fencing should be used to direct the majority of runoff to temporary sediment storage areas or stone check dams rather than to filter all water received.

Where silt fencing is being placed within 100’ of open waters, wetlands, or other protected areas, “super” or “reinforced silt fence” shall be used with welded wire mesh reinforcement placed between the fabric and support posts.

G. INLET PROTECTION

The purpose of inlet protection measures is to prevent heavily sediment laden water from entering a storm drain system through inlets. See the VSSEPSC for specific requirements on various types of inlet protection.

Inlet protection measures shall serve as permeable barriers to filter sediment and shall consist of one or more of the following elements: gravel check dams, silt fencing, masonry units with gravel, gravel or mulch filled “silt soxx” or specially designed and manufactured inlet filter bags. Where manufactured products are used, the Contractor shall closely adhere to the manufacturer’s recommendations for installation and maintenance. All manufactured devices intended for placement inside of existing or recently installed basins shall be appropriately sized for the inlet and tributary area. Filter bags shall be monitored frequently to ensure that the bag is not bypassed or become overfilled. Please note that simply placing filter or fencing fabric above or under the inlet casting and causing water to

pond on or adjacent to a town maintained roadway will not be accepted.

H. POLLUTION PREVENTION

Construction sites are required to be kept reasonably free of grease, oils, concrete, and other potential pollutants. For projects with cast-in-place concrete, concrete truck wash areas shall be included in the erosion control plan.

8.4 METHODS FOR INSTALLATION & EXECUTION

The installation and maintenance of all practices shall comply with The Vermont Standards & Specifications for Erosion Prevention & Sediment Control (VSSEPSC).

Some of the most commonly used practices are as follows:

A. PERIMETER FENCE

Barrier fence shall be installed prior to the start of construction phases where protection and delineation are required and shall be removed upon completion of the work.

B. STABILIZED CONSTRUCTION ENTRANCES

Stabilized construction entrances shall be installed in accordance with the VSSEPSC and Figure 8.1. The stabilized construction entrance shall be installed prior to the start of construction and removed upon completion of the land disturbing activities. The entrance shall be maintained in a condition which will prevent tracking of sediment onto the public right-of-way. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto the public-right-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto the public right-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping devise. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

C. MULCH

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems. Slope, grade and smooth the site to fit the needs of selected mulch products. Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required. Apply mulch after soil amendments and planting are accomplished or simultaneously if hydroseeding is used. See Figure 8.2 and the VSSEPSC for guidelines on the appropriate application

methods and installation criteria for various mulching methods.

D. EROSION CONTROL BLANKETS

Erosion control blankets or RECP shall be placed on disturbed areas that have been smoothly graded and cleared of debris such as rocks and roots, such that the blanket is in close and continuous contact with the ground. Erosion control blankets shall be placed loosely over the ground surface without folds or stretching. Blankets shall be securely attached per the manufacturer's recommendation with the proper number and spacing of anchoring mechanisms.

E. STONE CHECK DAMS

Stone check dams shall be installed in accordance with Figure 8.3 and the VSSEPSC. Stone check dams shall be installed during construction as needed to control runoff and are removed prior to permanent seeding unless the approved plan incorporates these elements as part of the permanent measures.

F. SILT FENCE

Silt fence shall be installed in accordance with Figure 8.4 and the VSSEPSC prior to the start of construction. The silt fence shall be maintained during the project and any accumulated sediment or debris shall be removed regularly to keep the silt fence functional. The silt fence shall be removed after permanent restoration has been established and at the direction of the Design/Project Engineer.

G. INLET PROTECTION

Inlet protection shall be installed in accordance with one of the methods outlined in the VSSEPSC. Inlet protection is installed after catch basins have been installed and maintained during construction. In the case of existing MS4 catch basins, every effort shall be made by the Contractor to contain run-off to within the project limits or inlet protection shall be installed. Inlet protection shall be removed once permanent stabilization of the surrounding area is established.

H. POLLUTION PREVENTION

Construction sites are required to be kept reasonably free of grease, oils, concrete, and other potential pollutants. Contractors shall be required to use equipment that is in reasonably good repair. Where equipment drips are anticipated, drip oil and grease shall be collected and properly removed from the site. For projects with cast-in-place concrete, concrete truck wash areas shall be controlled such that wet cement is not washed into the MS4 or waters of the State of Vermont.

I. PERMANENT STABILIZATION

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage. All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched.

J. REMOVAL OF TEMPORARY CONTROLS

Erosion control measures shall be continued until the permanent drainage facilities have been constructed and until grass on seeded slopes or specially installed shrubbery is established sufficiently to be an effective deterrent against erosion. With approval of the Town Engineer or Building Inspector, temporary erosion controls shall be removed, and any accumulated sediment or debris disposed of to provide a pleasing appearance.

END OF SECTION

SECTION 9. LANDSCAPING & PERMANENT EROSION CONTROLS

9.1 GENERAL

This Section includes information regarding measures and materials for the design and construction of measures used to plant grasses and landscaping plantings within the public right-of-way as well as other disturbed areas.

9.2 PROJECT REQUIREMENTS

A. PERMANENT STABILIZATION OF DISTURBED AREAS

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage. All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched in accordance with Section 9.3, below.

Lawns and Street Limits

Seed mixture in lawn areas around dwellings and within street limits shall be urban mix conforming to the following Table. For seeding between September 1 and October 15, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

All Other Disturbed Areas

Seed mixture in all other disturbed areas shall be conservation mix conforming to the following Table. For seeding between September 1 and October 15, winter rye shall be used in addition to the conservation mix at an application rate of 100 pounds per acre.

B. DELIVERY, STORAGE, AND HANDLING

Grass Seed

Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

Plants

Deliver plant life materials immediately prior to placement. Keep plants moist.

Fertilizer

Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

9.3 MATERIALS

A. SEEDING REQUIREMENTS

Reseeding must be done with one of the approved seed mixes accompanied by placement of straw mulch of sufficient coverage to control erosion until such time as the cover crop is established over ninety (90%) of the seeded area.

URBAN MIX GRASS SEED

% By Weight	Lbs. Live Seed Per Acre	Type of Seed
37.5	45	Creeping Red Fescue
31.25	37.5	Kentucky Bluegrass
31.25	37.5	Winter Hardy, Perennial Rye

CONSERVATION MIX GRASS SEED

% By Weight	Lbs. Live Seed Per Acre	Type of Seed
35	35	Creeping Red Fescue
23	23	Kentucky Bluegrass
15	15	Annual Rye
11	11	Winter Hardy, Perennial Rye
6	6	White Clover
10	10	Highland Benthgrass

B. TREES, SHRUBS, AND BUSHES

Tree species and sizes shall be identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

Trees, shrubs, and bushes shall be planted in the locations indicated on the approved plans and in accordance with the any planting details and specifications. Plantings shall be in accordance with the **Colchester Street Tree Master Plan** (see Appendix D). Replanting with native woody and herbaceous vegetation must be accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until the plantings are established and are capable of controlling erosion.

C. TOPSOIL

Excavated from site; or

Topsoil furnished by the Contractor shall be fertile, agricultural soil, typical for the locality, capable of sustaining vigorous plant growth; taken from a well-drained site; free of subsoil, impurities, plants, weeds, roots, stones larger than one inch, refuse or other materials detrimental to plant growth. Topsoil materials shall comply with specifications as set forth in Vermont Standard Specifications for Construction, Section 755.02 and as briefly summarized here. Materials shall be reasonably free draining with no more than 27% clay and shall be screened, loose, and friable material consistent with the following gradation:

SEIVE SIZE	PERCENT PASSING
1 – inch	100%
No. 10	85-100%
No. 40	35-85%
No. 200	10-35%
< 20 um	< 5 %

Topsoil shall have an organic content of not less than 5% or more than 10% for woody plant materials as determined by loss on ignition method for oven-dried samples. The allowable acidity range for topsoil shall be from 5.5 to 7.0 ph. Source materials with organic matter or acidity levels outside of the above ranges will only be permitted for transport to site after the soils have been adequately amended, thoroughly mixed, tested for compliance, and found to be acceptable.

D. SOIL AMENDMENT MATERIALS

Fertilizer

Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.

Peat Moss

Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range

of 4 to 5; moisture content of 30 percent.

Bone Meal

Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

Lime

Ground limestone, dolomite type, minimum 95 percent carbonates

Water

Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

E. MULCH MATERIALS

Landscaping Mulching: wood shavings, free of growth or germination inhibiting ingredients.

F. ENVIRONMENTAL REQUIREMENTS

Temperature Requirements: Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

Wind Restrictions: Do not install plant life when wind velocity exceeds 30 mph.

9.4 METHODS

A. PREPARATION OF SUBSOIL

Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

B. PLACING TOPSOIL

Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.

Place topsoil during dry weather and on dry unfrozen subgrade.

Remove vegetable matter and foreign non-organic material from topsoil while spreading.

Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

C. FERTILIZING

Apply fertilizer in accordance with manufacturer's instructions.

Apply after initial raking of topsoil.

Mix thoroughly into upper 2 inches of topsoil.

Lightly water to aid the dissipation of fertilizer.

D. SEEDING

Apply seed at a rate indicated in the seeding requirement table. Apply seed evenly in two intersecting directions. Rake in lightly.

Do not seed areas in excess of that which can be mulched on same day.

No seeding shall be performed after October 15, in accordance with the State of Vermont Erosion Control Manual.

Do not sow immediately following rain, when ground is too dry, or during windy periods.

Roll seeded area with roller not exceeding 112 lbs.

Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

E. HYDROSEEDING

Apply seeded slurry with a hydraulic seeder.

Do not hydroseed area in excess of that which can be mulched on same day.

Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

F. SEED PROTECTION

Identify seeded areas with stakes and string around area periphery. This temporary seed protection measure shall be removed following germination and prior to acceptance by the Town.

Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 12-inch overlap of adjacent rolls. Backfill trench, rake smooth and level with adjacent soil.

Secure outside edges and overlaps at 36-inch intervals with stakes.

Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

G. PLANTING

Set plants vertical.

Remove non-biodegradable root containers.

Set plants in pits or beds, partly filled with prepared plant mix

Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch layers. Maintain plant life in vertical position.

Saturate soil with water when the pit or bed is half full of topsoil and again when full.

See Figure 9.1.

H. PLANT RELOCATION AND RE-PLANTING

Relocate plants as indicated by approved plans.

Replant plants in pits or beds, partly filled with prepared topsoil mixture.

Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch layers. Maintain plant materials in vertical position.

Saturate soil with water when the pit or bed is half full of topsoil and again when full.

I. PLANT SUPPORT

Brace plants vertically with Arbortie material and stakes as indicated in Figure 9.1.

J. TREE PRUNING

Perform pruning of trees as recommended in ANSI A300.

Prune newly planted trees as required to remove dead, broken, and split branches.

9.5 QUALITY CONTROL

Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

9.6 MAINTENANCE

Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition. Maintain plant life immediately after placement and until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.

END OF SECTION

APPENDIX A

Champlain Water District

403 Queen City Park Road, South Burlington, VT 05403

Specifications and Details for the Installation of Water Lines and Appurtenances

March 2013

Table of Contents

Section	Sub Section	Title	Page
		Foreword	i
1.00		**Plans and Design**	**1**
2.00		**Ductile Iron Pipe**	**6**
3.00		**Polyvinyl Chloride (PVC) Pipe**	**7**
4.00		**High Density Polyethylene Pipe (HDPE)**	**7**
5.00		**Ductile Iron Water Main Installation**	**7**
6.00		**Fittings**	**9**
7.00		**CWD Connection Policy**	**10**
8.00		**Tapping Sleeves and Tapping Valves**	**13**
	8.07	Ductile Iron Tapping Sleeves	14
	8.08	Stainless Steel tapping Sleeves	14
	8.09	Tapping Valves	14
	8.10	Tapping Saddles	15
9.00		**Gate Valves – Resilient Seat**	**16**
10.00		**Butter Fly Valves**	**17**
11.00		**Valve Boxes**	**18**
12.00		**Fire Hydrant and Hydrant Branches**	**18**
13.00		**Hydrant Assemblies**	**20**
14.00		**Blow Off Assemblies**	**21**

Table of Contents

15.00		Service Connections	21
16.00		Backflow Prevention Devices	24
17.00		Rock Excavation	25
18.00		Pipe Bedding	26
19.00		Pipe Line Insulation	27
20.00		Polyethylene Pipe Encasement	27
21.00		Check Valves	28
22.00		Air Release Valves	29
23.00		Pressure Reducing Valves	29
24.00		Manholes and Vaults	30
25.00		Manholes and Vaults Lids, Frames and Covers	31
26.00		Concrete for Thrust Blocks	32
27.00		Protection of the Public and Work Personnel	32
28.00		Protection and Repair of Existing Utilities	33
29.00		Work Outside Owned Property Limits or Public Right Of Ways	33
30.00		Plan Errors and Omissions	34
31.00		General Installation	34
32.00		Backfilling	38
33.00		Water / Sewer Separation	39
34.00		Steel Sleeve, Jack and Bore	40
35.00		Execution of Sleeve Jack and Bore	41

Table of Contents

36.00		**Casing Spacers**	**43**
37.00		**Erosion Control**	**43**
38.00		**Testing and Disinfection**	**44**
39.00		**Submittal of Test Results**	**46**
40.00		**Final Inspection**	**46**
		CWD Responsible Persons	**47**
Appendix A		**Details**	
Appendix B		**Forms**	

Foreword

I. INTRODUCTION

a. Background

i. The Champlain Water District (CWD) is a regional water supplier supplying nine different communities consisting of twelve different municipal water systems: South Burlington, Jericho Village, Williston, Shelburne, Essex Town, Essex Junction, Colchester Town, Milton, Winooski, Colchester Fire District #1 and #3, and the Malletts Bay Water Company. CWD consist of two Departments that are directly responsible for the Installation of Water Lines and Appurtenances. They are:

1. The CWD Wholesale Department, as transmitter (transporter) of potable water to various municipalities and water systems, owns and maintains all pipelines dedicated to that purpose. The CWD Wholesale Department is responsible for the supply of water to all member communities through transmission mains, storage facilities and pump stations.

2. The CWD Retail Department provides managerial and operational support services to CWD served communities, and manages and operates the Malletts Bay Water Company and Colchester Town water distribution systems that are owned by the District. Presently the CWD Retail Department is providing various services to five of twelve served municipal water systems.

b. History

i. In February of 2007 Champlain Water District Wholesale and Retail departments published the District's first general specifications for the installation of water mains. Prior to February 2007 specifications were projects specific.

ii. In the February 2007 specifications there was a stark difference in what was acceptable in Retail managed system and what was acceptable in the Wholesale transmission system.

iii. This revision of the specification has brought the guidelines of both the Wholesale and Retail departments together and will ease any confusion that Contractors and Vendors may have.

c. Use of these Specifications

i. The CWD Specifications shall apply to the CWD transmission system and water distribution systems owned or managed by the Champlain Water District. For the purposes of this document the term “Retail Superintendent’ shall apply to the Malletts Bay Water Company and Colchester Town water systems, City of South Burlington Water Department, Village of Jericho, and Colchester Fire District #1.

ii. These CWD Specifications are considered the minimum acceptable standard specifications for the public water systems listed. The acceptability of any deviations from these standards shall be determined / approved by; in the case of the CWD Retail Department, the CWD Retail Superintendent; in the case of CWD transmission mains and appurtenances, the CWD Chief Engineer and/or the Transmission Systems Director; henceforth “appropriate CWD Supervisor” (See page 48 of these specifications for the CWD Contact List).

iii. All products incorporated in the work/design shall be subject to review and/or the requirement of a submittal by the appropriate CWD Supervisor. The submittal of any item shall include sufficient information for a determination of acceptability by the appropriate CWD supervisor. At a minimum, the information will include a description of the item, detailed materials information or reference to universally recognized standards (AWWA, ANSI, ASTM, etc.), a description of the methods to be used for construction and any testing necessary to verify the quality of the installation. The appropriate CWD supervisor may also require a list of locations and contact personnel where the item has previously been installed or the procedure used. It is not the intent of this document to prevent alternative solutions; however, the burden of proof for acceptability of alternate solutions lies with the party proposing the substitution.

iv. These specifications shall consist of policies, guidelines, and required procedural steps related to the excavation, installation, backfill, and testing required for water line construction. It shall also include detailed material specifications and typical details that are necessary for a complete water distribution / transmission system. Materials and installations shall be inspected and approved by the appropriate CWD supervisor or their designee before potable water is supplied to the project infrastructure.

v. All references to AWWA, ANSI, ASTM or the VT Water Supply Rule shall be to the most recent edition available, at the time of construction.

vi. The water systems included within these Specifications are defined below:

1. **CWD Owned Water Systems**

   a. CWD Wholesale Transmission: the water transmission system serving CWD consecutive member systems throughout Chittenden County.

   b. The Malletts Bay Water Company (MBWC): a primarily residential area in Colchester, north of the Winooski/Colchester Town line off Malletts Bay Avenue.

   c. The Colchester Town (CT) water system: a primarily commercial area around I-89 Exit 16 and Water Tower Hill in Colchester.

2. **CWD Managed Water Systems**

   a. City of South Burlington: A mixed residential and commercial water system located within the City of South Burlington municipal boundary.

   b. Colchester Fire District #1: A mixed residential and commercial area along Route 15 in Colchester around the Saint Michaels College campus.

   c. Village of Jericho: A mixed commercial and residential area around Route 15 in Jericho, extending from the Essex/Jericho Town line up to Packard Road, and over to Browns Trace Road in Jericho.

II. Variations

a. The Champlain Water District Specifications and Details for the Installation of Water Lines and Appurtenances (henceforth the "CWD Specifications") are applicable to all new construction and reconstruction of water infrastructure. Variations from the CWD Specifications will not be permitted except as provided for herein.

GENERAL SPECIFICATIONS

1.00 PLANS AND DESIGN

1.01. One complete set of construction drawings and specifications for the proposed water system expansion or rehabilitation shall be prepared and submitted by a licensed professional engineer registered in the State of Vermont to the Champlain Water District Chief Engineer and/or Transmission System Director whenever the project will connect directly to or impact the **CWD wholesale transmission system**.

1.02. One complete set of construction drawings and specifications for the proposed **water distribution system** expansion or rehabilitation shall be prepared and submitted by a licensed professional engineer in the State of Vermont to the Retail Superintendent for each CWD Retail Department managed water distribution system in accordance with that municipality's plan review requirements whenever that project may impact the distribution system noted herein.

1.03. Drawings shall be on a detailed, workable print (24" x 36"), and drawn to scale. Drawings shall contain a location map, plan and profile, type of materials to be used, locations of existing and proposed utilities, and necessary water system components required for a complete installation. Typical details and material and installation specifications shall be provided with all drawings. Construction drawings and specifications shall be submitted for review to the appropriate CWD Supervisor during the preliminary design review process. At each stage of a project's development, engineering plans are required to be reviewed to determine compliance with all water specifications and standards. The level of engineering detail required for approval generally increases with each stage of project approval. All construction drawings and specifications shall have a note stating, "All work to be performed in accordance with the Champlain Water District Specifications and Details for the Installation of Water Lines and Appurtenances." Upon receipt of acceptable final engineering plans, the appropriate CWD Supervisor will approve the plans for construction.

1.04. Any project involving tapping the water main for services one and one-half (1½) inches and larger shall have drawings submitted to the appropriate CWD Supervisor for review.

1.05. No water main extensions or alterations will be constructed within the CWD Retail Department owned or managed water distribution systems without the written approval of the CWD Retail Superintendent. All contract documents shall meet these specifications as well as any of the applicable Rules and Regulations of the CWD Retail Department, the South Burlington

Water Department (SBWD), Colchester Fire District #1 (CFD #1), or the Village of Jericho.

1.06. The applicant must state the purposes for which the water shall be required, and shall agree to conform to the Champlain Water District Retail Department's, the City of South Burlington's, Colchester Fire District #1, or the Village of Jericho's Rules and Regulations or Water Ordinances, and these Specifications. No person supplied with water from any CWD managed system's mains will be entitled to use it for any other purpose other than those stated. Requests for any other water use shall require a separate application.

1.07. The project shall be constructed, completed, maintained, and operated in accordance with the approved plans. No changes shall be made in the project without the written approval of the appropriate CWD Supervisor.

1.08. All water mains, appurtenances and other materials, and construction methods shall conform to the most recent edition of all applicable AWWA, ANSI, ASTM, State and Local codes, standards and regulations**,** and the VT Water Supply Rule. In the case of conflict between these construction details and specifications, project drawings, and a code or regulation, it shall be resolved to the satisfaction of the appropriate CWD Supervisor.

1.09. The applicant, developer or owner of record shall procure all permits**,** licenses**,** and easements that may be required to complete planned construction, including payment of all applicable fees, and shall comply with all conditions set forth in each permit in accordance with each water system's project review requirements.

1.10. At least fourteen (14) days before the start of actual construction of any utilities or improvements in each of the CWD managed water systems or owned transmission mains, the applicant, engineer**,** owner, or contractor shall notify the appropriate CWD Supervisor of their intent to proceed, and shall arrange a pre-construction meeting with the appropriate CWD Supervisor and/or water system owner, applicant, engineer, and the contractor to discuss the project. Pre-construction meetings shall take place a minimum of seven (7) days prior to the start of the actual work.

1.11. The applicant, developer or owner of record, beyond gaining approval of the contract documents by the appropriate CWD Supervisor, shall also be responsible for any permit issued or work completed under these specifications. The project applicant, or owner shall keep the appropriate CWD supervisor advised of the address to which bills, notices, and other communications are to be delivered, and shall provide an emergency contact list effective throughout the construction period.

1.12. All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi (VT Water Supply Rule, 8.1.1). The appropriate CWD Supervisor may require the installation of main line Pressure Reducing Valves (PRVs) depending on system configuration.

1.13. All service connections and water mains shall be buried to a depth of six feet (6') to the top of the pipe, and no more than eight feet (8') unless waived by the appropriate CWD Supervisor.

1.14. Looping of mains shall be done if at all possible, with the intent of avoiding dead-ends. Dead-ends should only be installed if (1) looping is impractical due to topography, geology, pressure zone boundaries, unavailability of easements or locations of users; or (2) the main will be extended in the near future, and the planned extension will eliminate the dead-end connection. In this condition the water main extension shall be continuous to the furthest property line of the project. A dead-end water main whether temporary or permanent shall have a fire hydrant or flushing hydrant installed at the end, unless approved otherwise by the Retail Superintendent.

1.15. In general, and unless stated otherwise in each Municipality's Rules, Regulations, Specifications, Ordinances, or Planning and Zoning requirements, easements of sufficient width shall be provided at locations acceptable to the Municipality if required. Easements for gas, telephone, electrical, and cable TV and private utilities should be located away from water lines and appurtenances wherever possible. The easement deed shall contain language that specifically indemnifies, and holds the water system owner harmless from any obligations, liabilities or claims arising from the existence of such easement or the construction of any utility within the easement, as well as wording preventing the construction of buildings or structures above the water line or within the water line easement.

1.16. All construction documents shall consider adequate fire protection and domestic service pressure. In the event a new extension cannot meet those requirements, the applicant or developer shall loop the waterlines, add a storage tank, provide booster pumps, or make other approved provisions to meet the requirements. The requirement to install the above appurtenances does not imply that each water system shall take ownership of the required provisions. Ownership shall be determined within the course of plan reviews, in accordance with each water systems rules, regulations, specifications, ordinances, and planning and zoning requirements.

1.17. There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system (VT Water Supply Rule, Appendix A, Chapter 21.8.8.1.).

1.18. Applications for irrigation purposes directly off of CWD Transmission mains shall not be approved. Applications for irrigation purposes off of distribution system mains shall be approved/rejected on a system by system basis, in accordance with each water systems rules, regulations, specifications, ordinances, and planning and zoning requirements.

1.19. The appropriate CWD supervisor shall be notified in advance to inspect all mechanical joint fittings, main line taps, appurtenances, thrust blocks, and water line crossings prior to occurrence of back filling.

1.20. The project engineer and /or contractor shall notify the appropriate CWD supervisor no less than two (2) working days in advance of any proposed testing of any completed mains. Attendance of all testing is at the discretion of the CWD Supervisor; however the absence of CWD representatives does not relinquish any of the above requirements. No testing shall be performed on weekends or legal holidays.

1.21. When unexpected subsurface conditions or conflicts with underground infrastructure are encountered that could affect the designed water line project, the Contractor must report the changed conditions to the Design/Project Engineer and the appropriate CWD supervisor before the work is allowed to proceed.

1.22. In the case of the reconstruction of existing facilities or disruption due to the installation of new utilities, the contractor/developer/owner shall be required to upgrade impacted portions of the existing water system to the standards outlined in these CWD Specifications. These upgrades shall also be required when new construction impacts existing infrastructure. It is the intent of the CWD to address all conflicts during the design stage of a project, however field changes to this regard may be required at the discretion of the appropriate CWD Supervisor.

1.22.01. There is a significant amount of Asbestos Cement (AC) water pipe within the CWD owned and managed water systems. There are a number of regulations that affect work involving AC pipe. It is the responsibility of the project engineer and contractor to insure that all work associated with AC pipe is performed by qualified personnel and in accordance with all applicable State and Federal regulations. Costs associated with any and all labor and materials to properly handle and dispose of existing AC pipe is the responsibility of the project owner.

1.23. If at any time during construction the CWD supervisor or their designee feels that improper materials, equipment, labor, safety provisions or traffic control is being utilized he/she may direct verbally and/or in writing that the situation be corrected at once. If the situation is not corrected, CWD may implement a stop work order. This may cause further construction to be terminated pending compliance.

1.24. The appropriate CWD supervisor reserves the right to direct the contractor to "dig up" any installation not meeting these requirements or that have been installed without prior approval or inspection, at the contractors expense.

1.25. No parallel underground utility (ex. phone, electric, cable, gas) shall be designed or installed within four feet (4') of the water main from either side, or above the water main from the bottom of the main to finish grade. Storm sewer and sanitary sewer separations are only as allowed in Section 33.00 of these specifications and the VT Water Supply Rule. No building or structure shall be built above the water line or within the water line easement. All projects that may cross or impact existing transmission or water distribution lines shall include the requirement to field verify all water associated infrastructure that may be impacted.

1.26. Prior to final acceptance and at the conclusion of the warranty period the following shall occur:

1.26.01. The appropriate CWD supervisor or his designee will conduct a preliminary walk-through inspection of the construction project and prepare a "punch-list" of identified deficiencies which the Contractor will promptly address.

1.26.02. Upon completion of the construction project or any Phase of the project, "Record Drawings" shall be supplied to the appropriate CWD supervisor in the form of one (1) hard copy and one (1) electronic copy in Auto-CAD Version 2010 Format (.DWG) or newer. All Record Drawings are to include valve and curb stop ties and valve and curb stop coordinates to sub-meter accuracy. On all projects CWD requires that approved submittals and O&M manuals be submitted in paper format and electronic Adobe Acrobat Reader (.pdf) format.

1.26.03. The contractor shall repair, replace or retest promptly as directed by the CWD supervisor and without further charges to the water system owner, all work, equipment, materials or parts, which may fail during the warranty period.

1.26.04. Final acceptance shall not take place until the appropriate CWD Supervisor has determined that complete record information has been received and all required improvements have been satisfactorily completed.

TECHNICAL SPECIFICATIONS

2.00 DUCTILE IRON PIPE

2.01. Ductile Iron Pipe is required on all CWD transmission system projects.

2.02. Pipe shall be ductile iron with a minimum diameter of eight inches (8") unless waived by the appropriate CWD supervisor**,** and conform to current AWWA C151 or ANSI Specification A21.51 for all distribution mains. Larger size mains will be required if necessary to allow withdrawal of the required fire flow while maintaining the minimum pressure specified in the VT Water Supply Rule, Chapter 21, 8.1.2. Any proposed departure from minimum requirements shall be justified by hydraulic analysis and future water use assessment, and will be considered only in special circumstances (VT Water Supply Rule, Chapter 21, 8.1.4).

2.03. Push-on joint pipe shall be minimum thickness class 52. Pipe shall be cement mortar lined on the inside in accordance with ANSI A21.4 and AWWA C104 except that the cement lining thickness shall not be less than one-eighth inch (1/8"**).** A plus tolerance of one-eighth inch (1/8") will be permitted.

2.04. Ductile iron pipe shall be given an exterior petroleum asphaltic coating in accordance with ANSI AWWA C151/ANSI A21.51

2.05. Four-inch (4") and six-inch (6") DI pipe shall have no less than two (2) brass wedges installed at each joint. Eight-inch (8") and larger DI pipe shall have no less than three (3) brass wedges installed at each pipe joint. Conductivity bonds may be installed in place of wedges.

2.06. When a pipe material is specifically noted on the approved project drawings, the contractor/developer shall not have the option of utilizing any other pipe material.

2.07. Galvanized pipe or fittings shall not be used in any water system managed or owned by the CWD Retail Department, or the CWD Transmission System.

2.08. All Ductile Iron water pipe shall be poly wrapped with a minimum thickness of 4 mil poly in accordance with AWWA Specification C105 / ANSI A21.5, unless approved otherwise by the appropriate CWD Supervisor.

3.00 POLYVINYL CHLORIDE (PVC) PIPE

3.01. PVC Pipe is not approved for use in the CWD transmission system or in any water system managed or owned by the CWD Retail Department.

3.02. Where existing PVC is encountered within CWD managed and owned water systems all Service connections shall require a tapping saddle. Only tapping saddles manufactured specifically for PVC pipe shall be used. The service saddle shall be designed to provide a drip tight connection. The body shall be Teflon or Epoxy coated Ductile Iron with double stainless steel straps, bolts, nuts, and mechanism for attaching to the pipe barrel (see Section 8.10). The maximum outlet size with a service saddle shall be two-inch (2”). Narrow U-bolt-type straps and saddles having lugs that dig into the pipe wall shall be prohibited.

4.00 High Density Polyethylene Pipe (HDPE)

4.01. Where approved by the appropriate CWD Supervisor, HDPE pipe may be used for limited main line installations, such as but not limited to:

4.01.01. Remote undevelopable areas with corrosive soils.

4.01.02. Unstable soil conditions.

4.01.03. Directional bores.

4.01.04. Intake lines.

4.02. When approved for use HDPE pipe and fittings will meet and be installed in accordance with ANSI AWWA specification C906 current edition.

4.03. A tracer wire will be required for all HDPE pipe installations.

4.04. No services or laterals will be installed on any runs of HDPE pipe.

5.00 DUCTILE IRON WATER MAIN INSTALLATION

5.01. The installation of ductile iron water lines shall conform to AWWA Standard C600, current edition.

5.02. The water main shall be laid and maintained on lines and grades established by the contract documents for the project, or as defined within these Specifications. Fittings and appurtenances shall be installed at the required locations unless approved otherwise by the appropriate CWD supervisor. Prior to excavation, an investigation may be required to determine the location of existing underground structures and conflicts.

5.03. Discharges from the trench shall be directed away from the trench to prevent trench instability. Excavated materials shall be placed in a manner that will not obstruct the work nor endanger workers or the public nor obstruct sidewalks, driveways, roadways, or other structures. Pavement and road surfaces shall be removed as part of the trench excavation. The amount removed shall depend on the width of trench required for the installation of the pipe and appurtenances, unless otherwise approved by the appropriate CWD supervisor or municipality. Trenches shall be wide enough to permit the placement of a trench box, sheeting, bracing, and appurtenances as required by safety requirements.

5.04. When excavation of rock is necessary, all rock shall be removed to provide a clearance below the pipe, valves, and fittings of twelve-inches (12”) and on all sides of at least eighteen-inches (18”), see typical A-19. A layer of appropriate backfill shall be placed on the bottom of the trench to the appropriate depths, then leveled and tamped after excavation is complete. Specified clearances shall be maintained between the bottom of the pipe and any part, projection, or point of rock, boulder, or stone of sufficient size and placement that could cause a fulcrum point or point load.

5.05. If the trench passes over a previous excavation, the trench bottom shall be sufficiently compacted to provide support equal to that of the native soil or conform to other regulatory requirements in a manner that will prevent damage to the existing installation.

5.06. When the excavated material is found to include ashes, cinders, refuse, organic material, or other unsuitable material, this material shall be removed to a minimum of at least twelve-inches (12”) below the bottom of the pipe. The removed material shall be replaced with clean, stable backfill material as approved by the appropriate CWD Supervisor.

5.07. The proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of pipe installation. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench using a backhoe, crane, tagged lifting chains, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings.

5.08. All pipes, fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for final disposition.

5.09. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.

5.10. When pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means specified. When practical the plug shall remain in place until the trench is pumped completely dry. All precautions shall be made to prevent flotation of the pipe in the trench.

5.11. All dead ends of new mains shall be closed with plugs or caps; such dead ends shall be equipped with suitable blow off facilities.

5.12. All new water mains shall be filled at a maximum velocity of 1ft/sec while venting air.

6.00 FITTINGS

6.01. All fittings shall be Ductile Iron with a 350 pounds working pressure, and shall conform to AWWA/ANSI C110/A21.10.

6.02. All fittings shall be domestic made in accordance with the Buy American Act, unless otherwise approved.

6.03. Pipe shall be inserted squarely into all fittings. No deflection will be allowed from any hydrant, tee, valve, or bend.

6.04. Anchor tees (aka: Hydrant tees and Swivel tees) shall be Class 350 ductile iron, cement lined, conforming to AWWA/ANSI C110/A21.10, C111/A21.11, and C104/A21.4. In lieu of Anchor tees, Mechanical Joint tees may be used if a Foster Adaptor is used to secure the valve directly to the branch of the tee. If a Mechanical Joint tee is to be used, it shall conform to the above referenced specifications.

6.05. Mechanical Joint restraints shall be incorporated into the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron, and have a minimum working pressure of 350 psi. Twist off nuts shall be used to ensure proper actuating of the restraining devices. Torque wrenches shall be used to tighten all bolts to manufacturer's specifications.

6.05.01. Mechanical joint retainer glands shall be domestic made and be either EBAA Iron MegaLug, Ford Uniflange Series 1400, Romac RomaGrip or approved equal.

6.06. Bolts shall conform to ANSI Specification A21.10.

6.07. Foster adapters shall be installed in all close-coupled connections of mechanical joint fittings and valves where a positive restraint mechanism is required. Foster adapters shall not be installed directly on hydrant shoes.

6.08. Pipeline couplings shall conform to AWWA C110 and ANSI A21.10. Mechanical Joint Connecting pieces of proper diameter shall be installed in accordance with the manufacturer recommendations and at locations directed by the plans or the appropriate CWD supervisor. Solid sleeve couplings shall be used when joining new pipes or like materials. Hymax couplings may be allowed when joining dislike pipe materials or new and old pipe connections.

6.09. All fittings shall be restrained; double poly wrapped and have concrete thrust blocks poured in place as defined herein.

6.10. Fittings located on the interior of vaults are to be #125 Flange fittings unless otherwise approved in writing by the appropriate CWD Supervisor.

7.00 CWD Connection Policy

7.01. CWD Wholesale Department

7.01.01. These regulations shall apply to all those wishing to connect to any CWD owned water transmission pipeline. Since it is the policy of the CWD Wholesale Department to deal only with the municipal water system purchasing water from the CWD, CWD will only accept tapping applications from those served member communities.

7.02. CWD Retail Department

7.02.01. These regulations shall also apply to all connections to distributions lines owned and/or maintained by the Champlain Water District Retail Department. CWD Retail Department owned and managed systems have individual forms that must be completed with the assistance of the Retail Department Superintendent.

7.03. **Definitions:** As used in these regulations the following definitions shall apply to both Wholesale and Retail departments:

7.03.01. Connection: the act of direct tapping an existing water main, “cutting in” a tee and valve, or connecting to a previously installed tee and/or valve; all connections are solely at the cost of the applicant.

7.03.02. Completed Connection: a connection that has passed all required testing which may entail but is not limited to; visually inspected, hydraulically pressure tested, suitably restrained, and substantially backfilled.

7.03.03. Municipality: shall be the political structure or organization responsible for the retail distribution of water in the area.

7.03.04. Connection Fee: shall be a charge levied for permission to connect to a water main owned and / or maintained by the Champlain Water District, and shall be prepaid by the applicant.

7.04. Those wishing to connect to or tap a water line within the Champlain Water District Transmission or Distribution systems must contact the municipality in which the water line is located.

7.05. Any connection to or tapping on a line shall be made only after:

7.05.01. The appropriate written application has been made to the Champlain Water District by a municipality.

7.05.02. Written approval has been granted by the Champlain Water District Copies of respective Wholesale and Retail application forms can be found in Appendix B.

7.05.03. The assessed connection fee has been paid to the Champlain Water District or the appropriate municipality.

7.05.04. Appropriate prior notification; a minimum of three (3) working days, has been given to the appropriate CWD Supervisor regarding the date and time that the connection is to take place.

7.06. The connection can only take place in the presence of a Champlain Water District employee.

7.07. A connection shall **not** be made after November 15 or before April 1 without prior approval of the appropriate CWD Supervisor, who may also restrict connections before November 15 and after April 1 during adverse weather conditions.

7.08. Connections shall be made by Champlain Water District approved contractors only. Work will only be allowed after a current certificate of insurance is provided by the tapping contractor.

7.09. Connections will only be permitted between the hours of 7:00am and 3:00pm and only on regular Champlain Water District business days. All connections must be completed by 3:00pm; connections that cannot be completed by 3:00pm may be suspended and completed the following business day. A suspended tap may entail back filling the excavation until the following day. CWD personnel have the authority to suspend connections that they deem cannot be completed within the time period stated above.

7.10. Excavations for connections shall comply with safety requirements outlined in Section 27.00, Protection of the Public and Work Personnel of these

specifications. CWD personnel have the authority to suspend connections that they deem do not comply with applicable VOSHA Guidelines.

7.11. No connection shall be located within 3 pipe diameters of any other fitting or pipe joint.

7.12. In the case of conflict between the CWD Specifications, construction details, and specifications or codes or regulations of a municipality, it shall be resolved to the satisfaction of the appropriate CWD Supervisor.

7.13. The regulations and specifications of the municipality pertaining to the use of its water system shall be followed, as well as the regulations and specifications of the Champlain Water District.

7.14. Connection fees shall be levied by the Champlain Water District and/or the local municipality in accordance with the appropriate schedule in Appendix B and/or the local municipality's regulations.

7.15. **CWD Wholesale Transmission Main Connection Fees and Exemptions.**

7.15.01. No charge shall be made to connect an existing member water system to a Champlain Water District transmission line in order to transmit water to that system, or to transfer an existing water service from a municipality owned water line to a Champlain Water District line.

7.15.02. No charge shall be made wherein a connection is made so as to solely create a loop in an existing system, provided no additional water demand is added to the system.

7.15.03. No charge shall be made wherein a connection is made to provide service solely to a new fire hydrant.

7.15.04. Charges associated with unique or unusual connection applications shall be reviewed and determined by the appropriate CWD supervisor.

7.15.05. The payment of a connection fee to the Champlain Water District shall not preclude the right of a municipality to levy any additional fee or cost item as a charge for said tap or supervision thereof.

7.15.06. The municipality shall be responsible for the payment of any fees due. The amounts due shall be paid at least three (3) working days prior to connection being made.

7.16. **CWD Wholesale Transmission System requirements:**

7.16.01. All tapping corporations, tapping sleeves and tapping valves on the CWD transmission pipeline will be installed only after permission of the specific CWD served municipal water system and the CWD.

7.16.02. All tapping corporations, tapping sleeves and tapping valves of any size, become the property of the CWD and the responsibility of operation, maintenance and/or replacement is the obligation of the CWD. A minimum one year warranty from the time of installation shall be provided by the installing contractor.

7.16.03. All pipe and appurtenances beyond the tapping corporations, tapping sleeves and tapping valves shall be owned, maintained and repaired by the host municipality and/or property owner, in accordance with each water systems rules, regulations, specifications, ordinances, and planning and zoning requirements.

7.16.04. All connections made to CWD Transmission mains will be equipped with certified Back Flow devices that meet the requirements of the Municipality in which the connection is being made. If the Municipality does not require backflow devices the connection must be equipped with a backflow device that meets the requirements in Section 17.00 of these specifications.

8.00 TAPPING SLEEVES AND TAPPING VALVES

8.01. The appropriate CWD Department shall be notified whenever a proposed tap is to be made on any CWD owned or managed water main. The appropriate application forms are included in the Appendix B of these Specifications.

8.02. Only approved tapping companies shall be allowed to perform wet taps on any CWD owned or managed water main. A current list of approved companies can be obtained from a CWD Supervisor.

8.03. Taps shall be a minimum of three pipe diameters away from any joint, other tap, or fitting in the water line being tapped. Example: If tapping a 12” water line the tapping saddle must be a minimum of 36” away from the nearest joint in the 12” water line.

8.04. All tapping sleeves shall be provided with a ¾” NPT test plug, for Hydrostatic testing of the valve and sleeve assembly. The test pressure shall be at 200 psi or not exceed the rated working pressure of any of the fittings. The sleeve and valve assembly shall hold the determined test pressure for a minimum of 30 minutes without any pressure drop. Any leaks or other problems must be remedied before the pipe is tapped. Air testing is **NOT** allowed on any tapping sleeve.

8.05. All Tapping Sleeves and Tapping Valves shall be poly wrapped with a minimum thickness of 4 mil poly in accordance with AWWA Specification C105, unless approved otherwise by the appropriate CWD Supervisor.

8.06. Direct taps over twelve inches (12”) in diameter shall **not** be allowed. Connections that require taps larger than twelve inches (12”) in diameter shall be direct tee and valve cut ins, unless otherwise approved by the appropriate CWD Supervisor.

8.07. All materials used when tapping for a branch connection or interconnection from any Champlain Water District owned or managed water main shall be as specified below:

8.08. **Ductile Iron Tapping Sleeves**:

8.08.01. AWWA C110/C153 (latest version) compliant Ductile Iron tapping sleeves shall be used on all CWD owned or managed Ductile Iron and Cast Iron water mains when the tap is 4” in diameter or larger.

8.08.02. Tapping sleeves shall be of the split sleeve design constructed with two solid half-sleeves bolted together. Sleeves shall be constructed of ductile iron, shall have a working pressure of at least 250 psi, and shall have mechanical joint ends with end and side gasket seals.

8.08.03. All bolts and nuts for mechanical joints of tapping sleeves shall be of high-strength cast iron or high-strength, low alloy steel conforming to ANSI/AWWA C111/A21.11 (latest version).

8.08.04. All bolts and nuts for flanged joints of tapping sleeves shall be of high-strength, low carbon steel conforming to ANSI/AWWA C110/A21.10 (latest version).

8.08.05. All bolts and nuts shall be sound, clean, and coated with a rust resistant lubricant; and their surfaces shall be free of objectionable protrusions that would interfere with their fit in the made-up mechanical or flanged joint.

8.09. **Stainless Steel Tapping Sleeves:**

8.09.01. ANSI/AWWA C223 (latest version) compliant Stainless Steel tapping sleeves shall be used on all CWD owned and managed Asbestos Cement and PVC C900 water mains.

8.09.02. Tapping sleeves shall be stainless steel with mechanical joint or flanged outlets as approved by the appropriate CWD supervisor.

8.10. **Tapping Valves**:

8.10.01. Tapping valves shall conform to ANSI/AWWA C509 (latest version) Standard for Resilient-Seated Gate Valves for Water Supply Service. Valves shall open counterclockwise (left) and shall have a minimum working pressure of 200 psi. Inlet flanges shall be Class 125

conforming to ASME B16.1 or ANSI/AWWA C110/A21.10 (latest version), and outlet connection shall be Standardized Mechanical Joint unless specified otherwise on the drawings for the type of pipe required for the branch or lateral pipeline.

8.10.02. Gate valves used to convey or dispense water for human consumption shall comply with the Vermont Law (Act 193) An Act Relating to Prevention of Lead Poisoning By Exposure to Lead in Consumer Products, and shall contain no more than 0.25% lead by weighted average. Fixtures containing brass must comply with NSF/ANSI 61 Annex G.

8.10.03. Tapping valves for Stainless Steel Tapping Sleeves shall be manufactured to meet all requirements of ANSI/AWWA C509 current edition.

8.10.04. Valves twelve inches (12") and smaller shall be bubble tight, zero leakage at 200 psi working pressure. Valves shall have non-rising stems, open counter clockwise and provide a two (2") square operating nut with an arrow cast in the metal indicating direction of opening.

8.10.05. All valve body bolts shall be stainless steel.

8.10.06. Each valve shall have the maker's name, pressure rating and year in which it was manufactured cast on the body. Valves shall be mechanical joint on each end. Prior to shipment from the factory each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. Gate valves shall be Mueller, , Kennedy, AFC or approved equal on distribution mains, and Mueller, AFC, or approved equal on CWD Transmission mains.

8.10.07. Tapping valves over twelve inches (12") diameter shall NOT be allowed.

8.10.08. Buried tapping valves shall be provided with a two inch (2") square wrench nut and shall be installed with a cast iron valve box as required to allow access to the valve operating nut at all times. In installations where the depth from grade to top of valve operating nut is greater than five feet (5'), a valve stem riser shall be provided and installed such that the depth from the valve stem riser nut to grade is from four feet to five feet (4'-5'). Valve stem risers shall be of high strength stainless steel and of welded construction (see detail A-20).

8.10.09. All contractors (or others) who apply to Champlain Water District for transmission water line taps shall submit complete specifications of the tapping material they intend to use at the time the Champlain Water District Tapping Application Form is submitted.

8.11. **Tapping Saddles (3/4" through 2")**:

8.11.01. Bodies shall be Ductile Iron per ASTM A536

8.11.02. Bodies shall have a fusion bonded epoxy or approved equal finish.

8.11.03. Body threads shall be CC per AWWA C800.

8.11.04. Bands are to be constructed of grade 304 stainless steel and have a minimum width of 2".

8.11.05. Bolts and nuts are to be constructed of grade 304 stainless steel.

8.11.06. Tapping Saddles shall be used only for the following: Ductile Iron and Cast Iron pipe for taps 1 ½" or 2" in size, All PVC pipe, All AC pipe.

8.11.07. A connection made to a pipe that requires a tapping saddle or that is not ductile iron will have a body with a suitable outlet, seal, and suitable means for attachment to the main. The body shall be made to conform to the outside configuration of the main. The service saddle shall be designed to provide a drip tight connection. The body shall be Teflon or Epoxy coated with stainless steel strap(s), bolts, nuts, and mechanism for attaching to the pipe barrel. Service saddles with a two-inch outlet shall not be used on a two-inch main. Service saddles must meet manufacturers' guidelines and recommendations for specific pipe materials.

9.00 GATE VALVES- RESILIENT SEAT

9.01. Valves shall be manufactured to meet all requirements of AWWA C509 or C515 latest edition. Valves Twelve inches (12") and smaller shall be bubble tight, zero leakage at 200 psi working pressure. Valves shall have non-rising stems, open counter clockwise (left) and provide a two (2") square operating nut with an arrow cast in the metal indicating direction of opening. Each valve shall have the maker's name, pressure rating and year in which it was manufactured cast on the body. Valves shall be mechanical joint on each end, and secured to the adjoining pipe with an approved retainer gland. Prior to shipment from the factory each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. Gate valves shall be Mueller, Kennedy, AFC, or approved equal on water distribution mains and Mueller, AFC, or approved equal on CWD Transmission mains.

9.02. Gate valves used to convey or dispense water for human consumption shall comply with the Vermont Law (Act 193) An Act Relating to Prevention of Lead Poisoning By Exposure to Lead in Consumer Products, and shall contain no more than 0.25% lead by weighted average. Fixtures containing brass must comply with NSF/ANSI 61 Annex G.

9.03. Buried gate valves shall be provided with a two inch (2") square wrench nut and shall be installed with a cast iron valve box as required to allow access to the valve operating nut at all times. In installations where the depth from grade to top of valve operating nut is greater than five feet (5'), a valve stem riser shall be provided and installed such that the depth from the valve stem riser nut to grade is from four feet to five feet (4'-5'). Valve stem risers shall be of high strength stainless steel and of welded construction (see detail A-20).

9.04. Gate valves shall normally be placed a maximum of five hundred feet (500') apart. Tee intersections shall have three (3) gate valves directly connected to all branches with the use of foster adapters (See also Section 7, Fittings). Mechanical joint cross connections (four way intersections) shall have a minimum of four (4) valves, connected with the use of foster adapters. On longer runs of pipe, or for long runs of transmission main, valve separation of >500' may be approved on a case-by-case basis.

9.05. All gate valve bolts, studs and nuts shall be made from corrosion resistant stainless steel**.**

10.00 BUTTERFLY VALVES

10.01. Valves 16" and larger are to be butterfly valves unless otherwise approved by the appropriate CWD Supervisor.

10.02. Butterfly valves are to be AWWA Class 250B.

10.03. Butterfly valves are manufactured by Mueller, Pratt or approved equal.

10.04. Iron Body Rubber Seated Butterfly Valves (buried application) are to at a minimum meet the following:

10.04.01. AWWA Specification C-504 (latest version).

10.04.02. *Valve body:* Ductile Iron ASTM A536, Grade 65-45-12, 70-50-05, or 80-55-06 or ASTM A395, Grade 60-40-18.

10.04.03. *Valve Disc:* Stainless Steel ASTM A240

10.04.04. *Valve Stem:* Stainless Steel ASTM A240

10.04.05. *End Connection:* Mechanical Joint

10.04.06. *Operation:* Open counter clockwise and provide a two (2") square operating nut with an arrow cast in the metal indicating direction of opening

10.04.07. *Coating:* Interior and Exterior to be coated with Epoxy (fusion bonded).

10.04.08. All valve body bolts and nuts are to be Stainless Steel.

10.05. Buried butterfly valves shall be provided with a two inch (2”) square wrench nut and shall be installed with a cast iron valve box as required to allow access to the valve operating nut at all times. In installations where the depth from grade to top of valve operating nut is greater than five feet (5’), a valve stem riser shall be provided and installed such that the depth from the valve stem riser nut to grade is from four feet to five feet (4’-5’). Valve stem risers shall be of high strength stainless steel and of welded construction (see detail A-20).

11.00 VALVE BOXES

11.01. Valve boxes shall be of the three-piece cast iron slide type with a minimum inside shaft diameter of five and one quarter inches (5¼”) and a six foot (6’) trench depth.

11.02. Valve boxes shall not transfer loads onto the valve.

11.03. Valve boxes shall have a cast iron cover marked “WATER”.

11.04. The boxes shall be dirt tight with the top of the cover flush with the top of the box rim.

11.05. Valve boxes located in roadways shall have one non-adjustable paving riser of a height ranging from one and a half inches (1.5”) to six inches (6”) as needed, to be brought to final pavement grade.

12.00 FIRE HYDRANTS AND HYDRANT BRANCHES

12.01. Fire Hydrants shall be Mueller Super Centurion 250, Figure A-423, Kennedy K-81 D, or Waterous Pacer and shall conform to AWWA C502 with the following specifications. Note: Waterous Pacer hydrants shall be installed with a Boston Operating Nut (see detail A-15).

12.02. Main Valve Opening: 5 ¼ inches

12.03. Nozzle Arrangement:

12.03.01. Two-2½ inch Hose Nozzles with National Standard Thread (NST), one approved hydrant flag (see detail A-27).

12.03.02. One 4½-inch Pumper Nozzle with National Standard Thread (NST) NOTE: Within the CFD #1, MBWC and CT water systems, a four-inch (4”) Storz Connection on the pumper nozzle shall be required in place of the 4 ½” NST nozzle.

12.04. Inlet Connection: 6 inch Mechanical Joint, “Mega-Lug” or equivalent retaining gland, and concrete thrust block

12.05. Operating Nut: Standard 1 ½ inch Pentagon

12.06. Direction of Opening: Counterclockwise

12.07. Depth of Bury: Six-foot cover. The hydrant shall have at least 15 inches and no more than 21 inches between the bottom of the pumper cap and the ground.

12.08. Hydrant Drain: The hydrant shall be non-draining or have the drains permanently plugged.

12.09. Color: Color shall be Red enamel.

12.10. Other: Hydrants shall be compression type closing with the pressure. Hose and pumper nozzles shall be ¼ turn type secured by stainless steel or corrosion resistant pins or screws. Pressure seals behind nozzle flanges shall be “O” rings. A breakable coupling retained in place by stainless steel or corrosion resistant pins shall make the union between the upper and lower stems. The two-piece traffic flange shall be held in place by nuts and bolts. The upper barrel shall be able to rotate 360 degrees without removing any bolts. Approve hydrant flags shall be required and placed on each hydrant at the time of installation**.** Wherever a traffic hazard appears to exist, curbing and/or bollards shall protect the hydrant except within municipal Right-Of-Ways.

12.11. Fire hydrants shall comply with AWWA C502 (latest version).

12.12. For single- family house subdivisions, there will be at least one hydrant at each intersection and a maximum of five hundred feet (500’) between hydrants with a minimum water flow of 500 gallons per minute (gpm) at the flow hydrant with a 20-psi residual pressure at the residual hydrant. Municipal hydrants should be located immediately adjacent to street property lines. A 20’ x 20’ easement will be required around all hydrants. No structures or plantings are to be placed within a 20’ x 20’ area of any hydrant. All approved subdivisions shall be installed with the same brand, make, and model of fire hydrant within the project limits.

12.13. Where dead-end mains occur they shall be provided with a fire hydrant if flow and pressure meet minimum requirements. If flows and pressure are not sufficient, then an approved flushing hydrant or blow off shall be installed for flushing purposes. (See Section 14)

12.14. When set in lawn space between the curb and sidewalk no portion of the hydrant or nozzle cap will be less than one foot off the gutter face of the curb or edge of the sidewalk. Hydrants shall be a minimum of four feet (4’)

and a maximum of six feet (6') from the edge of the sidewalk to the closest point on the hydrant when placed behind the sidewalk. Hydrants shall be located so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians, as approved by the appropriate CWD supervisor.

12.15. **CWD Transmission System Hydrant Installations**

12.15.01. Fire hydrants, tapping sleeves and tapping valves may be installed on Champlain Water District lines under the following conditions:

12.15.02. Fire hydrant assemblies (hydrant and isolation valve) may be furnished and installed on any portion of CWD transmission mains for use either as "blow offs" at low points in the system to flush the mains and/or for firefighting purposes.

12.15.03. All hydrant assemblies furnished and installed by CWD, as well as others which are furnished and installed by the local water systems <u>may</u> be used by CWD for line flushing or other purposes. Such hydrant assemblies shall become the property of the municipal water system and remain so for purposes of operation, maintenance and/or replacement.

12.15.04. Hydrants connected directly to a CWD Transmission main shall be owned and maintained by the municipality in which they are located. Ownership shall be from the outlet side of the hydrant isolation valve (See typical A-15). Hydrants designated as "private" within a municipal water distribution system shall be owned and maintained according to that water systems water ordinance or rules and regulations.

12.16. **Hydrant Flow Test**

12.16.01. Prior to acceptance by the municipality, Contractors/Owners shall provide a fire flow test for each installed hydrant.

12.16.02. Fire flow test shall witnessed and documented by a Professional Engineer and reports submitted to the appropriate CWD Supervisor.

12.16.03. The required standard form is located in the Appendix B.

13.00 <u>HYDRANT ASSEMBLIES</u>

13.01. Hydrant assemblies shall consist of either a tapping sleeve and valve or an anchor tee, a six inch (6") mechanical joint gate valve conforming to the above specifications, the appropriate length of six inch (6") Ductile Iron Cement Lined, Class 52 pipe secured to the gate valve with an approved retainer gland, all necessary anchor couplings and approved retaining glands, the fire hydrant and appropriate thrust block.

13.02. Care shall be taken to prevent damage to hydrants and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials; all debris and foreign material cleaned out of the hydrant bowl; all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. All hydrants shall be carefully incorporated in the water main and supported in their respective positions free from distortion and strain. Hydrants shall be set plumb. All hydrants shall be oriented to most efficiently allow fire truck access and connection for emergency purposes. Traffic model hydrants shall be installed so that the bury line is no more than two inches (2") above or below established grade. Generally, fire hydrants shall not be installed within ten-feet (10') of any new or existing light pole, telephone/power pole, gas line, utility box or other utility structure. Hydrant locations are subject to the approval of the appropriate CWD supervisor and the appropriate municipality's fire department. Installation procedures for fire hydrants can be found in AWWA C600.

14.00 BLOW-OFF ASSEMBLIES

14.01. Large diameter (4" or greater) blow-off assemblies shall consist of an anchor tee, a mechanical joint gate valve conforming to the specifications in Section 9.00, the appropriate length of Ductile Iron Cement lined, Class 52 pipe, all necessary anchor couplings, approved retaining glands, MJ and flanged fittings, and cap. The open end of a large diameter blow off shall terminate at least forty eight inches (48") above grade (See detail A-4).

14.02. The appropriate CWD supervisor may require the installation of a Kupferle MainGuard Model 77 two-inch (2") self-draining blow-off/flushing hydrant at various points on a water distribution line. Blow-off/flushing hydrants are typically required at the end of small diameter water lines that are not designed to support a fire hydrant. Blow-off/flushing hydrants shall be installed according to manufacturer recommendations (See detail A-31). Connection to the water main shall be in accordance with Section 15.00 of these specifications.

14.03. Blow-offs shall not be connected to any sewer, submerged in any stream or ditch, or installed in any manner that will permit back siphonage into the distribution system.

15.00 SERVICE CONNECTIONS

15.01. Service lines on all CWD Distribution and Transmission water mains shall be copper from the corporation to the curb stop. Service lines connected to CWD Transmission mains beyond the curb stop shall follow municipal specifications. Service lines shall be installed so as to run perpendicular, in a straight line from the water main to the curb stop (See detail A-14).

15.02. All service connections to mains shall comply with Section 8 of these specifications in its entirety.

15.03. Each service shall consist of a corporation, curb stop, copper tubing and an Erie style curb box with a stainless steel service rod. Service lines from three-quarter to two inch (¾" to 2") shall be copper tubing from the corporation stop to building. Copper tubing shall be type "K", soft temper, conforming to ASTM B88. The name or trademark of the manufacturer and type shall be stamped at regular intervals along the pipe. Copper service line sizes shall be three-quarter inch, one-inch, one and one-half inch, or two-inch (¾", 1". 1-1/2", or 2").

15.04. Copper service pipe shall be one piece from the corporation to the curb stop. Services lines crossing roadways shall be required to have a curb stop on each side of the roadway.

15.05. The minimum service size for a single-family residence shall be three-quarter inch (¾"). The minimum service size for a duplex shall be one inch (1"). Service lines for single family homes and duplexes with fire sprinkler systems shall be sized appropriately for sprinkler system and domestic demands.

15.06. All underground service line valves, fittings, corporations, curb stops, meter tail setters, elbows, and angle valves shall be manufactured in accordance with AWWA Standard C-800, latest edition, and as further specified in these specifications. All service line components used to convey or dispense water for human consumption shall comply with the Vermont Law (Act 193) and must also comply with NSF/ANSI 61 Annex G. Hereafter referenced as Low-Lead Brass.

15.07. Low-Lead brass fittings shall be by AY McDonald or Cambridge, or Department approved equal. All Low-Lead brass fittings shall have the manufacturers name or trademark integrally stamped or cast on it. Another marking, identifying the "Low-Lead" brass alloy shall also be cast or stamped on the fitting.

15.08. Corporations shall have threads per AWWA C800 Table 7 / Figure 2 at the inlet, and a compression type fitting at the outlet, per AWWA C800, Figure 4. Both inlet and outlet shall be the same size. In no instance, except when a tapping sleeve and valve is used, shall a tap be made without a corporation. Corporations shall be AY McDonald or Cambridge Brass Low-Lead, or Department approved equal. Corporations shall be ball valve type with minimum allowable pressure rating of 300 psi.

15.09. Curb stops shall be a ball valve type with a minimum allowable pressure rating of 300 psi and manufactured in accordance with AWWA C800. The curb stop shall open left, have a positive stop, be full port, provide a drip-

tight shutoff in the closed position, and be of the tee design or flat design. No curb stop shall have the ability to drain the service line. Both the inlet and outlet of the curb stop shall have compression type fittings. The tee head of the curb stop shall have the provision for the connection of a service rod. Curb stops shall be AY McDonald or Cambridge Brass Low-Lead, or Department approved equal. The curb stop shall rest on a four inch by eight inch by sixteen-inch (4" x 8"x 16") solid concrete block for support. Curb stops shall be installed just inside the municipal R.O.W unless otherwise approved by the appropriate CWD Supervisor.

15.10. Curb boxes shall be of sliding adjustable type capable of adjusting from five feet to six feet (5'-6') (Erie Style). The base of the box shall be arch type so as to prevent the box from resting on the curb stop. The adjustable upper section shall be one inch (1") diameter for use with ¾" and 1" curb stops. For larger curb stops, the curb box shall be installed over a heavy foot piece. Stationary rods affixed to the key of the curb stop with a brass pin shall be thirty inches (30") in length for ¾" and 1" curb stops and twenty-four inches (24") for large curb stops. Curb box rods shall be stainless steel. The word "WATER" shall be inscribed on the cover of the box. The cover of the box shall have countersunk brass pentagon plug for those curb boxes placed in paved or concrete areas, and standard two holes for grass areas. Curb box couplings and extensions will be the same material as the curb box. Both cover and upper section of the box shall be able to be located with a ferrous type metal locator.

15.11. All service connections shall be installed to the curb stop for all building lots before the street is paved.

15.12. Service connections shall be made by installing the approved service line from the curb stop/gate valve through the cellar wall or floor. In accordance with the water systems rules and regulations or water ordinances a ball valve or angle valve may be installed by the Department on the end of the service line to which a Department installed or furnished water meter shall be connected. Contractors shall be supplied meter flanges for meter connections larger than one-inch (1") to which the Department shall furnish and install the appropriate sized meter in accordance with water system rules and regulations and/or water ordinances. The contractor shall be required to perform all plumbing off the downstream meter connection, including a shut off, appropriate backflow device, and recommended pressure regulator, all installed in accordance with standard plumbing practices or municipal requirements. Meters shall be installed horizontally at the point of entry into a building and before any lateral. Meters shall be installed between 12" and 48" from the floor, and 12" from any wall. Reasonable space for access shall be provided around the water meter and valving to allow for maintenance.

16.00 BACKFLOW PREVENTION DEVICES

16.01. No water service connection shall be approved or maintained by the CWD Wholesale and Retail Departments, unless the water supply is protected as required by State laws, and local water system regulations and ordinances. The type of protective device shall depend on the degree of hazard that exists or may be created. Approved backflow prevention devices shall be located so as to provide containment protection at a minimum, and may be supplemented with the installation of internal protection backflow protection devices. In general, protection shall be provided by an air gap or an approved RPZ or DCV as a complete unit, installed in all commercial buildings, and a Dual Check Valve installed in residential buildings unless approved otherwise by the appropriate Department.

16.02. Only the following types of backflow prevention devices shown below shall be used for the containment of commercial on-premise hazards for low and high hazard situations respectively:

Low Hazard	*High Hazard*
Air gap	Air gap
Atmospheric vacuum breaker (Where bacteria hazards aren't present)	Reduced pressure/ backflow device
Pressure vacuum breaker	Or combination of the above
Double check valve assembly	
Reduced pressure backflow device	
Or combination of the above	

16.03. In the absence of municipal backflow requirements, any domestic, commercial, institutional, and fire protection service lines, including each line of a multiple service line, and a multifamily building serving more than two units shall be equipped with an approved backflow device or an approved air gap separation on each line. All other connections to any water main, including standpipes leading to elevated tanks, temporary connections, hose connections, and irrigation systems shall be equipped with approved backflow prevention devices.

16.04. All new residential buildings will be required to install at a minimum an approved dual check valve immediately downstream of the water meter (i.e. - Watts Series 7).

16.05. Provisions shall be made by the builder to provide for thermal expansion within a closed loop internal plumbing system (i.e. - the installation of thermal expansion devices and/or pressure relief valves).

17.00 ROCK EXCAVATION

17.01. Areas of known or suspected ledge may require subsurface investigation to determine its extent prior to job commencement, at the contractor's expense. A pre-blast survey is required and shall be conducted prior to any blasting, and a written blasting plan shall be provided prior to any blasting to the appropriate CWD supervisor and requesting municipal official.

17.02. Rock shall be excavated, when encountered, to the lines and grades indicated on the drawings or as directed by the appropriate CWD supervisor. Excavated material shall be disposed of and acceptable material shall be furnished for backfill in the space voided by the excavated rock.

17.03. Rock in pipe trenches shall be excavated to a depth not less than twelve inches (12") lower than the bottom of the installed pipe, in accordance with Section 5.04. When so specified or indicated, or when laying the pipe in an excavated rock area, the trench shall be backfilled with satisfactory material listed and approved under Pipe Bedding (see Detail A-19).

17.04. Blasting shall be in full compliance with all State and Federal laws and local ordinances. Blasting contractors shall provide a certificate of insurance and take all possible care to avoid injury to persons and damage to property. Blast areas are to be completely covered with blasting mats and sufficient warning given to all persons in the vicinity of the work before blasting. Care shall be taken to avoid damages to utilities or other structures above and below ground.

17.05. All blasting shall be conducted by persons qualified and experienced in drilling and controlled blasting procedures for rock excavation of the types required. Persons responsible for blasting shall be licensed blasters in the State of Vermont and shall have had acceptable experience in similar excavations in rock and controlled blasting techniques. Drillers shall have demonstrated proficiency in collaring and drilling holes precisely. The appropriate CWD supervisor shall be notified in advance of all drilling and blasting around existing transmission and distribution mains.

17.06. No blasting will be permitted under or adjacent to any street, road, or highway unless permission has been received in writing by the municipal authority having jurisdiction.

17.07. Blasting contractors shall comply with all municipal, State, Federal and other ordinances and codes relating to the storage and handling of explosives. Particular attention is called to adherence of requirements of the electric, gas and other utilities that may be located in the project area.

17.08. Damages and cost of whatever nature resulting from blasting operations shall be borne solely by the blasting contractor.

17.09. If rock below grade is shattered by blasting, caused by holes drilled too deep, or too heavy charges of explosives, or any other circumstance due to blasting, and if such shattered rock does not provide suitable foundation, the rock shall be removed and the excavation refilled with acceptable material by and at the expense of the contractor.

18.00 PIPE BEDDING

18.01. Water lines shall be laid and maintained on lines and grades established by the plans for the project**.** Pipeline trenches shall be excavated to the width and depths shown on the plan typical details or as defined herein.

18.02. Pipeline trenches in which pipe is to be laid directly on the trench bottom shall not be excavated entirely by machinery, but shall be finally excavated by hand tools such that the trench shall have a bottom shaped to support the pipe throughout its entire length by firm and undisturbed material.

18.03. Pipeline trenches, for which bedding is required, shall be excavated to the required depths using machinery. No pipe shall be laid directly on ledge, hard shale or a very compact glacial till. When excavation of rock is necessary, all rocks shall be removed to provide a clearance below all pipes, valves, and fittings of at least twelve inches (12”) below and eighteen inches (18”) on all sides of at least twelve-inches (12”) for nominal pipe sizes up to 24”. When excavation is completed, a layer of appropriate backfill material shall be placed on the bottom of the trench to the appropriate depths, then leveled and tamped. These clearances and bedding procedures shall also be observed for pieces of concrete or masonry and other debris that may be encountered during excavation. In all cases the specified clearances shall be maintained between the bottom of all pipe and appurtenances and any part, projection, or point of material of sufficient size that could cause a fulcrum point or point load.

18.04. When an unstable trench bottom is encountered and the appropriate CWD supervisor determines that it cannot support the pipe adequately, an additional depth shall be excavated and refilled to the pipe invert with approved material at the contractor’s expense.

18.05. Pipeline trenches shall be dry during the laying of pipe. Wood supports under pipe shall be removed prior to back filling.

18.06. Pipeline installation procedures can be found in AWWA Standard C600.

18.07. Bedding material shall consist of crushed or natural stone conforming to ASTM D2321.

Sieve	*Percent Passing*
1" Screen	100%
¾" Screen	100%
½"	90 – 100%
3/8" Screen	40 – 70%
#4 Sieve	0 – 15%

18.08. Bedding and blanket material shall be Class II material (ASTM D2321) consisting of clean, granular material (sand), particle size limits described as follows:

Sieve	*Percent Passing*
No. 4	100%
No. 100	30%
No. 200	12%

19.00 PIPELINE INSULATION

19.01. Approved waterlines with less than five feet (5') of cover over the crown, that cross a storm sewer, where indicated on the plans, or as required by the appropriate CWD supervisor, shall be protected against freezing by the installation of insulation board which is to be closed cell, extruded Polystyrene foam meeting ASTM 578, Type VI, 40 psi compressive strength (ASTM D1621) 0.1% max. Water absorption (ASTM C272).

19.02. The sheets shall be placed twelve inches (12") above the crown and twelve inches (12") from each side. Side sheets shall extend six inches (6") below the invert of the pipe (see Detail A-33). The area between the pipe and insulation shall be filled with clean medium or coarse sand. No less than four inches (4") of clean medium or coarse sand shall be placed directly over the insulation sheets after they are installed. Joints shall be overlapped so there is no gap that will allow frost to penetrate. Care shall be exercised during backfill and compaction over the polystyrene sheets to prevent damage to the sheets. In no cases shall the waterline have less than four feet (4') of cover over the top of the pipe.

20.00 POLYETHYLENE PIPE ENCASEMENT (Sleeve)

20.01. Polyethylene pipe encasement may be required in areas of corrosive soils and shall conform to the current AWWA C105/ANSI A21.5 standard**.** Minimum material requirements for the polyethylene film shall be high density; cross-laminated virgin polyethylene 4 mil film sleeves.

20.02. The polyethylene encasement shall prevent contact between the pipe or fittings and the surrounding backfill and bedding material and shall be installed as outlined in section 4.1 of the above AWWA/ANSI standard. Lumps of clay, mud, cinders, etc., on the pipe shall be removed prior to installation of the polyethylene encasement. During installation, soil or embedment material shall not be trapped between the pipe and polyethylene. Overlap and ends shall be secured with adhesive tape. All cuts, tears, punctures, or damage to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene sheet, wrapped around the pipe to cover the damaged area, and secured in place. Backfilling around polyethylene-wrapped pipe shall be in accordance with ANSI/AWWA C600.

21.00 CHECK VALVES

21.01. Check valves may be required in certain parts of the transmission / distribution system. Where required, check valves:

21.01.01. Shall meet ANSI/AWWA Specification C-508.

21.01.02. Shall be rated for a 250 psig working.

21.01.03. Shall have a Ductile Iron body, bonnet and disc that exceeds ASTM A-536 66-45-12.

21.01.04. Shall have a fusion bonded epoxy coating inside and out.

21.01.05. Shall not have outside lever and weights or springs.

21.01.06. Shall have the disc as the only moving part.

21.01.07. Shall have a drop tight shut off pressure as low as 5 psig.

21.01.08. Shall be suitable for buried service.

21.01.09. Shall have a 100% unobstructed flow area that is free if pockets which can trap debris.

21.01.10. Shall have a factory installed flushing actuator that can be furnished as an option.

21.01.11. Shall have a ductile iron disc fully encapsulated with Buna N rubber.

21.01.12. Shall have disc travel to closure that shall not be more than 35 degree.

21.01.13. Shall have stainless steel hardware.

21.01.14. Shall be American Flow Control Series 2100, or approved equal.

21.01.15. See details A-23 and A-24.

22.00 AIR RELEASE VALVES

22.01. The primary function of air release valves is to automatically release small pockets of air as they accumulate at local high points within the water system. Air release valves must also discharge high velocity air during main filling and admit air during drainage. Air release valves are to be provided at required locations as shown on drawings.

22.02. Air release valves shall be designed to open positively and vent air to the atmosphere at system working pressures up to 250 psi.

22.03. Apco style valves shall have epoxy coated ductile iron bodies, a stainless steel float and stainless steel or bronze trim.

22.04. ARI style valves shall have reinforced nylon bodies, foamed Polypropylene float and E.P.D.M seals.

22.05. Piping: the upstream connecting piping shall consist of two brass ball valves, one brass tee and brass connection piping; all shall be one inch (1") in diameter unless otherwise specified. Downstream discharge piping shall be two inch (2") galvanized piping with appropriate fittings (See detail A-2).

22.06. The open end of an above grade air release venting pipe shall terminate at least forty eight inches (48") above grade and be fitted with an insect screen on the end.

22.07. Automatic air relief valves shall **not** be used in situations where flooding of the access-way or chamber may occur.

22.08. Valves shall be A.R.I D-040, APCO No. 200A, or approved equal. All air release valves shall conform to ANSI/AWWA C512 and be installed according to the VT Water Supply Rule, A-8.4.

23.00 PRESSURE REDUCING VALVES

23.01. Pressure Reducing Valves (PRV's) shall be; Cla Val 90-01/690-01 with positioning stems, containing the check valve feature (unless otherwise stated); Flomatic Model C101with position indicator stem; or approved equal (See details A-21 and A-22).

23.02. Pressure reducing valves shall be set horizontally and be connected to a flanged pipe on the incoming side and a dismantling coupling on the downstream side.

23.03. Pressure reducing valves are to be installed in precast concrete vaults that allow adequate space for removal and maintenance. Vaults shall also have

access hatches that are sized appropriately for the insertion and removal of all components. Vaults designs shall be subject to approval by the appropriate CWD Supervisors (See details A-21 and A-22).

23.04. To prevent fouling of the pressure reducing valves during water main filling and flushing, a temporary spool piece may be installed in place of the PRV.

23.05. The adjustment range for the pressure reducing valve must be approved by the appropriate CWD supervisor prior to ordering.

24.00 MANHOLES AND VAULTS

24.01. Precast manholes and vaults shall conform to ASTM Designation C478 and meet the following additional requirements also see detail A-2:

24.01.01. All manholes and vaults shall be design by a professional engineer addressing design criteria, such as, but not limited to: wheel loading, thrust restraint, buoyancy, soils, wall penetrations, access . . . .

24.01.02. Sections shall have tongue and groove joints with butyl mastic rope installed between sections.

24.01.03. The exterior of all sections shall have a Bituminous coating.

24.01.04. Drainage from the manhole or vault shall be designed to run to daylight whenever possible.

24.01.05. Manhole top sections shall be eccentric except that the concentric flat top sections shall be used where shallow cover requires a top section less than three feet deep.

24.01.06. Vault top sections shall be of special design and appropriate to the application.

24.01.07. Precast bases, cast-in-place bases, or precast bases integral with base sections may be used.

24.01.08. Cement shall be Type II Portland Cement, conforming to ASTM Designation C150.

24.01.09. Ladder rungs shall be aluminum alloy 6061-T6 in accordance with ASTM designation B221, by Aluminum Company of America or Washington Aluminum Company or equal, conforming to Washington Aluminum Company Model T-14-OR. Rungs shall be set in precast sections during casting of section or grouted with a non-shrink grout. Plastic coated steel ladder rungs secured in the walls of the precast structure shall also be acceptable. Rungs shall be aligned so as to allow access from the top of the manhole to the base in a vertical line.

24.01.10. All manholes and vaults shall be equipped with an approved “ladder-up” safety device.

24.01.11. Brick or masonry shall **not** be used to raise the manhole or vault frame cover to grade. Only concrete grade rings shall be allowed for this function.

24.01.12. All sections shall be cured by an approved method. Sections shall not be shipped or manhole rungs subjected to loading until the concrete has attained a compressive strength of 3,000 psi or until 5 days after fabrication, whichever is the longer.

24.01.13. Precast concrete manhole and vault manufacturers shall incorporate flexible pipe sleeves within the construction of the manhole in such size to accommodate the size pipe being used.

24.01.14. In no case shall a manhole be constructed such that it bears directly or indirectly on the pipeline or any appurtenances thereof.

24.01.15. All joints, lift holes, and other openings inside and outside the manhole shall be filled with water plug to prevent leakage.

25.00 MANHOLE AND VAULT FRAME AND LID

25.01. All manholes shall be provided with ductile iron manhole frames and lids of the size and type as required in the drawings, unless covers of another material are required by the appropriate CWD or Municipal supervisor.

25.02. Frame and lid shall be one of the following:

25.02.01. *Standard frame and lid:* Non-rocking design with a solid infiltration resistant lid.

25.02.02. *Waterproof frames- bolted lids:* Waterproof frames shall have a solid lid with machined bearing surfaces, and sealed with a rubber gasket. Lid shall fasten securely to the frame with countersunk bronze hexagonal-head cap screws. Frame shall be supplied with anchor bolts and boltholes. Manhole frame and lid shall be Neenah No. R-1915-F (Type L) or equal.

25.02.03. *Hinged frame and cover:* Hinged frames and covers shall incorporate a blocking feature to prevent accidental closure. The cover must be removable if required. Hinged frames and covers may be used in off road locations, or in traveled ways with approval of the Municipal Engineer. Hinged frame and cover units shall be Pamrex, Bilco or approved equal.

25.02.04. Manhole lids for manholes on buried water mains shall have the word "WATER" cast into the top surface.

26.00 CONCRETE FOR THRUST BLOCKS

26.01. Concrete shall be Portland Cement concrete of 3000 psi minimum 28-day compressive strength. ASTM C-94 specification for transit mixed concrete shall control the concrete quality. A maximum water cement ratio of 6 gallons per sack and a maximum slump of 4 inches will be allowed (See detail A-1 and A-25).

26.02. Concrete shall be clean and not mixed with other material, including previously prepared concrete products.

26.03. Thrust blocks shall be installed on caps, tees, hydrants, and bends of 22.5 degrees and greater.

26.04. Blocking shall be placed on all sides of each fitting in the direction of thrust and not underneath for use as a foundation or support.

26.05. All other bends less than 22.5 degrees shall be restrained by use of retainer glands on each end of each bend.

26.06. All fittings shall be poly-wrapped prior to pouring any concrete. Concrete shall not overlap any joints and/or glands, hence restricting future access to nuts and bolts. Adequate form work shall be employed to prevent such overlap.

27.00 PROTECTION OF THE PUBLIC AND WORK PERSONNEL

27.01. Work personnel and the public shall be protected by the contractor, from any and all hazards connected with the construction work. Open trenches, materials, or equipment within the working limits of the public right of way are to be guarded by the use of adequate barricades, certified flag persons or both. All barricades left in position overnight are to be properly lighted from dawn to dusk. When work narrows the useable pavement, certified flag persons shall be used to aid the flow of traffic so that there will no undue delays. Temporary construction signs shall be erected in accordance with State and local requirements. The Contractor shall be held responsible for the safety of all work persons and the general public and all damages to property from the hazard of open trenches, materials, or equipment at any time of day or night within the working area. All work shall be in conformance to applicable VOSHA regulations and the MUTCD guidelines, latest addition.

27.02. All trenching safety standards shall be in conformance with all applicable State and Federal guidelines. The contractor shall be solely responsible for any safety citations by State or Federal inspectors.

28.00 PROTECTION AND REPAIR OF EXISTING UTILITIES

28.01. The contractor shall notify Dig Safe prior to excavation, and otherwise comply with all permit requirements of each municipality work is performed in. Wherever culverts, sewers, drains, manholes, catch basins, storm drains, water mains and services, water valves or curb stops, electric, telephone or cable TV conduits, utility poles, overhead lines or other existing facilities are encountered, they shall be protected and firmly supported by the contractor at their expense, by methods approved by the authority having control of the utility structure, until excavation is backfilled and the affected structures are made secure. Injury to such structures caused by or resulting from the contractor's operations shall be repaired at the contractor's expense within a time period that will not place an unreasonable burden on the users. The authority having charge of any particular structure shall be notified promptly of injury to its structure.

28.02. Any water distribution component damaged during excavation shall be replaced with an in-kind material or a material approved by the appropriate CWD supervisor.

28.02.01. All materials used for the repair of an existing water main shall be disinfected in accordance with AWWA C651. Repairs shall be made so as to have the water service interrupted for as short a period of time as possible.

28.03. No CWD Transmission main or water distribution main excavation shall be left open unattended. All unattended excavations shall be completely backfilled to grade with adequate protection around the excavation site, as approved by the appropriate CWD Supervisor.

28.04. Approval for relocation of any existing facilities shall be obtained from the appropriate party and/or the respective municipality prior to relocation. The contractor shall be responsible for the work and for providing notice to users before planned interruptions of service.

29.00 WORK OUTSIDE OWNED PROPERTY LIMITS OR PUBLIC RIGHTS OF WAYS

29.01. The contractor shall not, without written consent of a property owner enter or occupy with persons, tools, materials or equipment, any private land without written consent of the property owner. In a similar manner, no excavation shall take place within the public right of way without first obtaining authorization from the Municipality or State, as applicable.

29.02. The contractor shall obtain permission from the appropriate CWD supervisor for any change to the approved plans of the project that may require work outside of the defined areas.

30.00 PLAN ERRORS OR OMISSIONS

30.01. The fact that specific mention of a fixture or of any part of the work is omitted in the specifications, whether intentionally or otherwise, when the same is clearly indicated on the plan drawings, or is usually and customarily required to complete fully such work as specified, will not entitle the Contractor of the project to consideration in the matter of any claim for extra compensation. Said fixtures, work, or both shall be installed or done the same as if called for both by drawings and by the specifications.

30.02. All work indicated on the drawings and not mentioned in the project specifications, or vice versa, and all work and material usually necessary to make the work complete in all its parts, whether or not they are indicated on the drawings or mentioned shall be considered the same as if they were called for both by drawings and by the specifications.

31.00 GENERAL INSTALLATION

31.01. Contractors shall notify the appropriate CWD supervisor and Dig Safe at least seven days prior to any work on the water system. Each appropriate CWD supervisor shall be contacted at least 48 hours prior to any scheduled work within the project limits, unless different from other sections of these specifications.

31.02. The contractor shall at all times be responsible for conduct and discipline of his employees and/or any subcontractor or persons employed by subcontractors. All workers must have sufficient knowledge, skill, and experience to perform properly work assigned to them. Tools shall be adequate for the work and in good condition so as to produce good, clean cut ends and threads of the correct size, pitch, and taper.

31.03. Any contractor who does not maintain local headquarters 24 hour a day must make satisfactory arrangements with the appropriate CWD supervisor to service emergencies or complaints which may occur at night, over the weekend, or when the job is shutdown (these arrangements shall include road maintenance and repairs). The contractor shall provide the appropriate CWD supervisor with emergency telephone numbers of the Superintendent and Project Manager.

31.04. Installation of all water mains shall be in accordance with the latest version of AWWA C600 or AWWA C605 as applicable. Materials and equipment shall be stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated into the work shall be located so as to facilitate prompt inspection by authorized CWD personnel.

31.05. Temporary water lines may be required as appropriate for existing water customers and must remain in service until a new water main has been

tested, disinfected, and accepted by the appropriate CWD supervisor. Planned water outages during the course of project work, for all or portions of any existing customers of each of the above referenced water distribution systems, shall first be coordinated with, and approved by the appropriate CWD supervisor, with a minimum of seventy-two (72) hours notice. All work shall be performed to minimize planned water outages to existing water customers to the greatest degree possible.

31.06. Upon final acceptance of the proposed water main, the temporary water mains shall be disconnected. At least one-week in advance of a planned shut down of any service line, notices must be delivered to all affected customers. Due to the nature of certain business activity, planned shut downs may be required to be scheduled after normal working hours of the affected customer.

31.07. Excavated material shall be placed in a manner that will not obstruct the work nor endanger the workers or the public, or obstruct sidewalks, driveways, roadways or other structures. Excavated materials shall be placed in compliance with federal, state, or local regulations.

31.08. Connection to an existing water main shall be done under the supervision of and with the approval of the appropriate CWD supervisor. It is the applicants, developers, or owner of record responsibility to secure ALL necessary connection permits and pay ALL applicable fees to make the connection, and to coordinate all parties involved in the process. The engineer and the appropriate CWD supervisor shall be notified at least two working days in advance of the intended connection time. No existing valves, hydrants, curb stops, etc shall be operated without prior approval of the appropriate CWD supervisor. Any damage occurring after the use of any valve operated by the contractor shall be the contractors' responsibility.

31.09. Care shall be taken to prevent damage to valves and other appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials:

31.09.01. All debris and foreign material cleaned out of valve openings, etc.;

31.09.02. All operating mechanisms operated to check their proper functioning, and all other nuts and bolts checked for tightness.

31.09.03. Valves and other equipment, which do not operate easily, or are otherwise defective, shall be replaced. All valves shall be carefully incorporated into the water main and supported in their respective positions free from all distortion and strain.

31.10. Valves and valve boxes shall be set plumb. Valve boxes, besides being plumb, shall be centered directly over the valves.

31.11. All pipes showing cracks shall be rejected. If cracks occur in the pipe, the contractor may, at his own expense and after approval of the appropriate CWD supervisor cut off cracked portions at a point at least twice the pipe diameter from the visible limits of the crack and use the sound portion of the pipe.

31.12. Repairs on any damaged newly installed pipe shall include two solid sleeve couplings, retainer glands, and an appropriate length of pipe of the same material as that which was broken, or approved equal.

31.13. Prior to the date of acceptance by the system owner, the contractor shall replace any new pipe or accessory found to be defective at any time, at no expense to the system owner.

31.14. All water mains shall have no less than six feet (6') of cover unless waived by the appropriate CWD supervisor. Each pipe shall be laid so as to form a close joint with the next adjoining pipe and to bring the inverts continuously to the required grade. In no cases shall the waterline have less than four feet (4') of cover over the top of the pipe. Temporary support, adequate protection, and maintenance of all underground structures, drains, sewers, and other obstructions encountered in the progress of the work shall be provided at all times. If utility service is interrupted as a result of work for the project, the contractor shall immediately restore service by repairing the damaged utility at the contractors' expense.

31.15. At all times, when pipe laying is not actually in progress, the open ends of the pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed. During construction, the contractor shall conduct operations so as to prevent the accumulation of water ice, and snow in the vicinity of excavations or in the vicinity of excavated areas, and to prevent water from interfering with the progress and quality of the work. Under no conditions shall water be allowed to rise in open trenches after pipe has been laid.

31.16. Accumulated water, ice, and snow shall be promptly removed and disposed of by pumping or other approved means. Disposal shall be carried out in a manner that will not create a hazard to public health, nor cause injury to public or private property, work completed or in progress, or public streets. Disposal shall not cause any interference in the use of streets and roads by the public. Disposal may also require protection of storm drain facilities. Pipes under construction shall not be used for drainage of excavations.

31.17. Any deflection of joints in D.I. pipe shall be within the limits specified by the manufacturer.

31.18. Concrete thrust blocks shall be installed on all hydrants, plugs, tees, and bends deflecting 22.5 degrees and more. Concrete thrust blocks shall be used in conjunction with "Mega-Lug" restraining glands or equivalent. Care shall be taken to ensure that concrete will not come into contact with flanges, joints, or bolts. The required area of thrust blocks shall be indicated on plan typical's and approved by the appropriate CWD supervisor. Concrete shall be placed against undisturbed soil. Wooden side forms or equal shall be provided for thrust blocks. No backfilling shall be allowed until concrete masonry has set sufficiently. Where directed by the appropriate CWD supervisor and engineer, concrete encasement of the waterline may be required for stream crossings and similar purposes. Where required on the plans or as directed by the appropriate CWD supervisor or engineer, a concrete cradle shall be used to bolster and strengthen the pipe. The appropriate CWD supervisor or his designee shall inspect all thrust blocks prior to backfilling. Excess concrete shall not be used in the formation of thrust blocks or disposed of on site.

31.19. There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks that are supplied with water that is, or may be, contaminated.

31.20. As necessary**,** temporary PVC markers shall be supplied at all gate valves, curb boxes, and at the end of water lines to a minimum of twelve inches (12") above finish grade until accepted by the appropriate CWD supervisor**.**

31.21. All surplus material and debris shall be removed as the project progresses, leaving all areas clean and presentable.

31.22. Unless otherwise required, all paving and sidewalks that may be damaged during construction shall be replaced with the same kind of material that previously existed, as required by the municipal authority.

31.23. All areas within the limits of a set of drawings shall be loamed and seeded as called for in the project specifications. This shall include areas of new construction, except as the actual area occupied by structures, roads, parking areas, and walks, and shall include areas of established landscape and flora through which the work may pass where grassed areas are affected. Areas to be seeded may have subgrade placed at any time of the year. However, placement and preparation of loam (topsoil) and seeding shall be performed only between the dates of April 20 and October 15, or as approved otherwise by the appropriate CWD supervisor. Eroded areas shall be graded to specific contours prior to loaming or seeding.

31.24. No water lines shall be installed after November 15 or before April 1 without prior approval of the appropriate CWD supervisor. The appropriate CWD supervisor may restrict work before November 15 and after April 1 during adverse weather conditions. The appropriate CWD supervisor **may** not

allow excavating for water mains during the winter months except by special permission.

31.25. The project contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in association with the project. The contractor will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees and other persons who may be affected thereby, materials or equipment to be incorporated therein, whether in storage on or off the project site, and other property at the project site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation or replacement in the course of construction.

31.26. The contractor will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction within the project area. The contractor will erect and maintain all necessary safeguards for safety and protection. He will notify owners or adjacent utilities or properties when prosecution of the project may affect them. The contractor will remedy all damage, injury or loss to any property caused, directly or indirectly by work associated with the project. In emergencies affecting the safety of persons or the project, or property at the site or adjacent thereto, the contractor shall act to prevent threatened damage, injury, or loss.

31.27. Prior to commencement of any project, the contractor shall provide construction signage and traffic control plans in accordance with the Manual of Uniform Traffic Control Devices to the appropriate public works official of each community. Adequate notification must also be given to landowners that may be affected by traffic changes.

32.00 BACKFILLING

32.01. Trenches shall be backfilled to subgrade with, wherever possible, material excavated from the trench, provided the material consists of loam, sand, gravel or other suitable material and shall be done only after the approval of the appropriate CWD supervisor. Material for backfilling shall be free of roots, stumps, and frost. Backfill shall not be placed on frozen material. Materials used for backfilling trenches shall be free of stones weighing more than thirty (30) pounds. No stones measuring over three inches (3”) in the longest dimension shall be placed within one foot (1’) of the pipeline being backfilled. Stones found in the trench shall be removed for a depth of at least six inches (6”) below the bottom of the pipe. In general, use of blasted rock, as trench backfill will not be permitted. Any materials excavated from the site not conforming to these Specifications, shall be disposed of and replaced with approved material by the contractor, as required.

32.02. Backfill material shall be tamped in layers around the pipe to a sufficient height above the pipe to adequately support and protect the pipe. Backfill for pipelines under roadways shall be placed in six-inch (6”) lifts, each lift being compacted to not less than 95% of maximum dry density as determined by the AASHTO-T-99 Standard Proctor. Pipelines outside of roadways or in cross country routes shall be compacted to 90% maximum density as determined by the AASHTO-T-99 Standard Proctor. If conditions warrant, the backfilling of trenches may be done with mechanical equipment. Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe, pipe coating or structure. The backfill shall be brought up evenly. Around valve boxes, the backfill shall be tamped to a distance of four feet (4’) on all sides of the box, or to the undisturbed trench face, if less than four feet (4’). Backfilling in all public roadways shall be so compacted as to leave no depression in the road. Additional backfill requirements may apply within State or local Municipal Highway Right-Of-Ways. All public road surfaces shall be restored to a condition at least equal to that, which existed prior to the start of construction unless approved otherwise by the appropriate public works or street department authority. Precautions shall be taken against undue damage to existing surface materials.

32.03. No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction.

32.04. Surplus excavated materials shall be disposed of in a satisfactory manner. Surplus material or spoil shall be removed promptly and disposed of so as not to be objectionable to abutters or the general public.

32.05. Trenches that have been improperly backfilled, enclosed or covered before inspection of fittings and joints shall be reopened and re-backfilled at the contractor’s expense.

33.00 WATER/SEWER SEPARATION

33.01. Water mains crossing sewers shall be laid to provide a minimum vertical distance of eighteen inches (18”) between the outside of the water main and the outside of the sewer line. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of pipe shall be located so both joints will be as far from the sewer as possible. This vertical separation shall be maintained for that portion of the water main located within ten feet (10’) horizontally of any sewer it crosses. Water mains must be laid at least five feet (5’) horizontally from any existing or proposed storm sewer and ten feet (10’) from any existing or proposed sanitary sewer (See Detail A-9 and A-10).

33.02. When it is impossible to obtain horizontal and vertical separation on new water installations, all joints that fall within ten feet (10') of a crossing shall be double wrapped with poly-wrap and then encased in flowable fill. No water main shall pass through or come in contact with any part of a sewer manhole (See detail A-8).

33.03. Distribution lines shall not be placed closer than fifty feet (50') horizontal distance from any septic tank or leach field unless approved by the VT Water Supply Rule Provisions under Chapter 21.8.6.4 and the appropriate CWD supervisor. In the event of a variance in the 50' separation requirement, supplemental protective measures as mentioned above shall be required.

33.04. Sewer and waterline separation shall conform to all VT Water Supply Rule requirements, and installed in accordance with the latest edition of the "Ten States Standards- Recommended Standards for Water."

34.00 STEEL SLEEVE, JACK AND BORE

34.01. Before beginning operations related to excavation by jacking, the Contractor shall submit to the appropriate CWD supervisor a detailed, written description of the equipment and methods he /she proposes to use and acceptable sketches showing details of the jacking pit, head, frame, reaction blocks, and arrangement of the jacks. The contractor shall not proceed with work until authorized by the appropriate CWD supervisor. All requests to construct new water lines across existing municipal streets shall be reviewed by the appropriate CWD supervisor and the appropriate municipal official responsible for highway maintenance and permits (See details A-6 and A-7).

34.02. All work to construct highway crossings as indicated on drawings shall be performed by a contractor with at least three years experience in jacking. Three (3) weeks prior to start of work, the contractor shall furnish the appropriate CWD supervisor a Statement of Experience and Welding Certification for such work from those doing the jacking.

34.03. The wall thickness of the steel casing pipe shall be 3/8" as indicated on the drawings and steel plate for steel casing pipe shall conform to ASTM A36. The steel plate shall be rolled and welded to the diameter size as indicated on drawings. Welding shall be done by approved standard welding practice. When more than one section of casing is to be used, the ends of the section to be joined shall be welded in accordance with approved standard welding practices for the use intended.

34.04. Services up to two inches (2") may use PVC pipe for a sleeve with approval of the appropriate CWD supervisor. PVC service sleeves shall be Schedule 80.

34.05. All carrier pipes larger than two inches (2”) shall be ductile iron as shown in drawings.

35.00 EXECUTION OF SLEEVE JACK AND BORE

35.01. The jacking pit shall be of adequate size to accommodate the sheeting, shoring or trench box, jacking head, frame, jacks, reaction blocks, added section of pipe, and other material and equipment, and to provide sufficient working space. The pit shall be excavated by suitable methods as specified for normal excavations and shall be kept free of water.

35.02. Sleeves shall be at the same elevation as the water main.

35.03. The jacking head shall be of suitable bearing pieces to protect the pipe from damage due to the thrust from the jack to the pipe, and to transfer that thrust from the jack to the pipe.

35.04. The jacking frame, upon which the pipe being jacked will rest, shall be on railroad rails or suitable steel or wooden members set to correct line and grade to act as guides for the true alignment of the pipe.

35.05. The jacks shall be of ample capacity to provide more than the anticipated jacking capacity needed.

35.06. The reaction blocks shall be suitable to provide resistance to, and distribution of, the reaction from the jacks.

35.07. It is extremely important that the jacking apparatus be strongly constructed, set, and maintained in proper relative position and alignment in order to minimize forces that would tend to bend the pipe, cause it to deflect from true alignment, or displace the reaction blocks.

35.08. Joints of steel casing pipe shall be welded before being subjected to the jacking operation.

35.09. All welds shall conform to the AWWA C206 for Field Welding of Steel Water Pipe Joints.

35.10. In excavation from within the jacking pipe, extreme care shall be used to avoid the loss of material from outside the limits of the pipe in the final position. Excavation shall be carried ahead of the pipe only to the extent possible without the loss of material. Should material, either earth or rock, be lost outside the limits of the pipe in its final position, pressure grout shall be applied outside the casing with such equipment as may be directed.

35.11. Should rock or boulders be encountered after jacking has commenced and blasting is necessary, blasting shall be done only after required permits have been approved and then in such a manner that neither the jacked

casing nor the road above the blast will be damaged. The size of the blast and the procedures for blasting shall be acceptable to the agency controlling the road.

35.12. Once jacking has started, it shall be a continuous operation until completion of the jacking operation in order to reduce the possibility of a so-called "stuck" pipe, even though this may involve working outside the normal workday.

35.13. Care shall be taken during excavation and jacking operations to ensure that the jacked pipe remains true to line and grade. Maximum deviation from line and grade shall be ½"/100' for carrier pipe and casing pipe. Guided boring equipment utilizing a pilot tube for steering to the target with an LED illuminated target within the tube should be utilized to ensure the accuracy of the jacking process. Steel sleeve jacking and boring shall be performed in such a manner so as to avoid any bends or extra fittings on the water main.

35.14. During jacking operations, voids shall be prevented outside of the sleeve being jacked. If they occur they shall be filled with a lean grout to the satisfaction of the appropriate CWD supervisor.

35.15. The carrier pipe shall be installed in the sleeve, using casing spacers described below, two (2) per each section of pipe. Pipe shall be Tyton-Joint or approved flexible restrained joint pipe.

35.16. Following installation, the carrier pipe shall be tested for leakage in accordance with testing procedures outlined in Section 37, Testing and Disinfecting.

35.17. The sleeve ends shall be plugged using hydraulic cement or concrete or otherwise sealed.

35.18. A weep hole shall be installed in the lower end of the sleeve for drainage.

36.00 CASING SPACERS

36.01. Casing spacers shall be bolt on style with a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. Each shell section shall have bolt flanges and/or a hinged side; bolt flanges shall be formed with ribs for added strength. Connecting flange shall have a minimum of three 5/16" T-304 bolts. The shell shall be lined with ribbed PVC extrusion with a retaining section that overlaps the edge of the shell and prevents slippage. Bearing surfaces (runners) made from UHMW polymer with a static coefficient of friction of .11-.13 shall be attached to support structures (risers) at appropriate positions to properly support the carrier within the casing and to ease installation. The runners shall be attached mechanically by T-304 threaded fasteners that are inserted through the punched riser section and TIG welded for strength. Risers shall be made of T-304 stainless steel of a minimum 10 gauge. All risers over six inches (6") in height shall be reinforced. Risers shall be MIG welded to the shell. All metal surfaces shall be fully chemically passivated (See detail A-5).

36.02. Casing spacers shall be model CCS as manufactured by Cascade Waterworks Mfg. Co. or prior approved equal.

36.03. Annular space may remain void as directed by the appropriate CWD supervisor when casing spacer's fit tightly within the casing. However, sleeve ends shall be plugged using hydraulic cement or concrete.

37.00 EROSION CONTROL

37.01. The contractor shall construct and maintain all erosion control measures in accordance with Municipal standards. In the case of no standard, then erosion measures shall conform to the "Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites", current edition. The contractor shall carry out project construction in such a manner as to give adequate protection of water courses and minimize surface erosion.

37.02. The contractor shall be perform all erosion control measures as indicated on approved plans and specifications, including installation, maintenance and removal of temporary dams and inlet protection.

37.03. Dust shall be controlled through the application of calcium chloride or water, as required by the municipality.

38.00 TESTING AND DISINFECTION

38.01. All water mains shall be constructed, tested and disinfected in accordance with AWWA Standards C-600, C-605, C-651 and The Vermont Water Supply Rule. Minimum testing pressure shall be 1.5 times the working pressure of the installed line or 200 psi, whichever is greater, and will be monitored at the lowest elevation in the length of the pipeline being tested. The longest length of test pipe shall be 1,000 feet unless waived by the appropriate CWD supervisor. Pressure tests shall be up to the curb stop with corporations fully open.

38.02. No hose or fire hydrant shall be used in collection of samples. A corporation stop shall be installed in the main with a copper gooseneck assembly for testing. After testing is completed and samples have been collected, the corporation on the test line shall be shut off and disconnected and the gooseneck assembly removed.

38.03. All water flushed during charging and sampling of the water main shall be dechlorinated.

38.04. Maximum allowable leakage will be $L = \frac{SD\sqrt{P}}{148{,}000}$ (as outlined in AWWA Standards)

38.05. Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge).

See attached Champlain Water District - Water Main Pressure Test Inspection Record

38.06. *Testing:* All tests shall be conducted by and at the expense of the Contractor. The Engineer will give direction pertaining to the test methods and observe the field-testing.

38.07. *Hydrostatic Test of Pipeline:* The pipeline, including hydrant laterals, shall be tested in accordance with AWWA C-600 Section 4.

38.08. *Disinfection:* Disinfection of the pipeline shall be directed by the Engineer and at the Contractor's expense. AWWA C-651 shall be used as a basis for the disinfection process.

38.09. The Engineer or appropriate CWD supervisor will require as minimum:

38.09.01. Complete flushing of the pipeline to wash out all dirt, debris, etc. which may have accumulated in the pipeline during construction. A reducing agent (de-chlorinating agent) shall be used at the point of flushing to eliminate the free chlorine residual per the direction of the appropriate CWD supervisor.

38.09.02. Following flushing to clean clear water, the Contractor will add chlorine to the entire pipeline volume of water such that the water will have not less than 25 mg/L free chlorine, and let the mixture set for at least 24 hours.

38.09.03. After the 24-hour duration, the water in the pipeline shall be tested for residual free chlorine and must contain a minimum of 10 mg/L chlorine. If less than 10 mg/L are found, then the disinfection procedure shall be repeated until at least 10 mg/L chlorine residual is indicated by test.

38.09.04. Upon successful completion of step 3 above, the pipeline shall be flushed again until the chlorine concentration in the pipeline is no higher than that prevailing in the supply system. A reducing agent (de-chlorinating agent) shall be used to eliminate the free chlorine residual in the flushing process per the direction of the appropriate CWD supervisor.

38.09.05. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main, and submitted to the Vermont Health Department for analysis. At least one set of samples shall be collected from every 1,000 feet of the new water main, plus one set from the end of the line and at least one set from each branch. All samples shall show the absence of coliform organisms and, if required the presence of a chlorine residual. (AWWA C651.) If the initial disinfection fails to produce samples, which pass the V.S.H.D. requirements for potable drinking water, then the new main shall be re-flushed and shall be resampled until satisfactory test results are obtained. All sample reports must be submitted to the appropriate CWD supervisor prior to opening any connection to an existing water line.

38.09.06. Upon satisfactory results by the Vermont State Health Department or State certified laboratory, the pipeline may be placed in service. All costs for water, materials, equipment and labor to perform the required testing disinfection, and flushing of the pipeline shall be paid by the Contractor.

39.00 SUBMITTAL OF TEST RESULTS

39.01. The applicant or project engineer shall be responsible for submittal of test results to the appropriate CWD supervisor. The applicant or project engineer shall also provide a letter to the appropriate CWD supervisor certifying that the water system has passed all tests, is constructed in accordance with the approved plans, except as may have been modified by approved change order, and is in condition to be placed in service. Submittal of all test results shall be required prior to the water main being placed into service.

40.00 FINAL INSPECTION

40.01. The applicant, developer/contractor will be responsible for any necessary repairs or corrections as part of the project warranty. The project warranty period will be determined by each system owner, but shall be no less than one year or no more than two years from project completion. Repairs made during the warranty period will carry a minimum warranty of one year from the time that the repair was completed. At the end of the warranty period, and after Record Drawings have been submitted, an inspection will be performed by the appropriate CWD Supervisor prior to the system owner assuming ownership of any of the lines and appurtenances. The contractor shall correct any punch list items accumulated during the inspection after receipt of this list. Incomplete work on the system shall not be included in the initial inspection, but shall be inspected as the project continues. The contractor shall repair, replace, or retest promptly as directed by the appropriate CWD supervisor and without further charges, all work equipment, materials or parts, which may fail during the warranty period.

40.02. The final walk through inspection conducted by the appropriate CWD supervisor shall include but not be limited to:

40.02.01. Valves, hydrants, and curb stops operating properly.

40.02.02. Valve boxes and covers set plumb and at proper elevations.

40.02.03. Proper hydrant nozzle height above grade.

40.02.04. Proper hydrant opening direction, nozzle thread, and barrel color.

40.02.05. Proper distance from the face of the curb of hydrant nozzles.

40.02.06. Hydrant flags meeting the CWD specifications installed on each fire hydrant at the time of installation.

40.02.07. Static and residual hydrant pressures and flow rates if requested.

40.02.08. Curb boxes inside ROW, set to grade, containing stainless steel operating rod, and plumb.

40.02.09. Tie information on record drawings complete and correct.

40.02.10. Material testing results, lab reports, manufacturer's certificates, and leakage test results complete and on file.

40.02.11. General appearance and restoration.

40.03. Submittal of O&M manuals in hard copy and Adobe Acrobat Reader (.pdf) format.

40.04. Submittal of accurate Record Drawings in hardcopy format and Auto-CAD Version 2010 format (.DWG) or newer.

40.05. Generally, Record Drawings shall include:

40.05.01. Accurate measurements of all water lines

40.05.02. Measurement to within six inches (6") to all valves and curb stops, from permanent fixtures such as telephone poles, fire hydrants, buildings, transformers, etc.

40.05.03. Accurate depths of water lines.

40.05.04. Locations of all other buried utilities and structures.

CWD RESPONSIBLE PERSONS

Jim Fay, General Manager	**CWD 864-7454 ext. 103** jimf@cwd-h2o.org
Dick Pratt, Wholesale – Chief Engineer	**CWD 864-7454 ext. 126** dickp@cwd-h2o.org
John Tymecki, Retail Superintendent	**CWD 864-7454 ext. 120** johnt@cwd-h2o.org
Eric Pepin, Retail Department Foreman	**CWD 864-7454 ext. 109** ericp@cwd-h2o.org
Paul Tice, Wholesale –Transmission Systems Director	**CWD 864-7454 ext. 131** pault@cwd-h2o.org
George Wimble, Wholesale Foreman	**CWD 864-7454 ext. 128** georgew@cwd-h2o.org

APPENDIX B

INTRODUCTION

These Specifications and Standards present updated design parameters for improved or new streets in Colchester. They apply to the design of four types of roadways: minor collectors, commercial / industrial streets, residential streets, and rural roads. Arterials and major collectors are not included in these standards as they consist of major state and town highways designed using applicable State and Federal design standards.

1. Minor Collector Street
   A minor collector is defined as a street serving as a connection between a residential, commercial or industrial street and a major collector or arterial.

2. Commercial / Industrial Street
   Commercial / industrial streets provide access primarily to commercial and/or industrial lots

3. Residential Street
   Residential streets are local streets within subdivisions including single family and duplex houses.

4. Rural Road
   The rural road standard will apply to the construction of unpaved gravel roads.

MINOR COLLECTOR STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for a minor collector will vary from 26-30 ft wide depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below. Minor collector streets serving commercial / industrial areas shall be designed using the commercial / industrial street standards in the next section.

Travel Lane Widths
Travel lanes shall be 11 ft wide on minor collector streets in residential areas.

Paved Shoulder Widths
Four-inch wide painted white lines will be required along both sides of minor collector streets to delineate the paved shoulder. The paved shoulder width varies from 2-4 ft based on the projected daily traffic volumes and the presence of a separated multi-use path. Table 1 provides a reference for the various cross-section scenarios shown on the following pages.

Table 1
Minor Collector Street
Cross-Section Scenarios

Projected Daily Traffic Volume	**With Multi-Use Path**	**Without Multi-Use Path**
500 – 2,000 vpd	#1	#2
>2,000 vpd	#3	#4

On-Street Parking
On-street parking shall not be permitted along minor collector streets.

2. DRAINAGE OPTIONS

Closed Drainage
Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C.

Open Drainage (Standard)
Standard open drainage may not be used on minor collector streets where a multi-use path or sidewalk is to be constructed. Uncurbed streets with standard drainage swales shall be constructed using the typical cross-section shown on Figure 3.2 in Appendix C.

Open Drainage (Shallow Swale)
Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line where sidewalks, multi-use paths and / or planting strips are located.

Sidewalks

A 5 ft wide sidewalk may be constructed along one or both sides of minor collector streets, as required by the Town Engineer. Sidewalks shall be located with a 1 ft clearance to the right-of-way line.

Multi-Use Path

Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

Construction of a multi-use path is required along one side of minor collector streets located in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with 3 ft clearance to the right-of-way line.

Planting Strips

A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

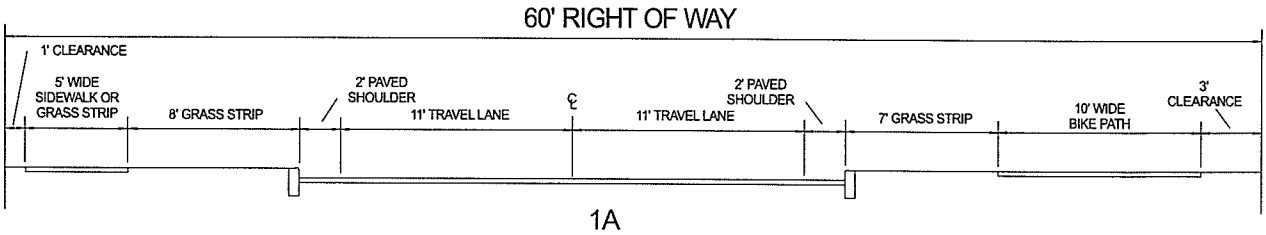
4. CORNER RADII

Corner radii at roadway and drive intersections on a minor collector shall be designed to accommodate a WB-62 design vehicle, unless serving a commercial or industrial area in which case a WB-67 design vehicle shall be accommodated.

5. RIGHT-OF-WAY

Right-of-way widths on minor collector streets will vary from a minimum of 60 ft to a maximum of 71 ft, depending on the cross-section scenario.

CROSS-SECTION #1 SCENARIOS

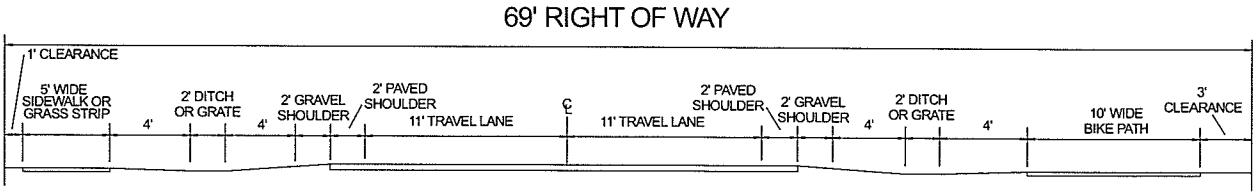


1A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

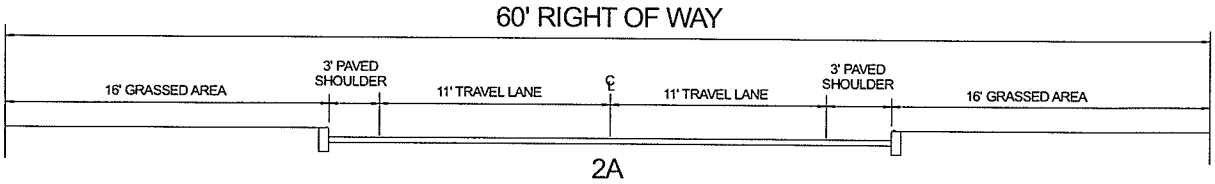


1B

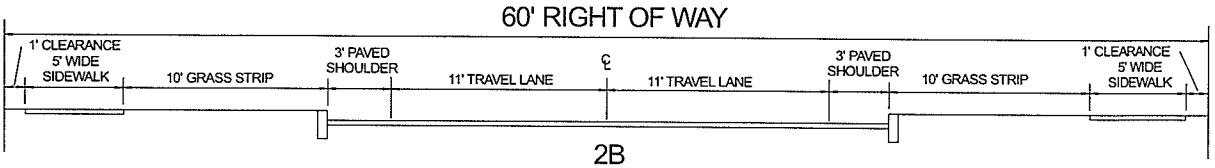
OPEN DRAINAGE (SHALLOW SWALE)

<u>MINOR COLLECTOR STREET STANDARDS</u>

CROSS-SECTION #2 SCENARIOS

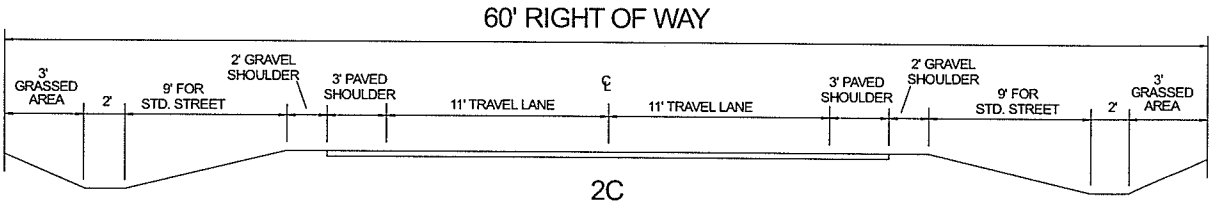


2A



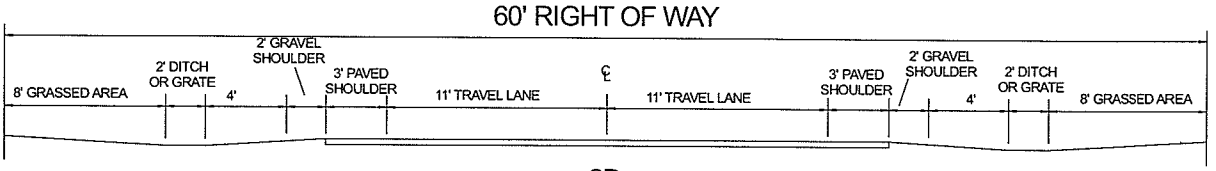
2B

CLOSED DRAINAGE

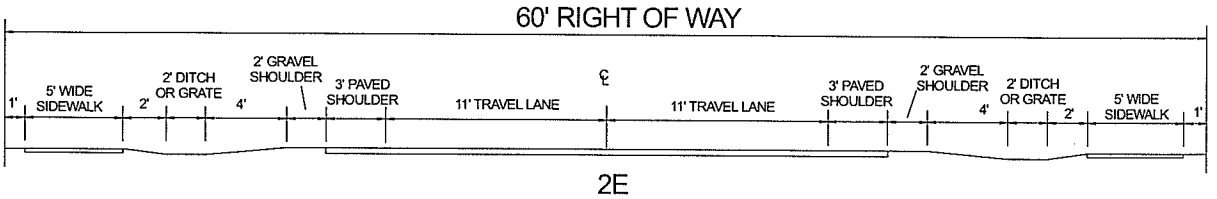


2C

OPEN DRAINAGE (STANDARD)



2D

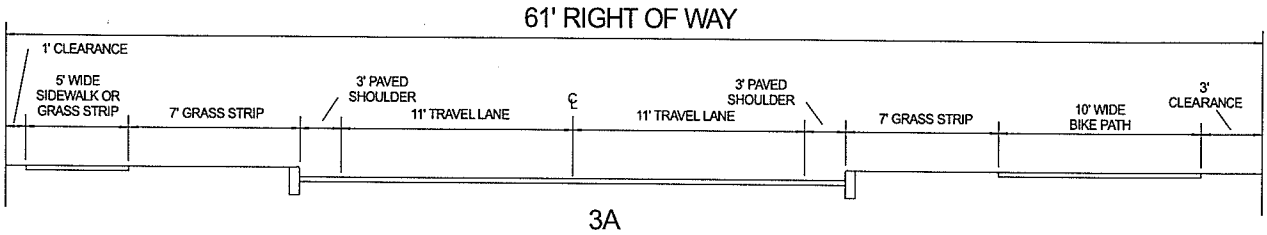


2E

OPEN DRAINAGE (SHALLOW SWALE)

MINOR COLLECTOR STREET STANDARDS

CROSS-SECTION #3 SCENARIOS

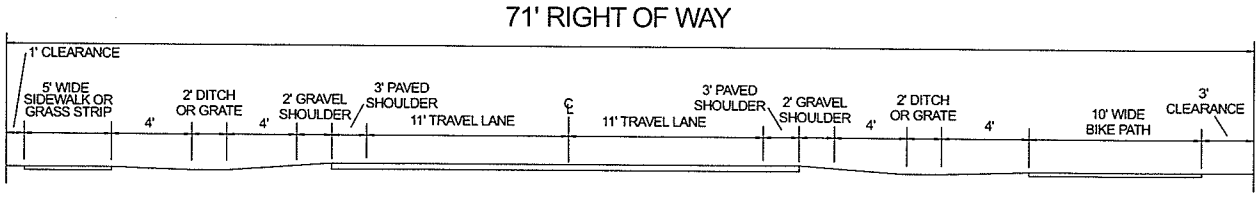


3A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)



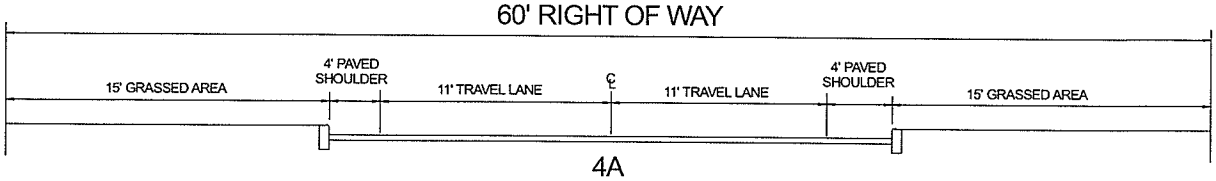
3B

OPEN DRAINAGE (SHALLOW SWALE)

<u>MINOR COLLECTOR STREET STANDARDS</u>

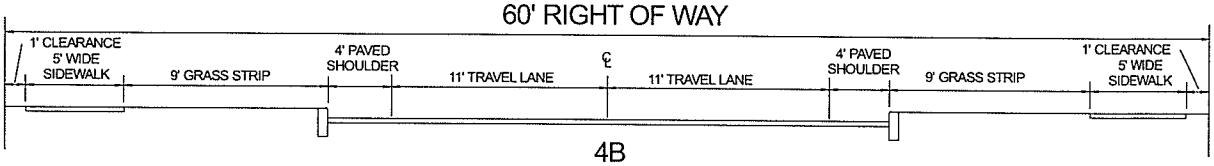
CROSS-SECTION #4 SCENARIOS

60' RIGHT OF WAY



4A

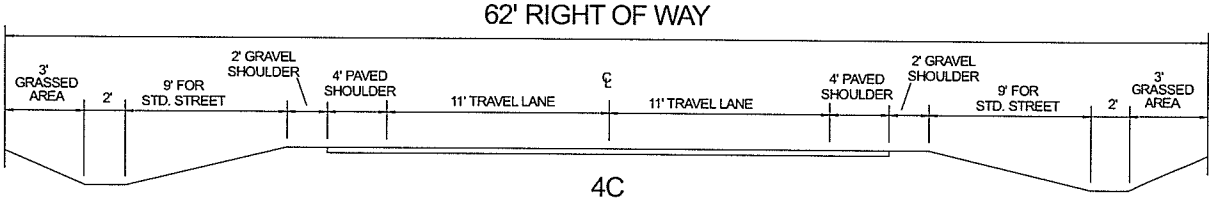
60' RIGHT OF WAY



4B

CLOSED DRAINAGE

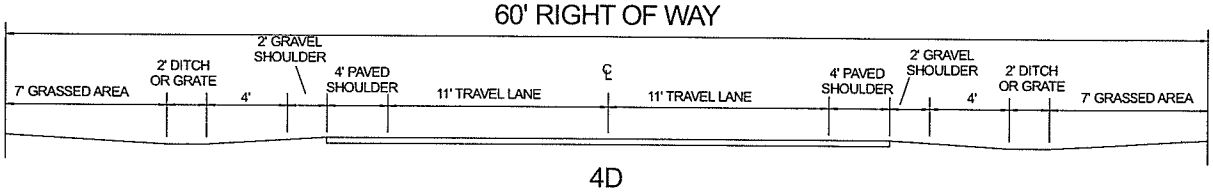
62' RIGHT OF WAY



4C

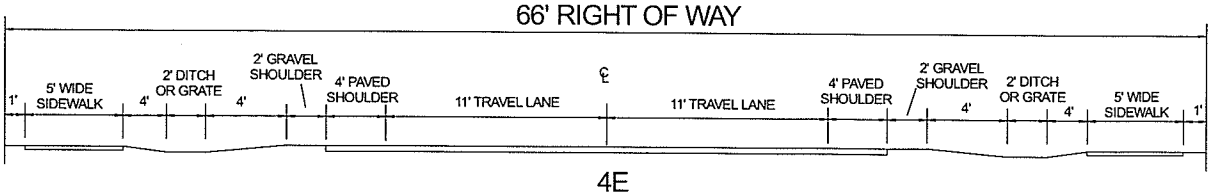
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



4D

66' RIGHT OF WAY



4E

OPEN DRAINAGE (SHALLOW SWALE)

<u>MINOR COLLECTOR STREET STANDARDS</u>

COMMERCIAL / INDUSTRIAL STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for commercial / industrial streets will vary from 28-32 ft, depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below.

Travel Lane Widths
Travel lanes shall be 12 ft wide on commercial / industrial streets.

Paved Shoulder Widths
Four-inch wide, painted, white lines will be required along both sides of commercial / industrial streets to delineate the paved shoulder which may vary in width from 2-4 ft based on projected daily traffic volumes and the presence of a separated multi-use path. Table 2 provides a reference for the various cross-section scenarios provided on the following pages.

Table 2
Commercial / Industrial Street Cross-Section Scenarios

Projected Daily Traffic Volume	With Multi-Use Path	Without Multi-Use Path
<500 vpd	#5	#6
500-2,000 vpd	#7	#8
>2,000 vpd	#9	#10

On-Street Parking
On-street parking shall not be permitted along commercial / industrial streets.

2. DRAINAGE OPTIONS

Closed Drainage
Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C.

Open Drainage (Standard)
Standard open drainage may not be used on commercial / industrial streets where a multi-use path or sidewalk is to be constructed. Uncurbed streets with standard drainage swales shall be constructed using the typical cross-section shown on Figure 3.2 in Appendix C.

Open Drainage (Shallow Swale)
Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line where sidewalks, multi-use paths and / or planting strips are located.

Sidewalks

A 5 ft wide sidewalk may be constructed along one or both sides of commercial / industrial streets, as required by the Town Engineer. Sidewalks shall be located with a 1 ft clearance to the right-of-way line.

Multi-Use Path

Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

Construction of a multi-use path is required along one side of commercial / industrial streets which are located in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with a 3 ft clearance to the right-of-way line.

Planting Strips

A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

4. CORNER RADII

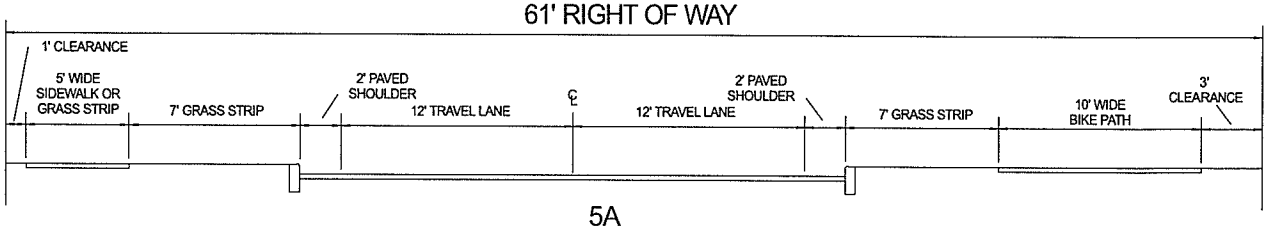
Corner radii at roadway and drive intersections on commercial / industrial streets shall be designed to accommodate a WB-67 design vehicle.

5. RIGHT-OF-WAY

Right-of-way widths on commercial / industrial streets will vary from a minimum of 60 ft to a maximum of 75 ft, depending on the cross-section scenario.

CROSS-SECTION #5 SCENARIOS

61' RIGHT OF WAY



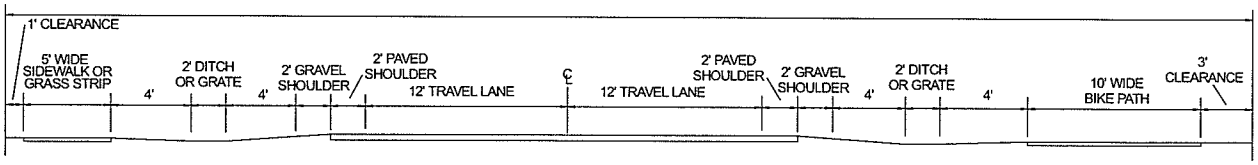
5A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

71' RIGHT OF WAY

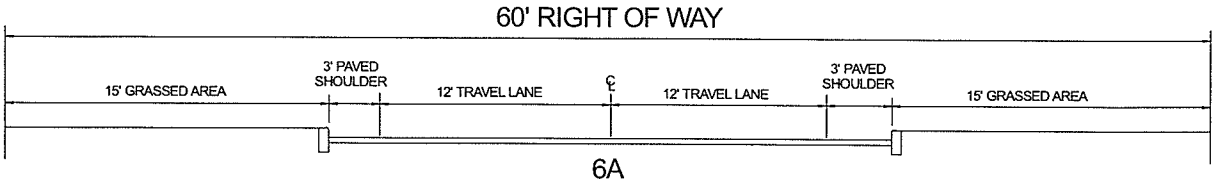


5B

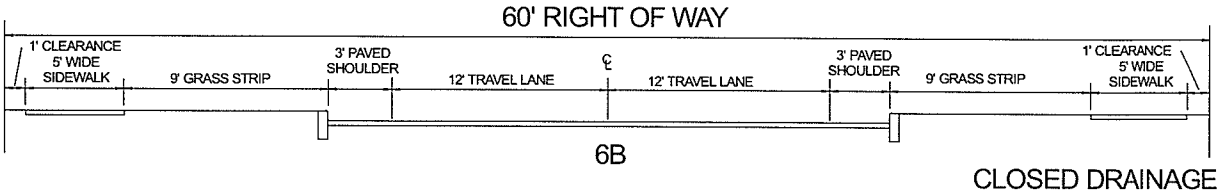
OPEN DRAINAGE (SHALLOW SWALE)

<u>COMMERCIAL / INDUSTRIAL STREET STANDARDS</u>

CROSS-SECTION #6 SCENARIOS

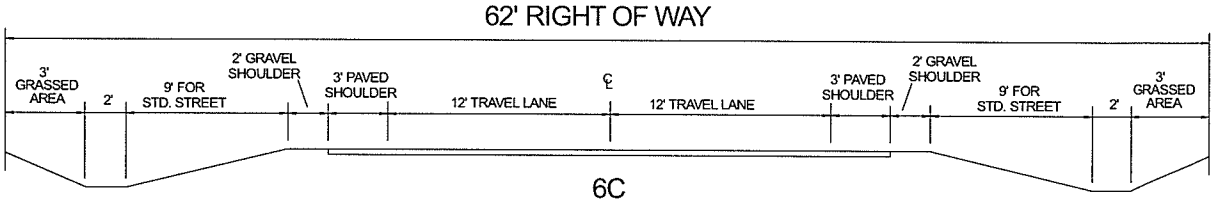


6A



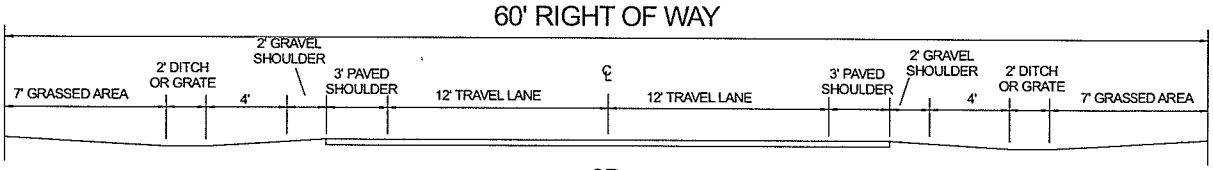
6B

CLOSED DRAINAGE

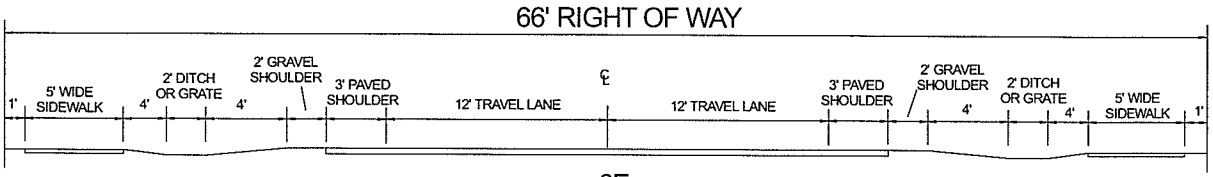


6C

OPEN DRAINAGE (STANDARD)



6D

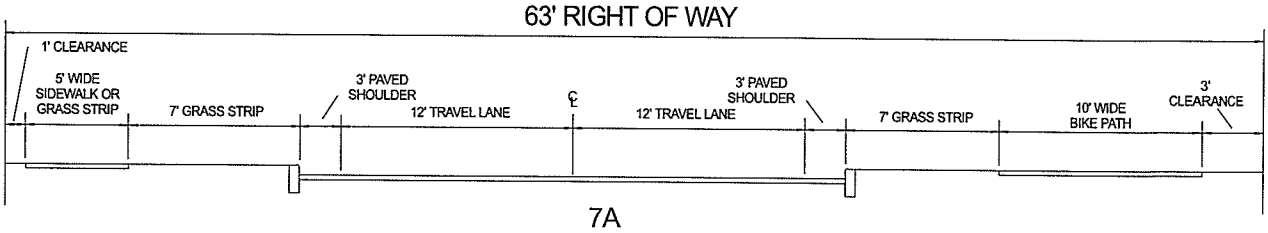


6E

OPEN DRAINAGE (SHALLOW SWALE)

<u>COMMERCIAL / INDUSTRIAL STREET STANDARDS</u>

CROSS-SECTION #7 SCENARIOS

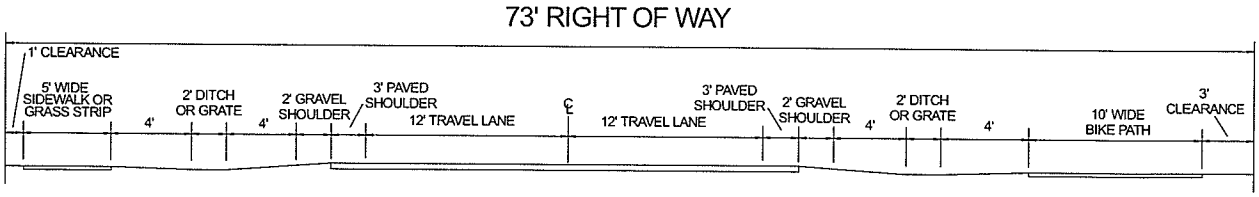


7A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)



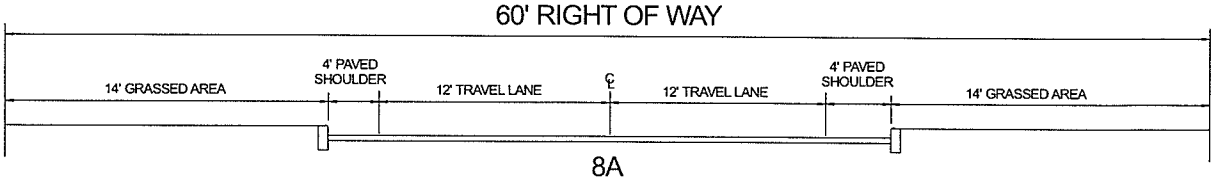
7B

OPEN DRAINAGE (SHALLOW SWALE)

<u>COMMERCIAL / INDUSTRIAL STREET STANDARDS</u>

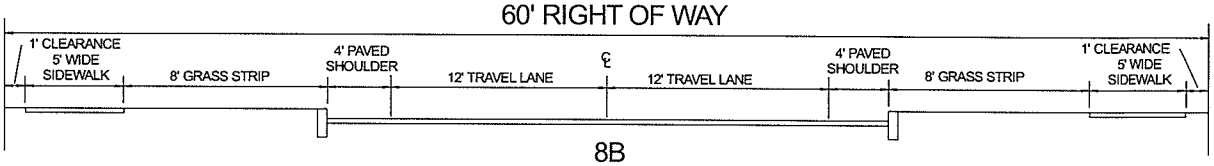
CROSS-SECTION #8 SCENARIOS

60' RIGHT OF WAY



8A

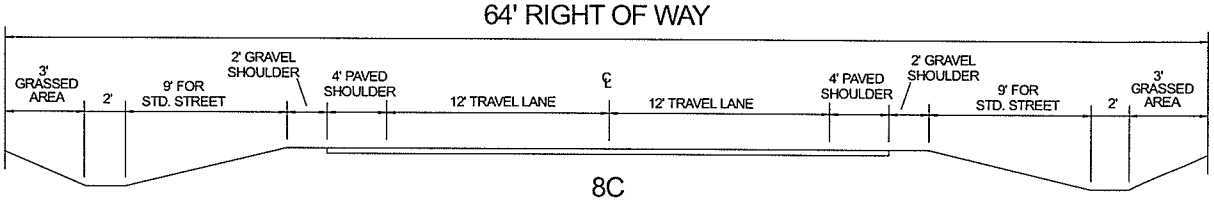
60' RIGHT OF WAY



8B

CLOSED DRAINAGE

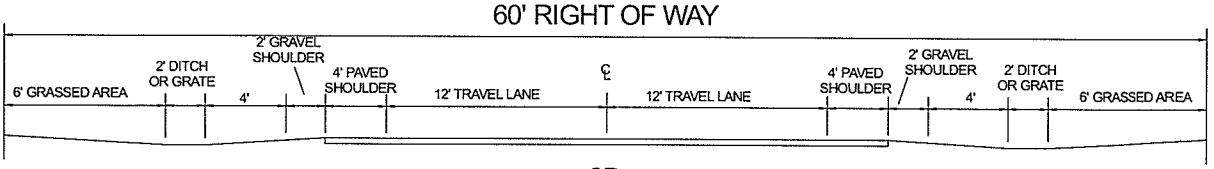
64' RIGHT OF WAY



8C

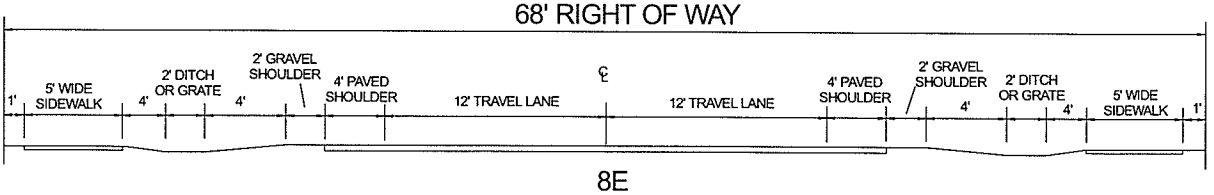
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



8D

68' RIGHT OF WAY



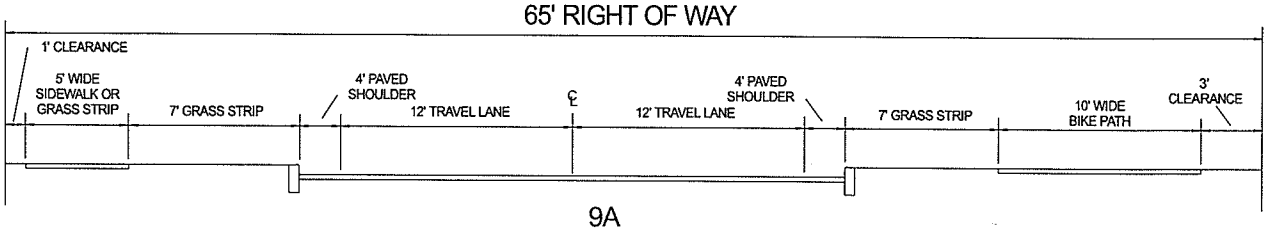
8E

OPEN DRAINAGE (SHALLOW SWALE)

<u>COMMERCIAL / INDUSTRIAL STREET STANDARDS</u>

CROSS-SECTION #9 SCENARIOS

65' RIGHT OF WAY



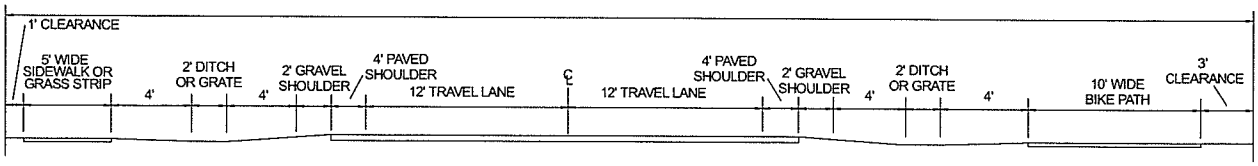
9A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

75' RIGHT OF WAY

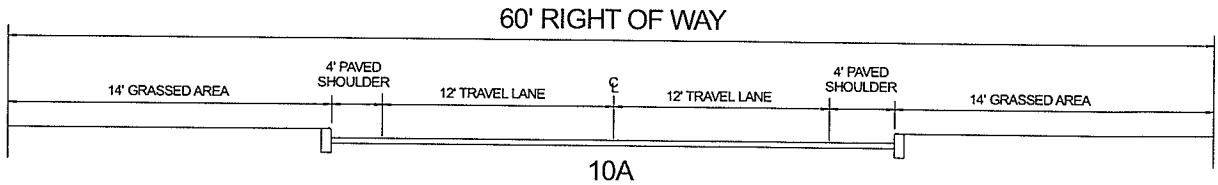


9B

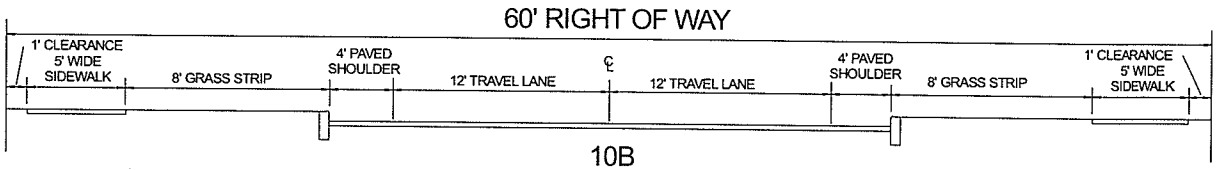
OPEN DRAINAGE (SHALLOW SWALE)

<u>COMMERCIAL / INDUSTRIAL STREET STANDARDS</u>

CROSS-SECTION #10 SCENARIOS

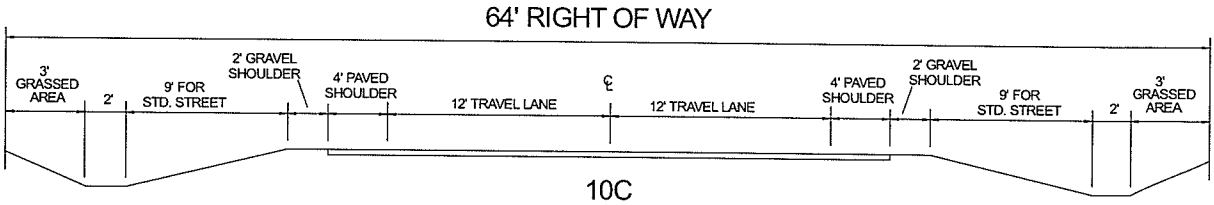


10A



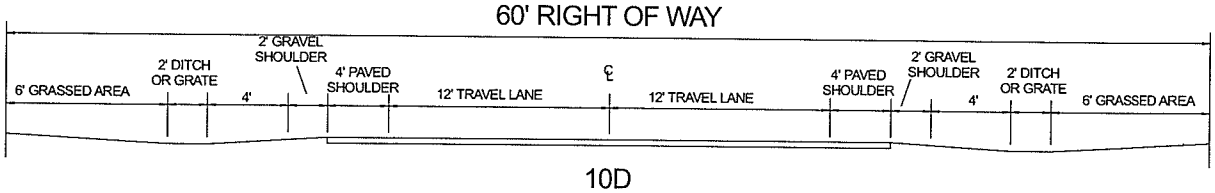
10B

CLOSED DRAINAGE

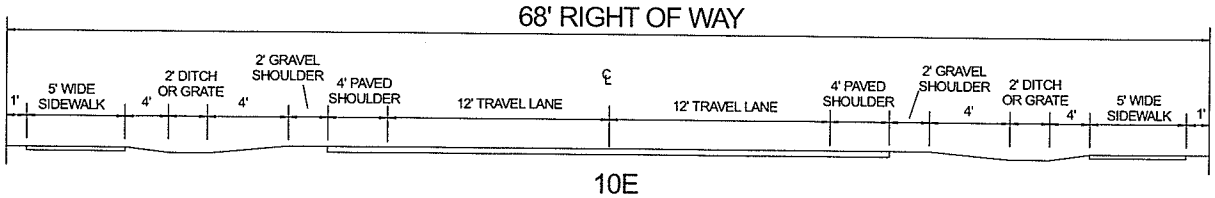


10C

OPEN DRAINAGE (STANDARD)



10D



10E

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

RESIDENTIAL STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for residential streets will vary from 22-30 ft wide depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below.

Travel Lane Widths
Travel lanes shall be 11 ft wide on residential streets.

Shoulder Widths
Paved shoulders (1 to 4-ft wide) will be required on streets with projected daily traffic volumes over 100 vehicles per day. Four inch wide painted white lines will be required on both sides of the street to delineate shared use paved shoulders on streets without a multi-use path. Table 3 provides a reference to the various cross-section scenarios for residential streets.

Table 3
Residential Street
Cross-Section Scenarios

Projected Daily Traffic Volume	With Multi-Use Path	Without Multi-Use Path
<100 vpd	#11	#12
100-500 vpd	#13	#14
500-2,000 vpd	#15	#16

On-Street Parking
Unmarked, on-street parking will be allowed on residential streets unless otherwise restricted. Parking will be restricted on one-side only on streets less than 28 ft wide and on both sides for streets less than 24 ft wide.

2. DRAINAGE OPTIONS

Closed Drainage
Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C. When closed drainage is used, the minimum pavement width shall be 26 ft (11 ft travel lanes plus 2 ft paved shoulders).

Open Drainage (Standard)
Standard open drainage shall not be used on residential streets where a multi-use path or sidewalk is to be constructed.

Open Drainage (Shallow Swale)
Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line.

Sidewalks
A 5 ft wide sidewalk shall be provided along at least one side of all new residential streets located with a 1 ft clearance to the right-of-way line. Sidewalks shall be provided along both sides of the street, when required by the Town Engineer.

Multi-Use Path
Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

A multi-use path is required along one side of all new residential streets with daily traffic volumes over 1,000 vehicles per day and along streets which are in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with a 3 ft clearance to the right-of-way line.

Planting Strips
A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

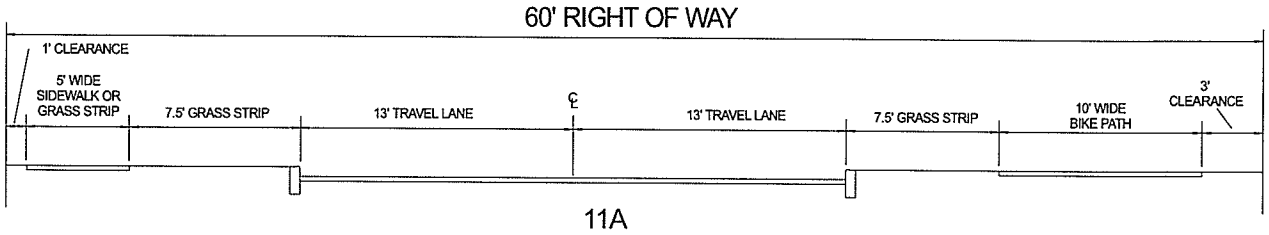
4. CORNER RADII

Corner radii at roadway intersections on residential streets shall be a minimum of thirty feet (30') and designed to accommodate the Towns fire equipment.

5. RIGHT-OF-WAY

Right-of-ways on residential streets will vary from a minimum of 60 ft to a maximum of 71 ft.

CROSS-SECTION #11 SCENARIOS

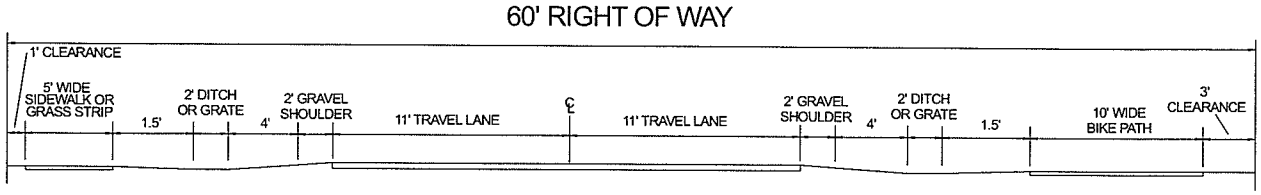


11A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

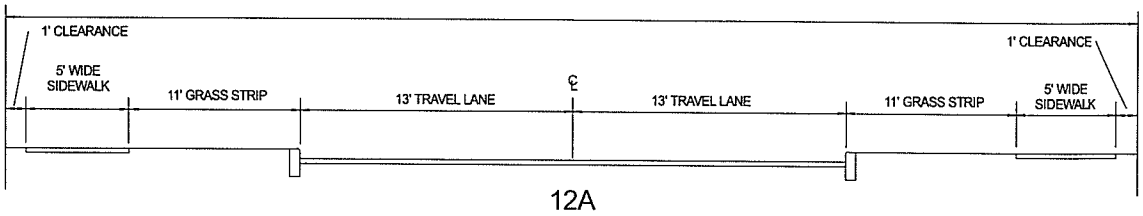


11B

OPEN DRAINAGE (SHALLOW SWALE)

CROSS-SECTION #12 SCENARIOS

60' RIGHT OF WAY



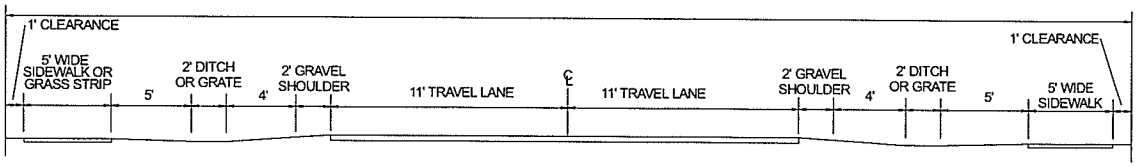
12A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY

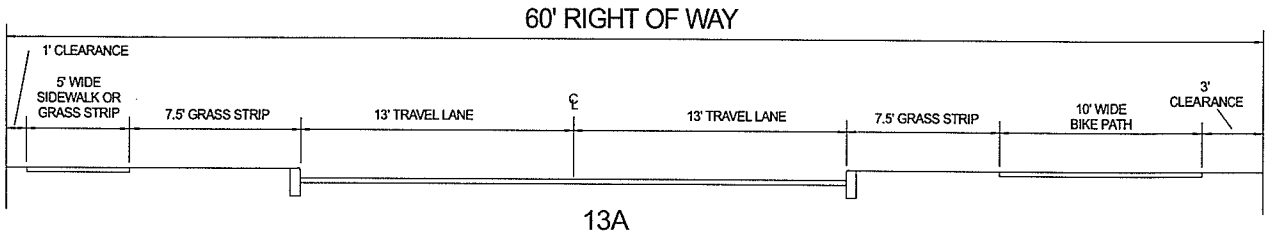


12B

OPEN DRAINAGE (SHALLOW SWALE)

<u>RESIDENTIAL STREET STANDARDS</u>

CROSS-SECTION #13 SCENARIOS

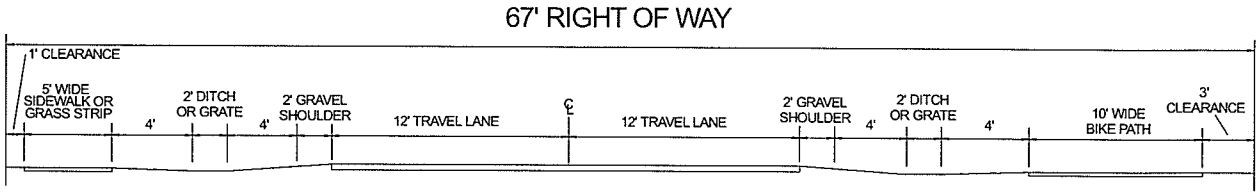


13A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

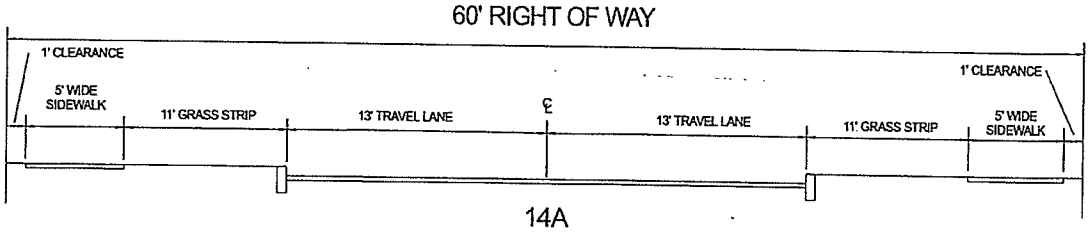


13B

OPEN DRAINAGE (SHALLOW SWALE)

CROSS-SECTION #14 SCENARIOS

60' RIGHT OF WAY



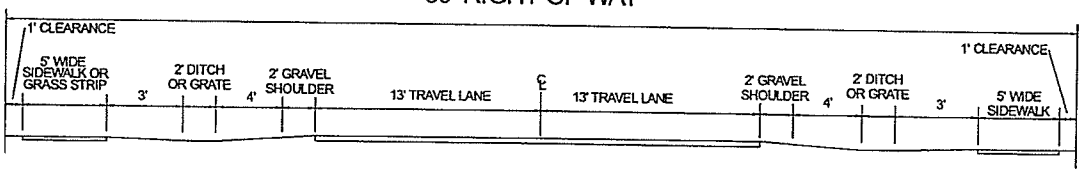
14A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



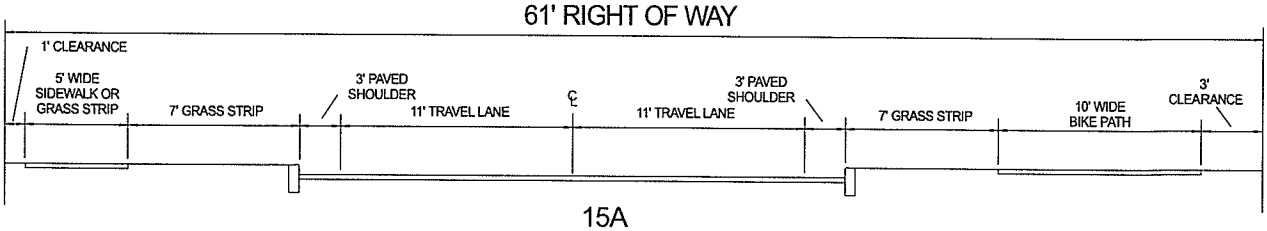
14B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #15 SCENARIOS

61' RIGHT OF WAY



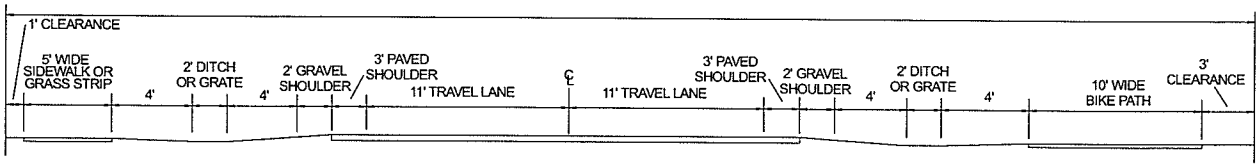
15A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

71' RIGHT OF WAY

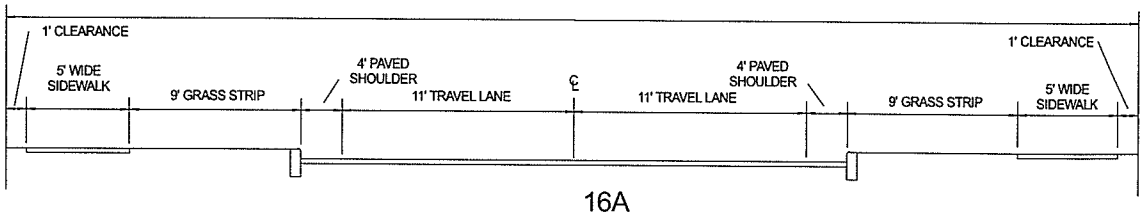


15B

OPEN DRAINAGE (SHALLOW SWALE)

CROSS-SECTION #16 SCENARIOS

60' RIGHT OF WAY



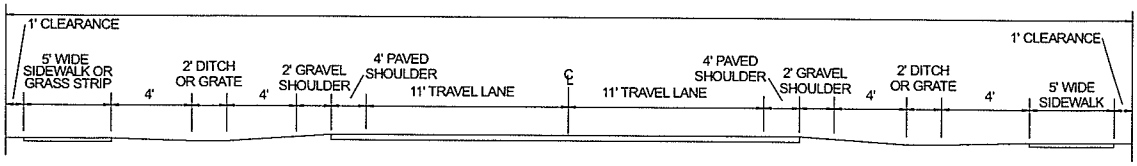
16A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

66' RIGHT OF WAY



16B

OPEN DRAINAGE (SHALLOW SWALE)

RURAL ROAD STANDARDS

1. ELIGIBILITY / DEFINITION

An unpaved road will be permitted for construction when the following conditions are met:

1. Shall connect to an existing unpaved road.
2. The Town has no plans to pave the existing unpaved road.
3. Shall serve as access to no more than six (6) dwelling units.
4. Shall be located in a residential area.
5. Shall be limited in length to 1,000 ft.
6. The grade of the proposed road shall not exceed 6%.

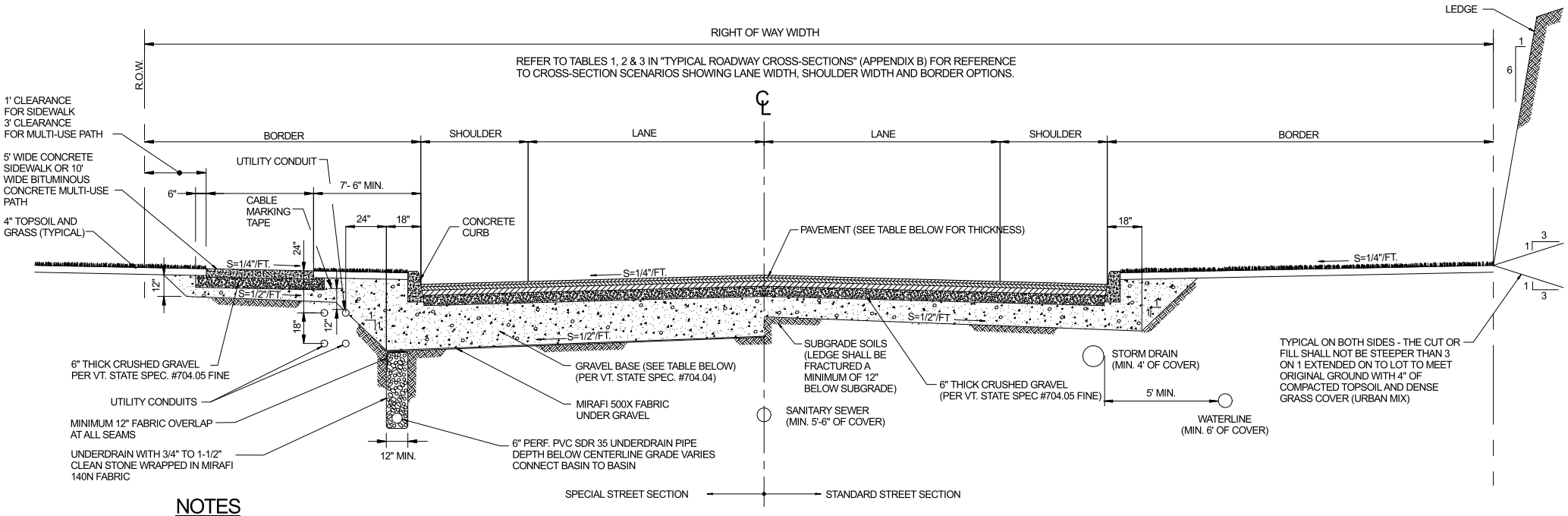
2. DESIGN

Rural roads shall have a 24 ft wide travel way with 2 ft wide stabilized shoulders, and shall be constructed using the typical cross-section detail shown on Figure 3.4 in Appendix C.

3. RIGHT-OF-WAY WIDTH

Rural roads shall have a 60 ft wide right-of-way.

APPENDIX C



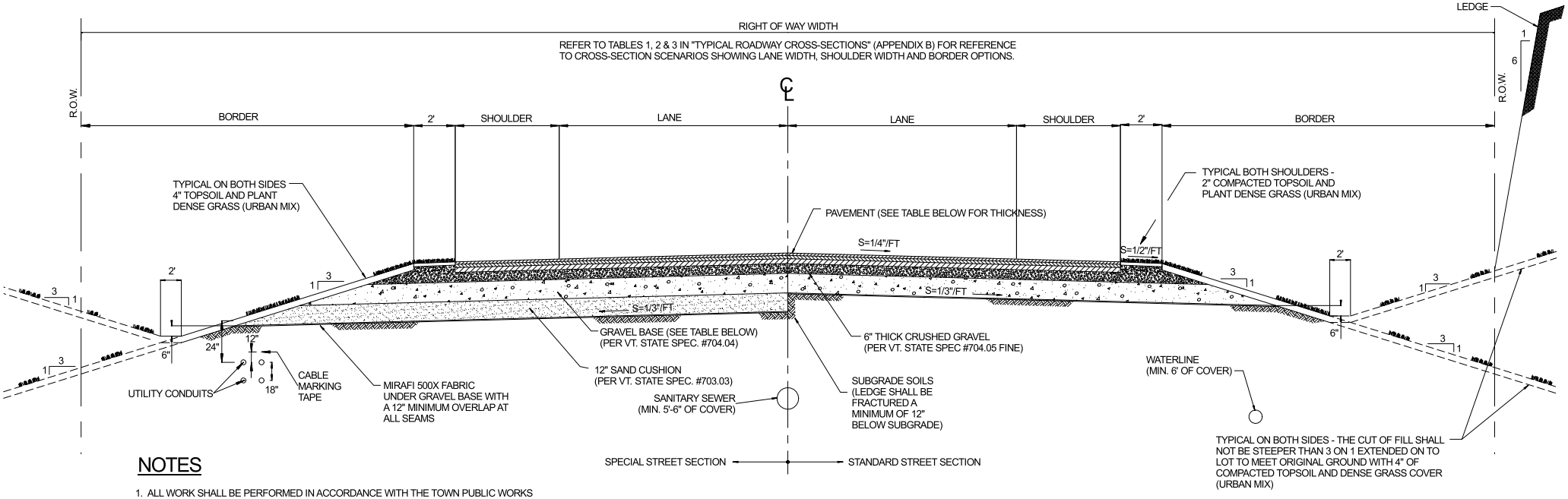
NOTES

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE TOWN PUBLIC WORKS REQUIREMENTS, THE REFERENCED VERMONT STATE STANDARD SPECIFICATIONS FOR CONSTRUCTION, AND THE APPROVED ENGINEERING PLANS AND SPECIFICATIONS.
2. SOIL BORINGS AND TEST PITS SHALL BE REQUIRED BY THE TOWN TO DETERMINE WHETHER THE STANDARD OR SPECIAL CROSS-SECTION SHALL BE USED.
3. THE SPECIAL SECTION WITH UNDERDRAIN AND THICKER BASE SHALL BE USED WHEN THE PLASTICITY INDEX OF THE SUBGRADE IF MORE THAN 6 AND THE LIQUID LIMIT IS GREATER THAN 25, WHEN THE SUBGRADE SOILS CONTAIN MORE THAN 8% BY WEIGHT OF PARTICLES FINER THAN A #200 SIEVE, OR WHEN THE SEASONAL HIGH GROUNDWATER IS WITHIN 3' OF THE FINISH GRADE.
4. IF THE TOP COURSE OF PAVEMENT IS NOT INSTALLED WITHIN 60 DAYS OF THE BASE COURSE, THE CONTRACTOR SHALL APPLY EMULSION TO THE FULL WIDTH OF THE BASE COURSE BEFORE INSTALLING THE TOP COURSE.
5. FOR ARTERIAL AND COLLECTOR STREETS, INSTALL 4" DOUBLE YELLOW CENTERLINES, 4" WHITE SHOULDER LINES AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD, RESIDENTIAL STREETS SHALL REQUIRE STOP BARS AND SIGNS, AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD.

	PAVEMENT THICKNESS		GRAVEL BASE THICKNESS	
AADT	TYPE I OR II BASE COURSE	TYPE III FINISH COURSE	STANDARD SECTION	SPECIAL SECTION
>500 VPD	3"	1-1/2"	18"	VARIES
< 500 VPD	2"	1-1/2"	15"	VARIES

TYPICAL ROADWAY CROSS-SECTION WITH CLOSED DRAINAGE

Figure3.1



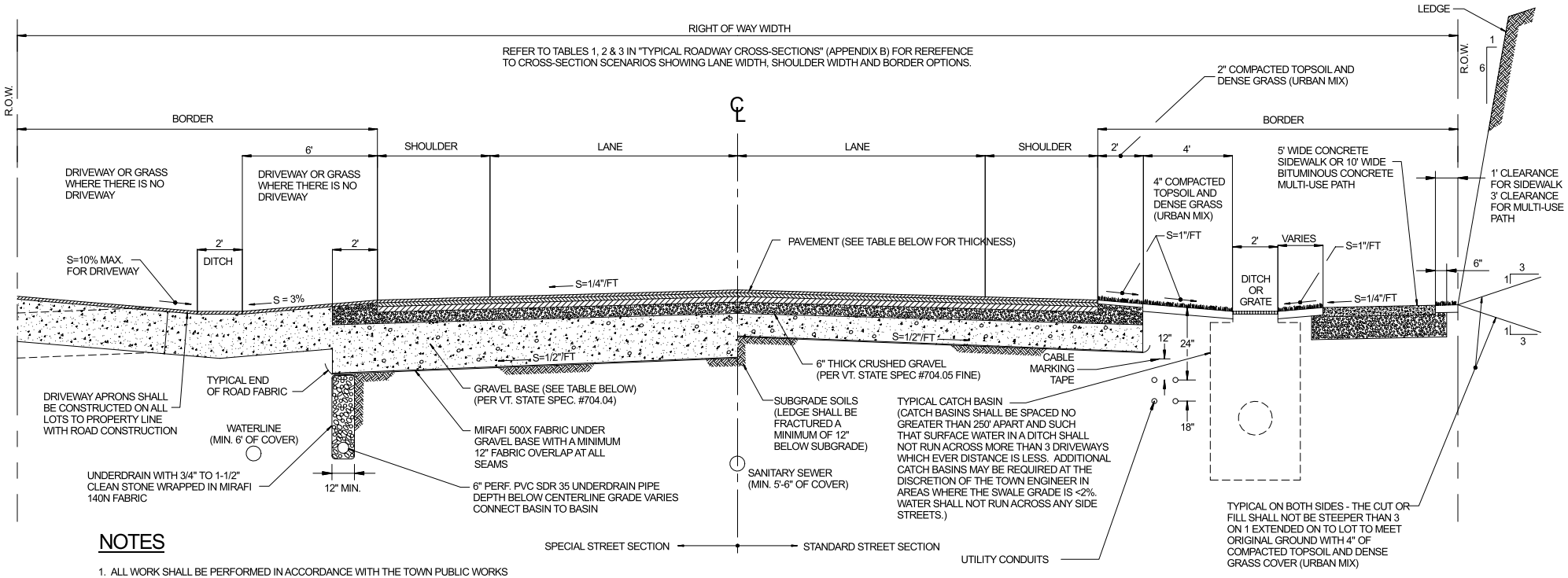
NOTES

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE TOWN PUBLIC WORKS REQUIREMENTS, THE REFERENCED VERMONT STATE STANDARD SPECIFICATIONS FOR CONSTRUCTION, AND THE APPROVED ENGINEERING PLANS AND SPECIFICATIONS.
2. SOIL BORINGS AND TEST PITS SHALL BE REQUIRED BY THE TOWN TO DETERMINE WHETHER THE STANDARD OR SPECIAL CROSS-SECTION SHALL BE USED.
3. THE SPECIAL SECTION WITH 12" SAND CUSION SHALL BE USED WHEN THE PLASTICITY INDEX OF THE SUBGRADE IF MORE THAN 6 AND THE LIQUID LIMIT IS GREATER THAN 25, WHEN THE SUBGRADE SOILS CONTAIN MORE THAN 8% BY WEIGHT OF PARTICLES FINER THAN A #200 SIEVE, OR WHEN THE SEASONAL HIGH GROUNDWATER IS WITHIN 3' OF THE FINISH GRADE.
4. IF THE TOP COURSE OF PAVEMENT IS NOT INSTALLED WITHIN 60 DAYS OF THE BASE COURSE, THE CONTRACTOR SHALL APPLY EMULSION TO THE FULL WIDTH OF THE BASE COURSE BEFORE INSTALLING THE TOP COURSE.
5. FOR ARTERIAL AND COLLECTOR STREETS, INSTALL 4" DOUBLE YELLOW CENTERLINES, 4" WHITE SHOULDER LINES AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD, RESIDENTIAL STREETS SHALL REQUIRE STOP BARS AND SIGNS, AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD.

	PAVEMENT THICKNESS		GRAVEL BASE THICKNESS	
AADT	TYPE I OR II BASE COURSE	TYPE III FINISH COURSE	STANDARD SECTION	SPECIAL SECTION
>500 VPD	3"	1-1/2"	18"	VARIES
< 500 VPD	2"	1-1/2"	15"	VARIES

TYPICAL ROADWAY CROSS-SECTION WITH STANDARD OPEN DRAINAGE

Figure 3.2



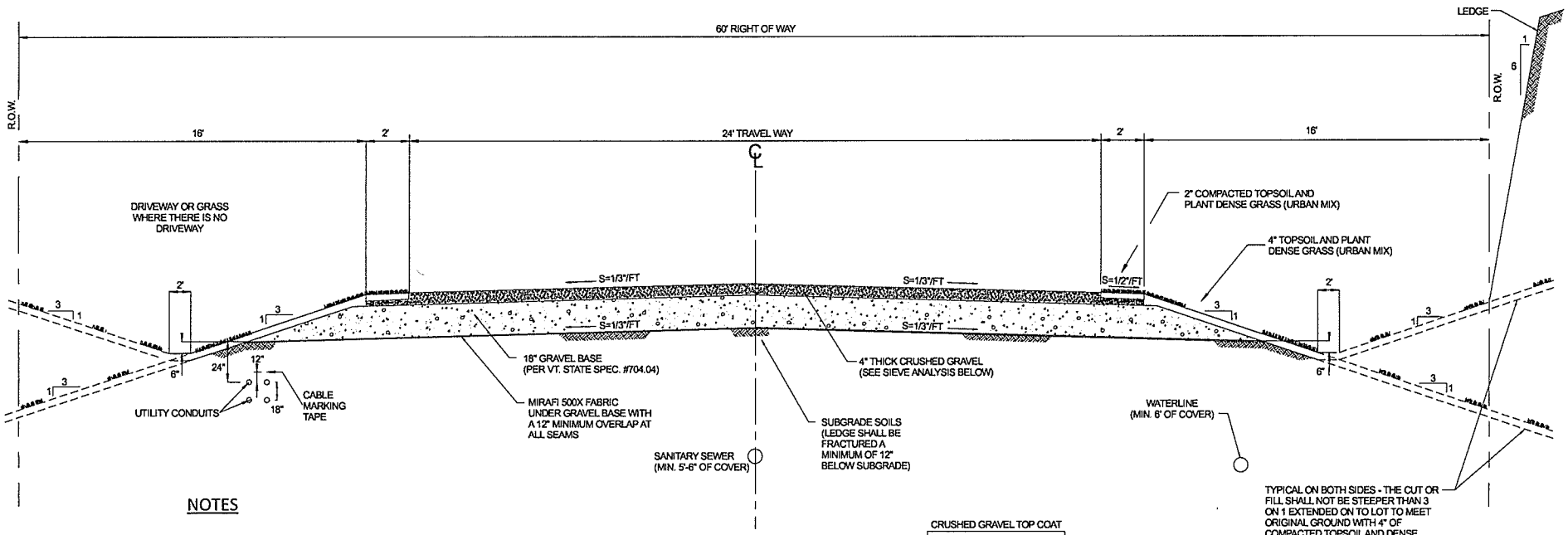
NOTES

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE TOWN PUBLIC WORKS REQUIREMENTS, THE REFERENCED VERMONT STATE STANDARD SPECIFICATIONS FOR CONSTRUCTION, AND THE APPROVED ENGINEERING PLANS AND SPECIFICATIONS.
2. SOIL BORINGS AND TEST PITS SHALL BE REQUIRED BY THE TOWN TO DETERMINE WHETHER THE STANDARD OR SPECIAL CROSS-SECTION SHALL BE USED.
3. THE SPECIAL SECTION WITH UNDERDRAIN AND THICKER BASE SHALL BE USED WHEN THE PLASTICITY INDEX OF THE SUBGRADE IF MORE THAN 6 AND THE LIQUID LIMIT IS GREATER THAN 25, WHEN THE SUBGRADE SOILS CONTAIN MORE THAN 8% BY WEIGHT OF PARTICLES FINER THAN A #200 SIEVE, OR WHEN THE SEASONAL HIGH GROUNDWATER IS WITHIN 3' OF THE FINISH GRADE.
4. IF THE TOP COURSE OF PAVEMENT IS NOT INSTALLED WITHIN 60 DAYS OF THE BASE COURSE, THE CONTRACTOR SHALL APPLY EMULSION TO THE FULL WIDTH OF THE BASE COURSE BEFORE INSTALLING THE TOP COURSE.
5. FOR ARTERIAL AND COLLECTOR STREETS, INSTALL 4" DOUBLE YELLOW CENTERLINES, 4" WHITE SHOULDER LINES AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD, RESIDENTIAL STREETS SHALL REQUIRE STOP BARS AND SIGNS, AND OTHER MARKINGS AND SIGNAGE IN ACCORDANCE WITH THE MUTCD.
6. THIS CROSS-SECTION IS USED IN RESIDENTIAL AREA WHEN THE DWELLING UNITS HAVE A MINIMUM SETBACK OF 30' FROM THE R.O.W. SIDELINE AND A MINIMUM 20' LONG DRIVEWAY OR OTHER SIMILAR OFF-STREET PARKING.

	PAVEMENT THICKNESS		GRAVEL BASE THICKNESS	
AADT	TYPE I OR II BASE COURSE	TYPE III FINISH COURSE	STANDARD SECTION	SPECIAL SECTION
>500 VPD	3"	1-1/2"	18"	VARIES
< 500 VPD	2"	1-1/2"	15"	VARIES

TYPICAL ROADWAY CROSS-SECTION WITH SHALLOW SWALE OPEN DRAINAGE

Figure 3.3



NOTES

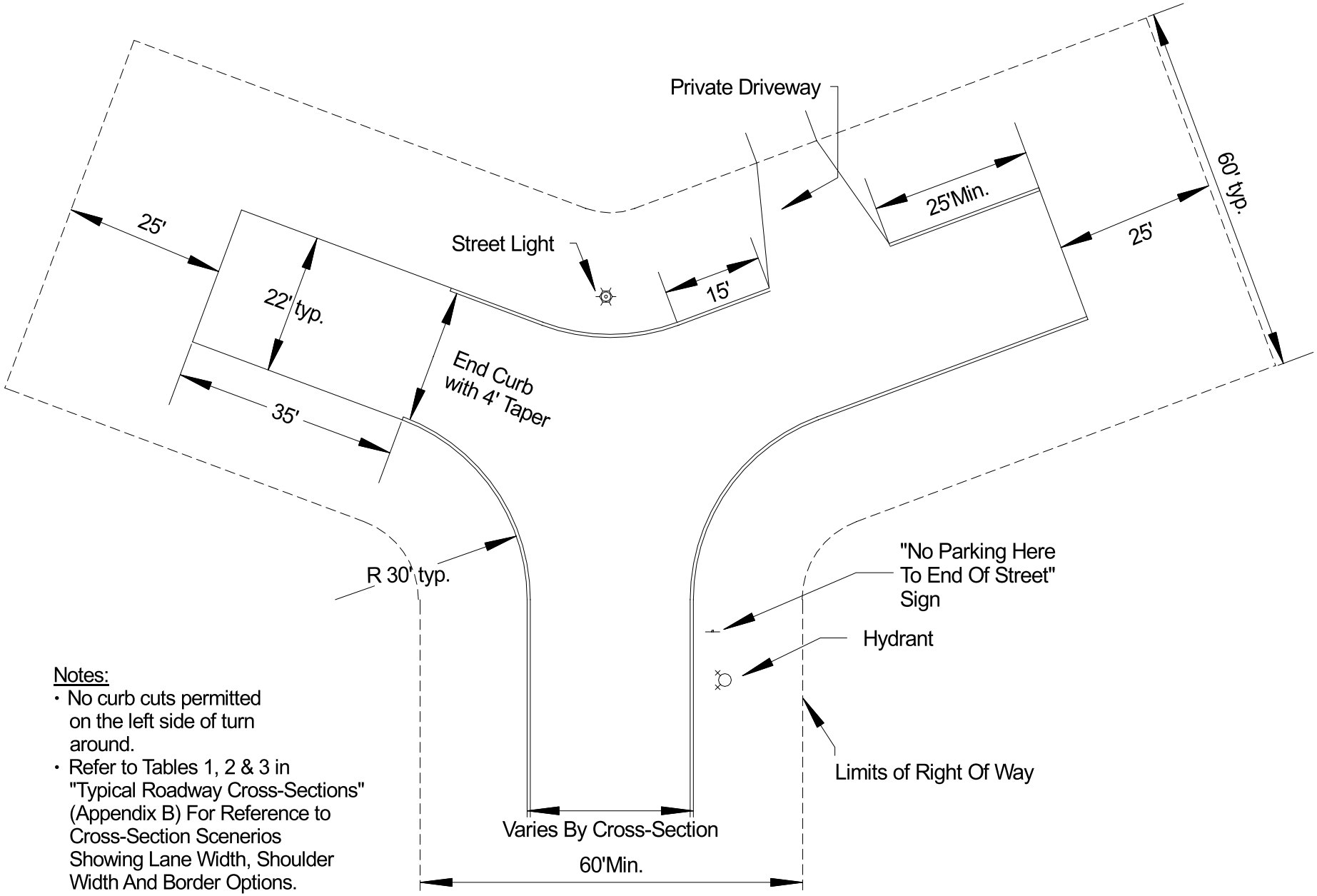
1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE TOWN PUBLIC WORKS REQUIREMENTS, THE REFERENCED VERMONT STATE STANDARD SPECIFICATIONS FOR CONSTRUCTION, AND THE APPROVED ENGINEERING PLANS AND SPECIFICATIONS.
2. RURAL ROADS SHALL CONNECT TO AN EXISTING UNPAVED ROAD AND THE TOWN HAS NO PLANS TO PAVE THE EXISTING UNPAVED ROAD.
3. RURAL ROADS SHALL SERVE AS ACCESS TO NO MORE THAN SIX (6) DWELLING UNITS.
4. RURAL ROADS SHALL BE LOCATED IN A RESIDENTIAL AREA AND LIMITED IN LENGTH TO 1,000 FEET.
5. THE GRADE OF RURAL ROADS SHALL NOT EXCEED 6%.

CRUSHED GRAVEL TOP COAT

SIEVE SIZE	PERCENT FINER
1"	100
#40	40 - 60
#16	20 - 30
#30	10 - 20
#50	5 - 15
#100	5 - 15
#200	4 - 6

TYPICAL UNPAVED ROADWAY CROSS-SECTION

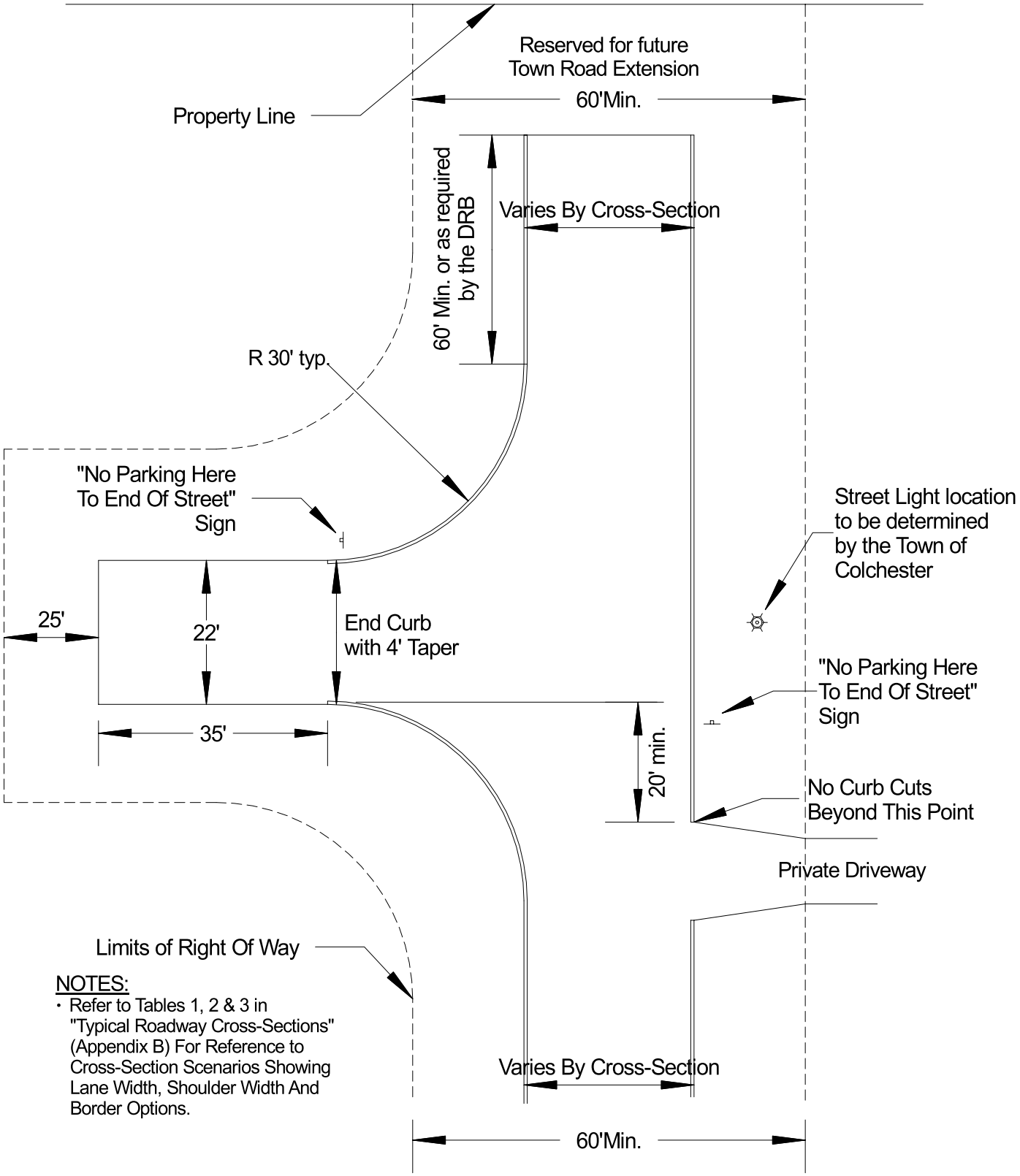
Figure 3.4



Notes:
- No curb cuts permitted on the left side of turn around.
- Refer to Tables 1, 2 & 3 in "Typical Roadway Cross-Sections" (Appendix B) For Reference to Cross-Section Scenerios Showing Lane Width, Shoulder Width And Border Options.

"Y" TURN AROUND

Figure 3.5

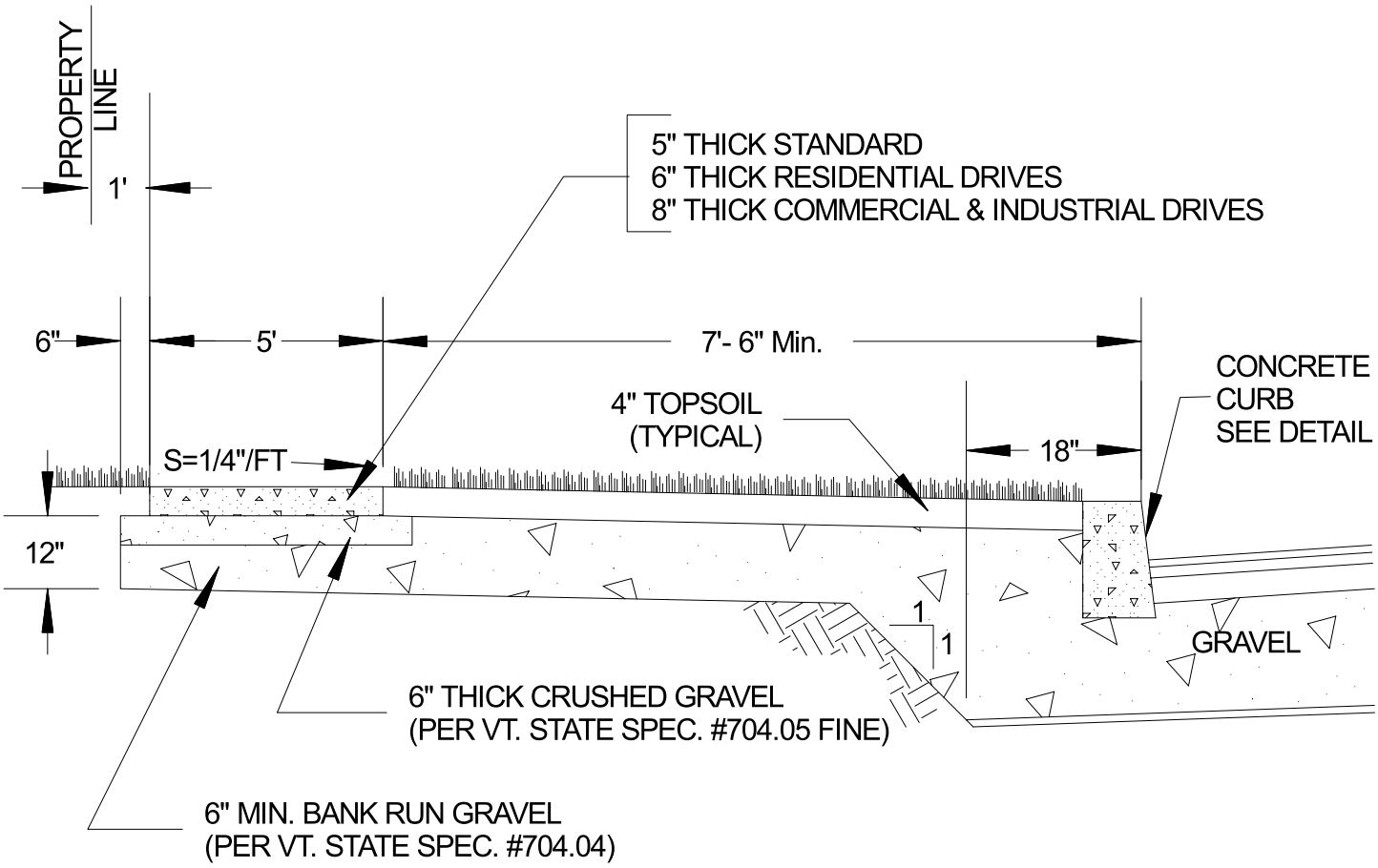


NOTES:

- Refer to Tables 1, 2 & 3 in "Typical Roadway Cross-Sections" (Appendix B) For Reference to Cross-Section Scenarios Showing Lane Width, Shoulder Width And Border Options.

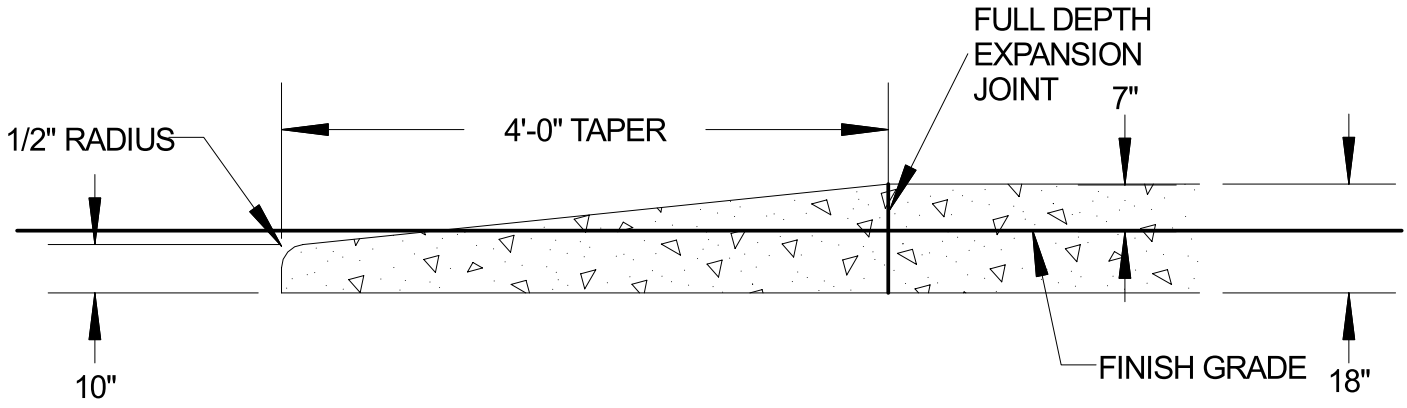
"L" TURN AROUND

Figure 3.6

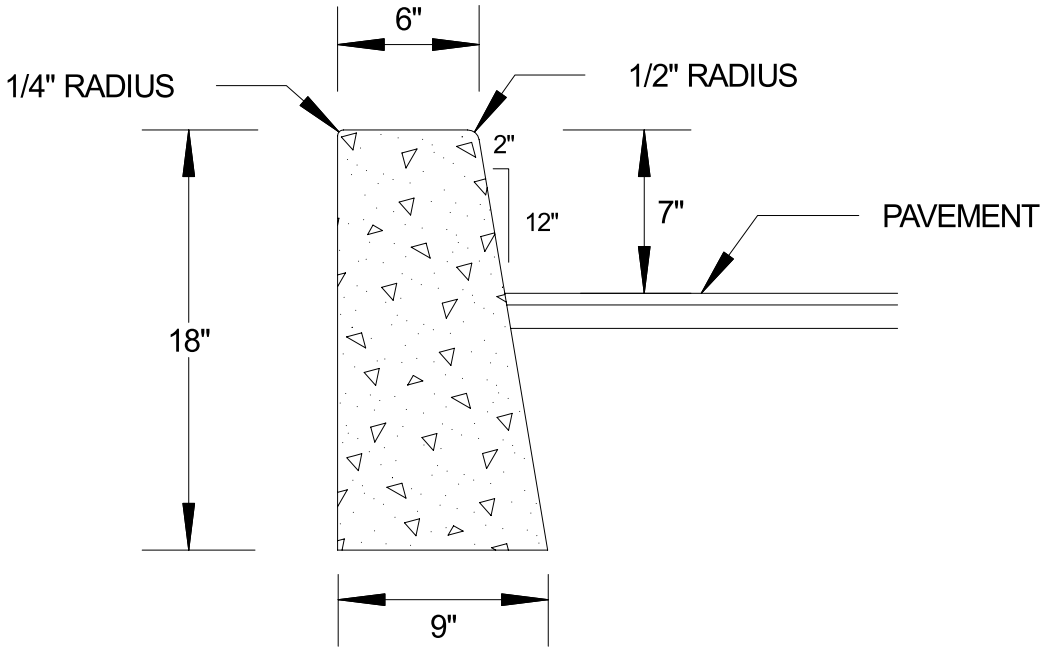


CONCRETE SIDEWALK

Figure 3.7

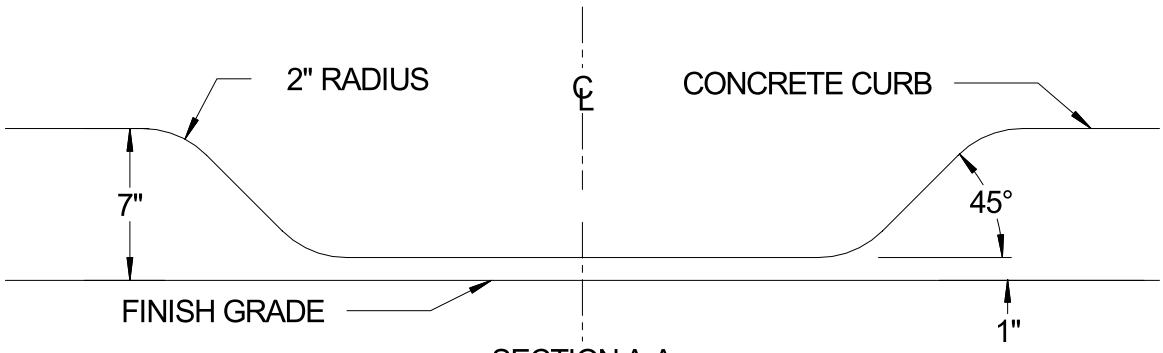


TYPICAL TAPERED CURB



TYPICAL CONCRETE CURB

Figure 3.8



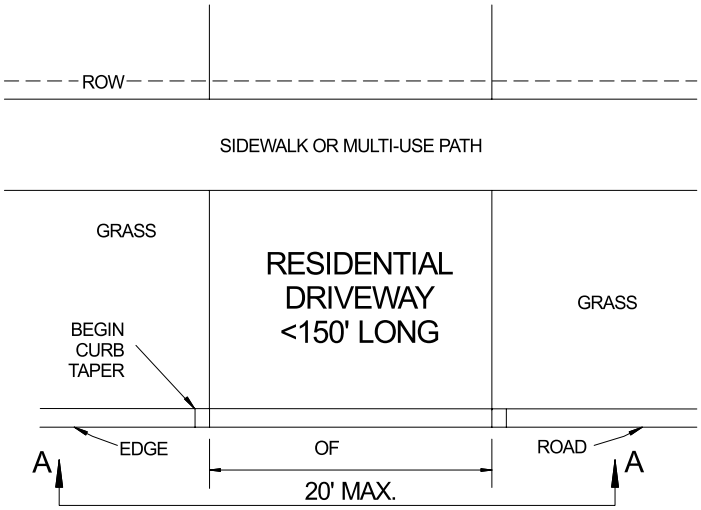
SECTION A-A

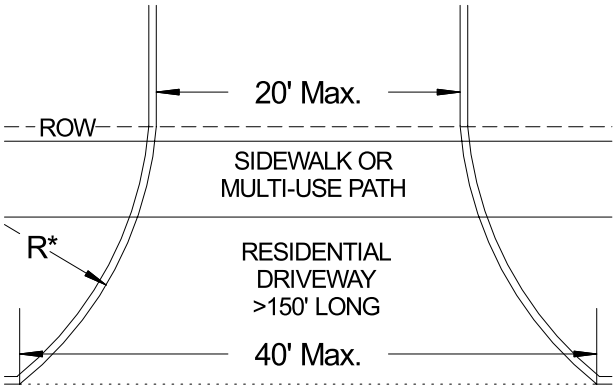
NOTES

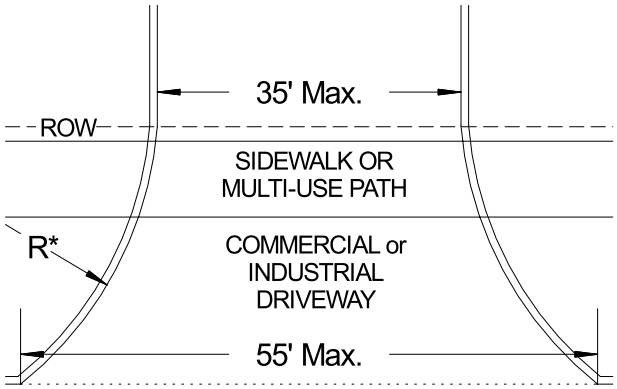
1. All driveways accessing paved streets shall be paved from the edge of the traveled way to limits of the Town Right-Of-Way.

2. Intersection sight distances equal to or greater than those shown on the chart, shall be provided in both directions for all driveways entering on public roadways. Intersection sight distance is measured from a point of the driveway 15 feet from the edge of traveled way of the adjacent roadway and measured from a height of 3.5 feet on the driveway to a height of 3.5 feet on the roadway.

SIGHT DISTANCE CHART		
Posted Speed (mph)	Passenger Car Min. Corner Sight Distance (Ft)	Large Truck Min. Corner Sight Distance (Ft)
25	275	460
30	330	575
35	385	680
40	440	780
45	495	960
50	550	1130



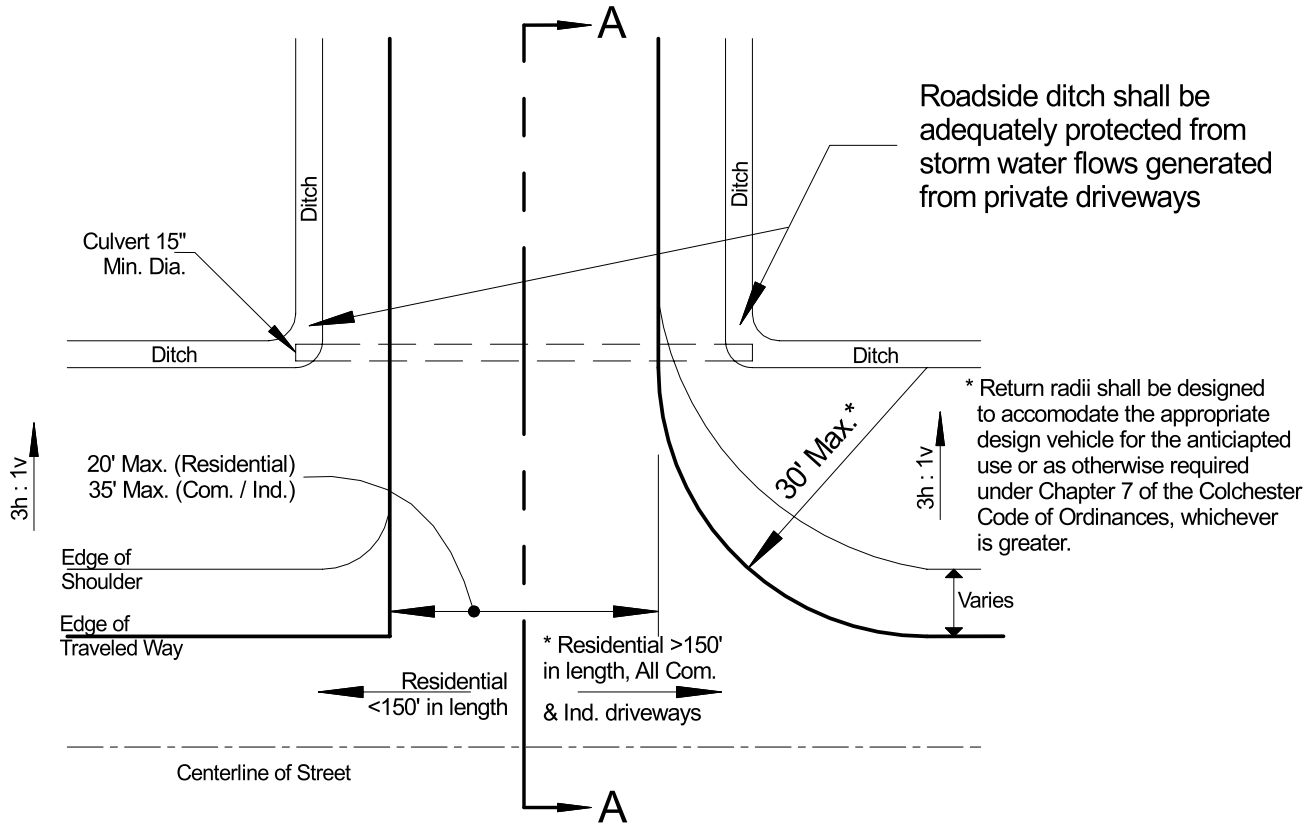




* Return radii shall be designed to accomodate the appropriate design vehicle for the anticipated use or as othewise required under Chapter 7 of the Colchester Code of Ordinances, whichever is greater.

DRIVEWAY ENTRANCE ON CURBED STREET

Figure 3.9



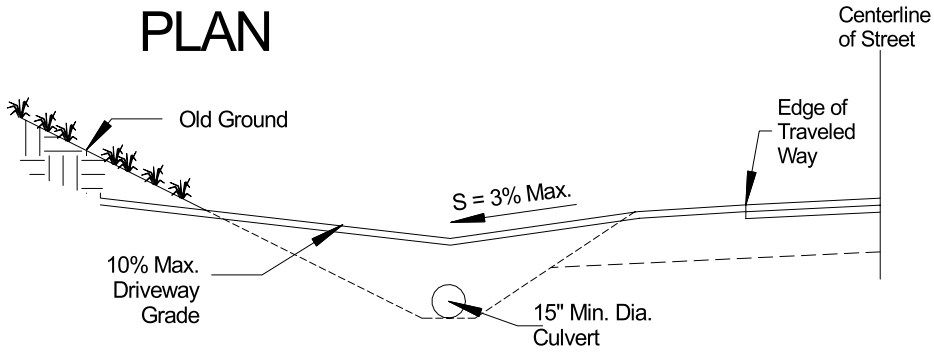
PLAN

NOTES

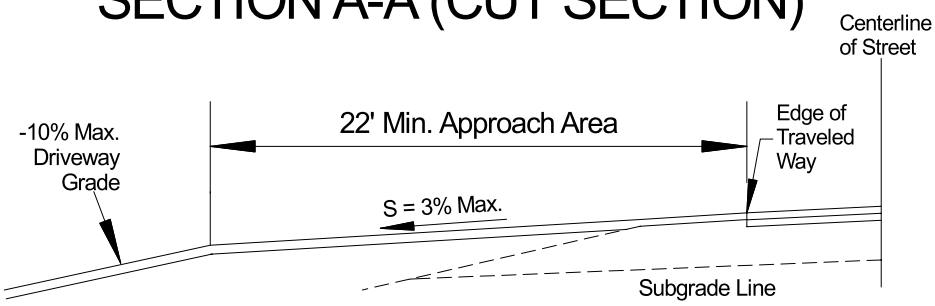
1. All driveways accessing paved streets shall be paved from the edge of the traveled way to limits of the Town Right-Of-Way.

2. Intersection sight distances equal to or greater than those shown on the chart, shall be provided in both directions for all driveways entering on public roadways. Intersection sight distance is measured from a point of the driveway 15 feet from the edge of traveled way of the adjacent roadway and measured from a height of 3.5 feet on the driveway to a height of 3.5 feet on the roadway.

SIGHT DISTANCE CHART		
Posted Speed (mph)	Passenger Car Min. Corner Sight Distance (Ft)	Large Truck Min. Corner Sight Distance (Ft)
25	275	460
30	330	575
35	385	680
40	440	780
45	495	960
50	550	1130



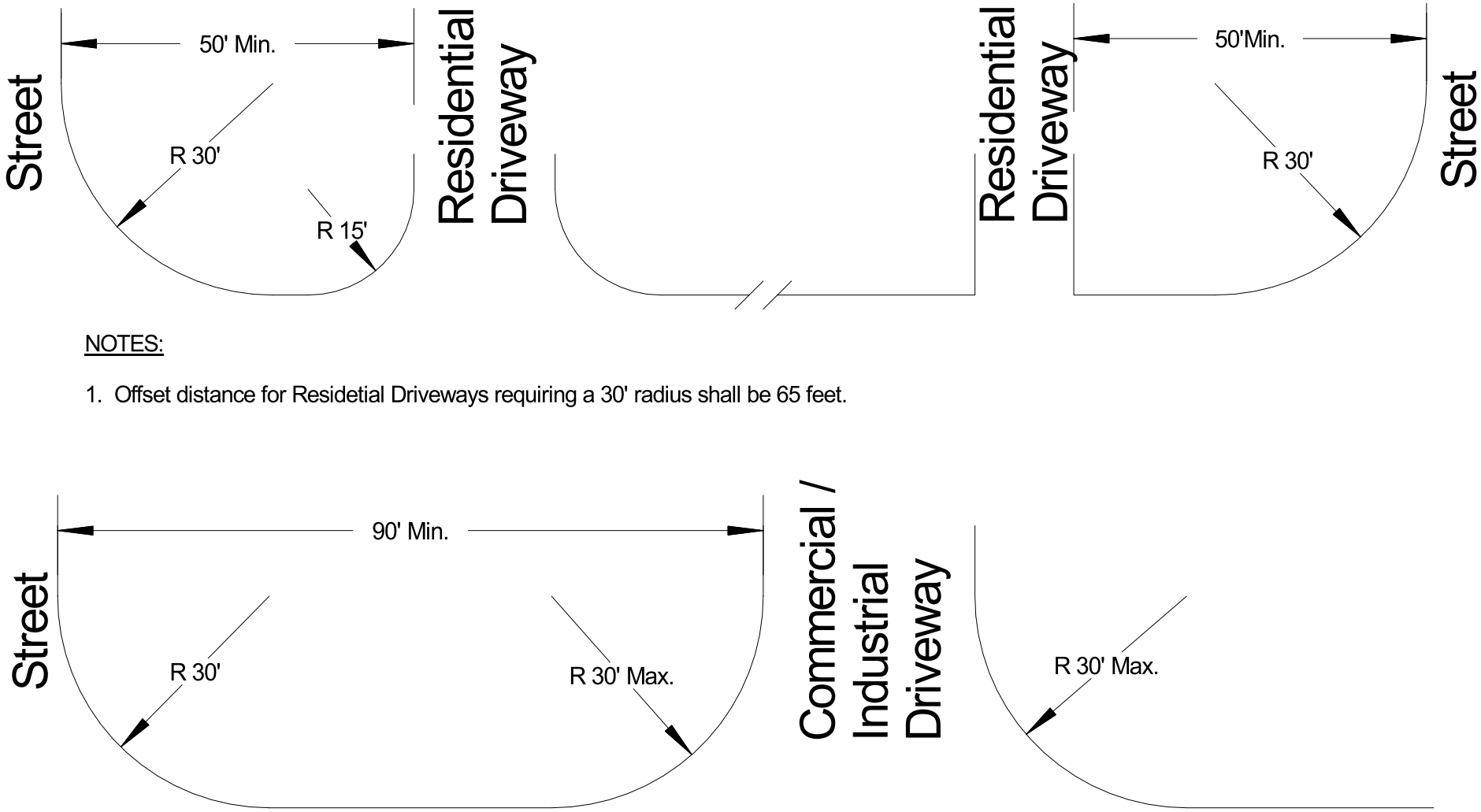
SECTION A-A (CUT SECTION)



SECTION A-A (FILL SECTION)

DRIVEWAY ENTRANCE ON UNCURBED STREET

Figure 3.10

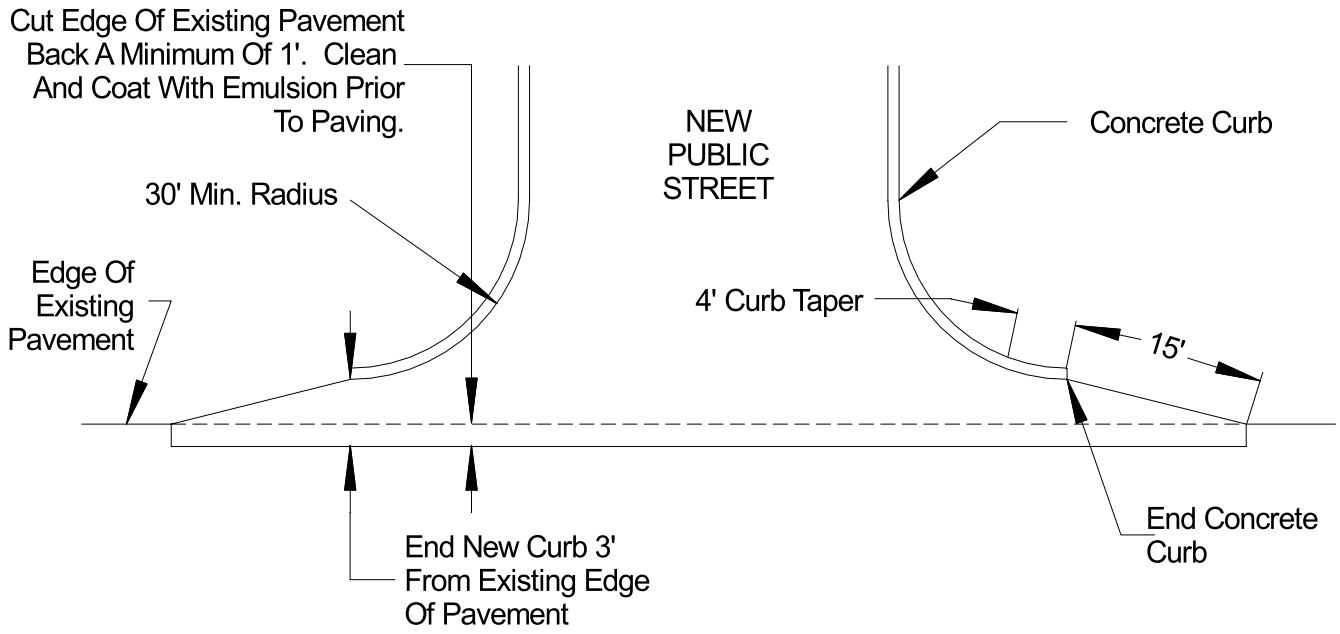


NOTES:

1. Offset distance for Residetial Driveways requiring a 30' radius shall be 65 feet.

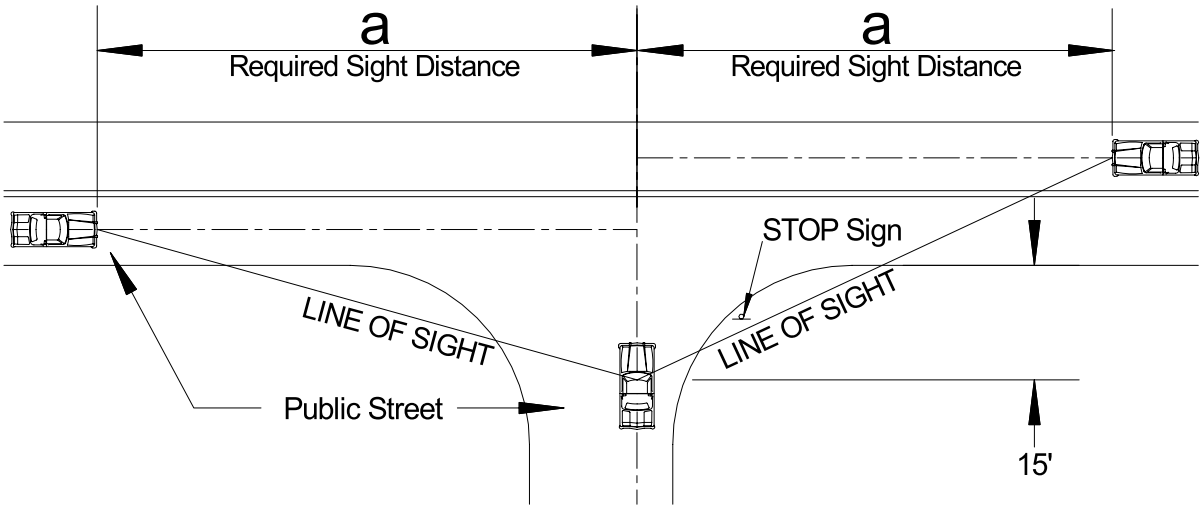
Figure 3.11

Street / Driveway Offset Distances



CURBED STREET INTERSECTION WITH EXISTING UNCURBED STREET

Figure 3.12



OPERATING SPEED (MPH)	25	30	35	40	45	50
DISTANCE (FEET) a[1]	275	330	385	440	495	550

NOTES:

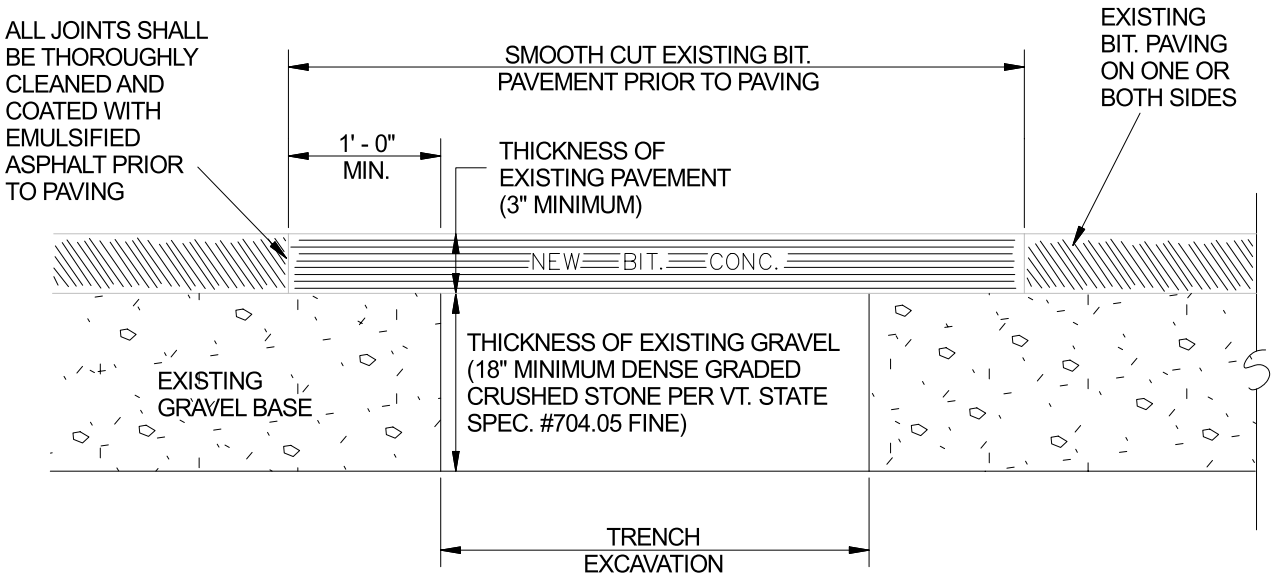
1 Distance "a" assumes flat grades at intersection. Where the grades of the intersection legs are other than flat, corrections should be made to the sight distance per AASHTO guidance.

2 Intersection sight distance is measured from a point on the roadway 15 feet from the edge of the traveled way of the adjacent roadway and measured from a height of eye of 3.5 feet on the roadway to a height of 3.5 feet on the adjacent roadway.

3 For intersections onto a roadway with a speed limit of 30 MPH or greater, sight distance shall be measured from 20 feet from edge of the traveled way.

SIGHT DISTANCE CHART

Figure 3.13



1. SET UP AND MAINTAIN TRAFFIC CONTROL SIGNS AND OTHER SAFETY DEVICES.

2. RESHAPE HOLE AND PATCH AREA BY CUTTING WITH A CONCRETE SAW INTO SQUARE OR RECTANGULAR SHAPE AND CUT SIDE FACES VERTICALLY. RESHAPE DOWNWARD TO SOLID MATERIAL AND AROUND HOLE TO SOUND PAVEMENT.

3. BACKFILL TRENCH IN 6" LIFTS AND COMPACT EACH LIFT TO 95% OF MAXIMUM DENSITY OF OPTIMUM MOISTURE CONTENT AS DETERMINED BY ASTM D1557 / AASHTO T180 METHOD A MODIFIED PROCTOR.

4. REMOVE ALL LOOSE MATERIAL AND THOROUGHLY SWEEP THE HOLE AREA CLEAN OF MUD AND STANDING WATER.

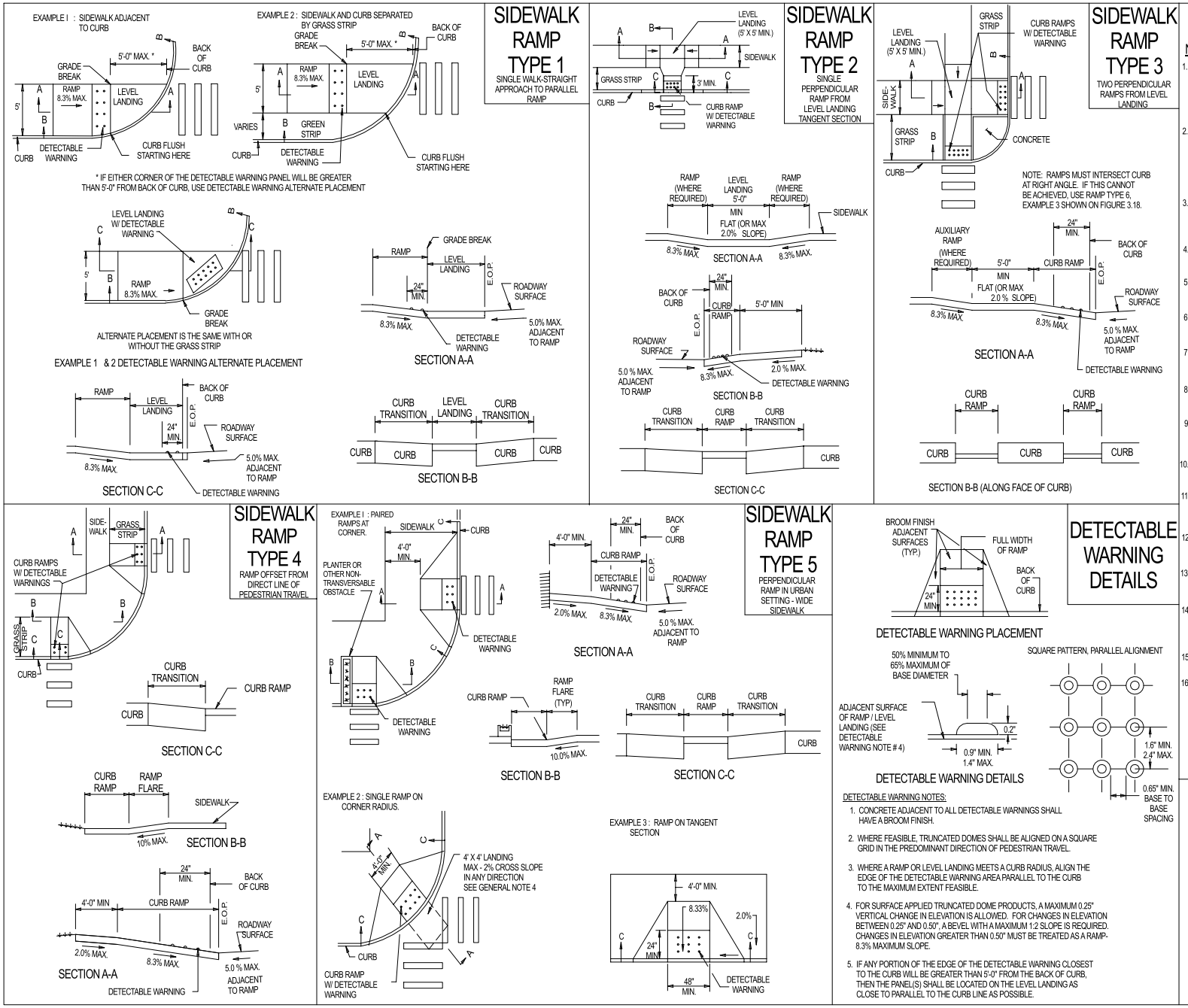
5. APPLY LIQUID ASPHALT TACK COAT TO VERTICAL FACES IN A UNIFORM MANNER. DO NOT PUDDLE TACK COAT ON BOTTOM OF HOLE.

6. FILL TOP OF HOLE WITH TYPE III BITUMINIOUS CONCRETE AND COMPACT IN LIFTS NO MORE THAN 2" THICK. FINAL UNCOMPACTED LIFT SHOULD BE 1/2" TO 1" ABOVE ADJOINING PAVEMENT SO THAT AFTER COMPACTION THE PATCH IS LEVEL WITH THE ORIGINAL PAVEMENT. EACH LIFT SHOULD BE THOROUGHLY COMPACTED WITH A VIBRATORY PLATE COMPACTOR OR A PORTABLE ROLLER. HAND TAMP SHOULD ONLY BE USED FOR SMALL AREAS (LESS THAN 1 S.F.).

7. CLEAN UP AREA. DO NOT LEAVE EXCESS FILL OR EXCAVATED MATERIAL ON THE PAVEMENT. REMOVE SAFETY SIGNS.

REPLACEMENT OF EXISTING BITUMINIOUS PAVEMENT

Figure 3.14



DETECTABLE WARNING NOTES:

1. CONCRETE ADJACENT TO ALL DETECTABLE WARNINGS SHALL HAVE A BROOM FINISH.
2. WHERE FEASIBLE, TRUNCATED DOMES SHALL BE ALIGNED ON A SQUARE GRID IN THE PREDOMINANT DIRECTION OF PEDESTRIAN TRAVEL.
3. WHERE A RAMP OR LEVEL LANDING MEETS A CURB RADIUS, ALIGN THE EDGE OF THE DETECTABLE WARNING AREA PARALLEL TO THE CURB TO THE MAXIMUM EXTENT FEASIBLE.
4. FOR SURFACE APPLIED TRUNCATED DOME PRODUCTS, A MAXIMUM 0.25" VERTICAL CHANGE IN ELEVATION IS ALLOWED. FOR CHANGES IN ELEVATION BETWEEN 0.25" AND 0.50", A BEVEL WITH A MAXIMUM 1:2 SLOPE IS REQUIRED. CHANGES IN ELEVATION GREATER THAN 0.50" MUST BE TREATED AS A RAMP-8.3% MAXIMUM SLOPE.
5. IF ANY PORTION OF THE EDGE OF THE DETECTABLE WARNING CLOSEST TO THE CURB WILL BE GREATER THAN 5'-0" FROM THE BACK OF CURB, THEN THE PANEL(S) SHALL BE LOCATED ON THE LEVEL LANDING AS CLOSE TO PARALLEL TO THE CURB LINE AS POSSIBLE.

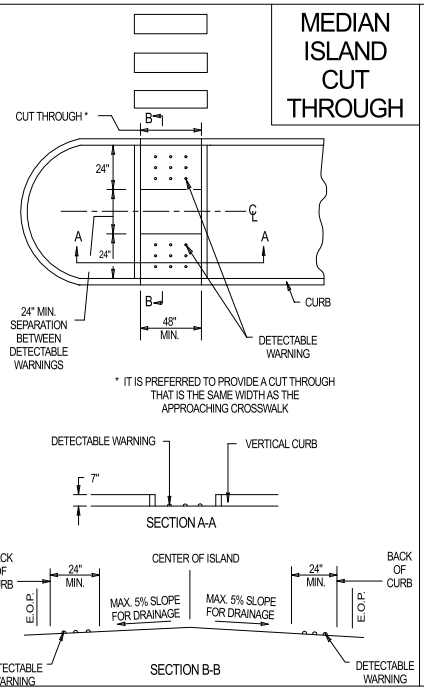
NOTES:

1. THE DIMENSIONS AND GRADES SHOWN ON THIS STANDARD WILL BE ADHERED TO IN THE DESIGN AND THE CONSTRUCTION OF SIDEWALK RAMPS. WHERE SIDEWALKS RUN ADJACENT TO THE ROADWAYS ON A STEEP (5% OR GREATER) GRADES, RAMP GRADES WILL BE AS FLAT AS POSSIBLE (ON LOW SIDE OF DRIVES AND INTERSECTING SIDE STREETS, RAMPS SHALL SLOPE TOWARDS DRIVE OR SIDE STREET @ 2%).
2. NOMINAL RAMP DIMENSIONS AND GRADES:
   RAMP WIDTH - 4'-0" MINIMUM
   RAMP SLOPE - 8.3% MAXIMUM
   FLARE SLOPE - 10% MAXIMUM
   RAMP CROSS SLOPE - 2.0% MAXIMUM
3. A LEVEL LANDING (NO GREATER THAN 2.0% SLOPE IN ANY DIRECTION) SHALL BE PROVIDED AT THE TOP OF SIDEWALK RAMPS TO ALLOW FOR STOPPING AND MANEUVERING OF WHEELCHAIRS.
4. LEVEL LANDINGS (NO GREATER THAN 2.0% SLOPE IN ANY DIRECTION) AT THE BOTTOM OF PERPENDICULAR RAMPS SHALL BE WHOLLY CONTAINED WITHIN MARKED CROSSWALKS.
5. DUMMY JOINTS SHALL BE PROVIDED AT TRANSITIONS (GRADE CHANGES) AT TOPS AND BOTTOMS OF RAMPS AND FLARES.
6. VERTICAL DROP-OFF EDGES TO RAMPS WILL NOT BE BUILT UNLESS THE RAMP ABUTS AN AREA WHICH WILL NOT BE USED BY PEDESTRIANS.
7. NO VERTICAL "LIP" OR "CURB REVEAL" WILL BE PROVIDED WHERE THE RAMP ADJOINS THE ROADWAY
8. AT MARKED CROSSWALKS, THE FULL WIDTH OF THE RAMP OR LANDING SHALL BE CONTAINED WITHIN THE PAVEMENT MARKINGS.
9. WHERE POSSIBLE, RAMP FLARES SHOULD BE LOCATED OUTSIDE THE DIRECT LINE OF TRAVEL MOST LIKELY TO BE FOLLOWED BY THE VISUALLY IMPARED.
10. SIGNS, POLES, PLANTERS, MAILBOXES, ETC. SHALL NOT BE LOCATED WHERE THEY WILL INTERFERE WITH THE USE OF SIDEWALK RAMPS.
11. WHERE POSSIBLE, SIDEWALK RAMPS SHOULD NOT BE LOCATED WHERE USERS MUST CROSS DROP INLET GRATES, MANHOLE COVERS OR OTHER ACCESS LIDS. IF THIS CANNOT BE AVOIDED THEN GRATE DESIGN AND PLACEMENT SHALL CONFORM TO ADA REQUIREMENTS.
12. CURB DRAINAGE SHOULD BE CONSTRUCTED SO AS TO PRECLUDE THE FLOW OF WATER PAST THE SIDEWALK RAMP.
13. WHEREVER FEASIBLE, TWO SIDEWALK RAMPS ARE RECOMMENDED IN PREFERENCE TO A SINGLE RAMP.
14. JOINTS WILL BE CONSTRUCTED IN ACCORDANCE WITH CURRENT SIDEWALK SPECIFICATIONS. HOWEVER EXPANSION JOINTS WITHIN THE SIDEWALK RAMP AREA WILL BE AVOIDED WHEREVER POSSIBLE.
15. E.O.P. = EDGE OF PAVEMENT
16. THE PUBLIC SIDEWALK CURB RAMP STANDARDS DEPICTED HERE MAY NOT BE APPROPRIATE FOR ALL LOCATIONS. FIELD CONDITIONS AT INDIVIDUAL LOCATIONS MAY REQUIRE SPECIFIC DESIGNS. DESIGNS MUST BE CONSISTENT WITH THE PROVISIONS OF THIS SHEET TO THE MAXIMUM EXTENT FEASIBLE ON ALTERATION PROJECTS AND WHEN STRUCTURALLY PRACTICABLE ON NEW CONSTRUCTION PROJECTS AS REQUIRED BY THE AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES.

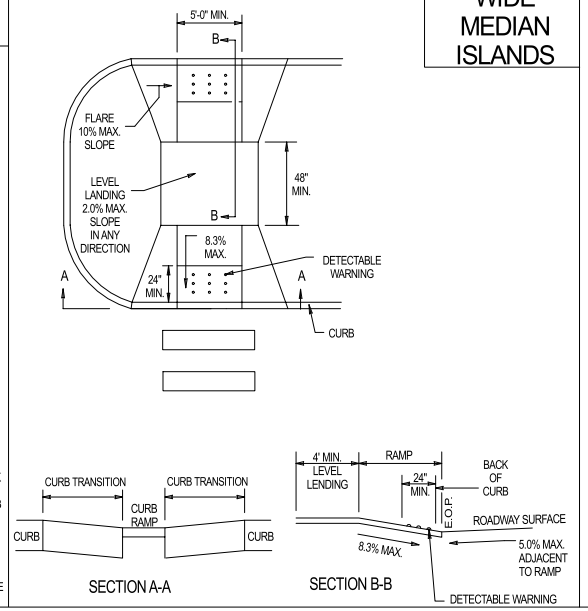
SIDEWALK RAMPS

Figure 3.15

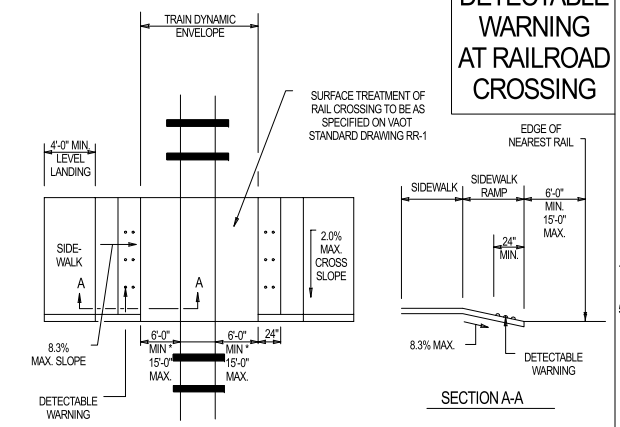
MEDIAN ISLAND CUT THROUGH



RAMPS AT WIDE MEDIAN ISLANDS



DETECTABLE WARNING AT RAILROAD CROSSING



* WHERE THIS DISTANCE CANNOT BE MET, A CLEARANCE DISTANCE BETWEEN THE TOE OF THE SIDEWALK RAMP AND THE FACE OF RAIL WILL BE UPON AGREEMENT BETWEEN THE REQUESTING PARTY AND THE RAILROAD. HOWEVER, THE DETECTABLE WARNING SHALL BE OUTSIDE THE EDGE OF THE DYNAMIC ENVELOPE.

NOTE: WHERE A PEDESTRIAN GATE IS PROVIDED ACROSS THE SIDEWALK, THE NEAREST EDGE OF THE DETECTABLE WARNING SHALL BE A MINIMUM OF 2'-0" FROM THE FACE OF THE GATE ARM.

NOTES:

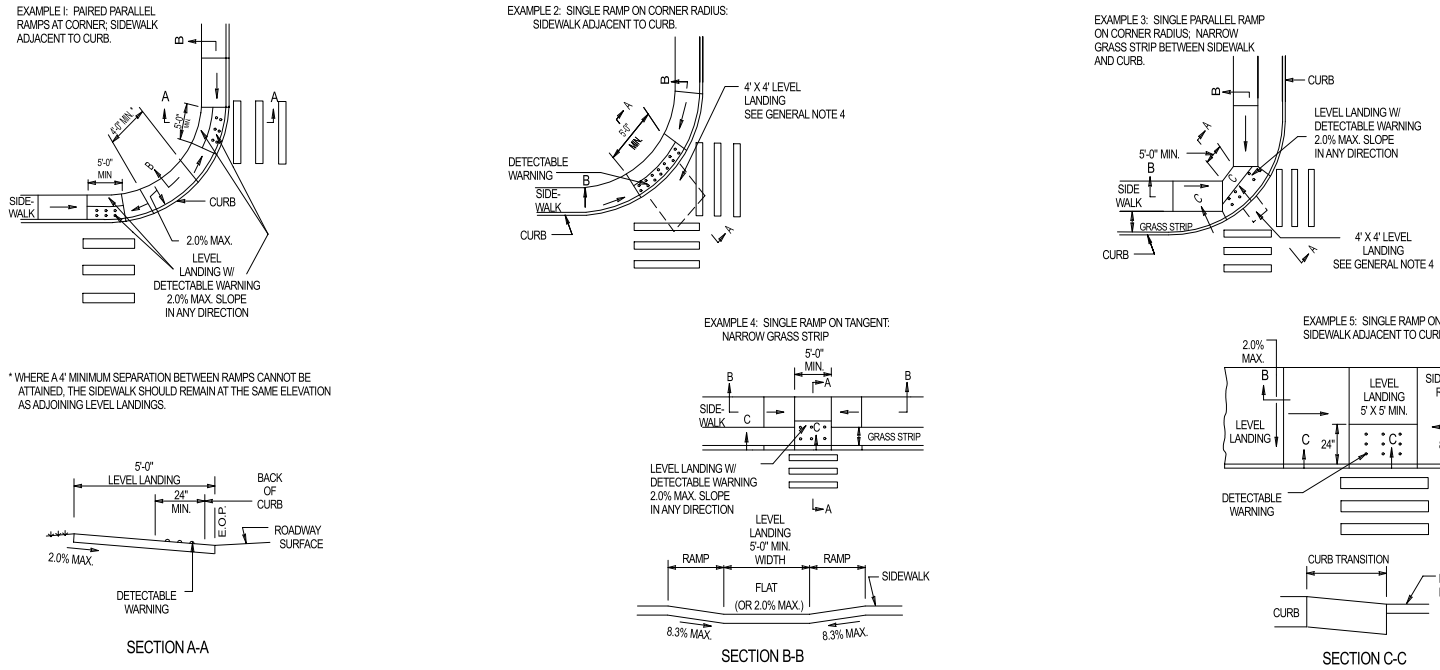
1. THE DIMENSIONS AND GRADES SHOWN ON THIS STANDARD WILL BE ADHERED TO IN THE DESIGN AND THE CONSTRUCTION OF SIDEWALK RAMPS. WHERE SIDEWALKS RUN ADJACENT TO ROADWAYS ON STEEP (5% OF GREATER) GRADES, RAMP GRADES WILL BE AS FLAT AS POSSIBLE, (ON LOW SIDE OF DRIVES AND INTERSECTING SIDE STREETS, RAMPS SHALL SLOPE TOWARDS DRIVE OR SIDE STREET @ 2%).
2. NOMINAL RAMP DIMENSIONS AND GRADES:

   RAMP WIDTH - 4'-0" MINIMUM
   RAMP SLOPE - 8.3% MAXIMUM
   FLARE SLOPE - 10% MAXIMUM
   RAMP CROSS SLOPE - 2.0% MAXIMUM

3. A LEVEL LANDING (NO GREATER THAN 2.0% SLOPE IN ANY DIRECTION) SHALL BE PROVIDED AT THE TOP OF SIDEWALK RAMPS TO ALLOW FOR STOPPING AND MANEUVERING OF WHEELCHAIRS.
4. LEVEL LANDINGS (NO GREATER THAN 2.0% SLOPE IN ANY DIRECTION) AT THE BOTTOM OF PERPENDICULAR RAMPS SHALL BE WHOLLY CONTAINED WITHIN MARKED CROSSWALKS.
5. DUMMY JOINTS SHALL BE PROVIDED AT TRANSITIONS (GRADE CHANGES) AT TOPS AND BOTTOMS OF RAMPS AND FLARES.
6. VERTICAL DROP-OFF EDGES TO RAMPS WILL NOT BE BUILT UNLESS THE RAMP ABUTS AN AREA WHICH WILL NOT BE USED BY PEDESTRIANS.
7. NO VERTICAL "LIP" OR "CURB REVEAL" WILL BE PROVIDED WHERE THE RAMP ADJOINS THE ROADWAY
8. AT MARKED CROSSWALKS, THE FULL WIDTH OF THE RAMP OR LANDING SHALL BE CONTAINED WITHIN THE PAVEMENT MARKINGS.
9. WHERE POSSIBLE, RAMP FLARES SHOULD BE LOCATED OUTSIDE THE DIRECT LINE OF TRAVEL MOST LIKELY TO BE FOLLOWED BY THE VISUALLY IMPAIRED.
10. SIGNS, POLES, PLANTERS, MAILBOXES, ETC. SHALL NOT BE LOCATED WHERE THEY WILL INTERFERE WITH THE USE OF SIDEWALK RAMPS.
11. WHERE POSSIBLE, SIDEWALK RAMPS SHOULD NOT BE LOCATED WHERE USERS MUST CROSS DROP INLET GRATES, MANHOLE COVERS OR OTHER ACCESS LIDS. IF THIS CANNOT BE AVOIDED THEN GRATE DESIGN AND PLACEMENT SHALL CONFORM TO ADA REQUIREMENTS.
12. CURB DRAINAGE SHOULD BE CONSTRUCTED SO AS TO PRECLUDE THE FLOW OF WATER PAST THE SIDEWALK RAMP.
13. WHEREVER FEASIBLE, TWO SIDEWALK RAMPS ARE RECOMMENDED IN PREFERENCE TO A SINGLE RAMP.
14. JOINTS WILL BE CONSTRUCTED IN ACCORDANCE WITH CURRENT SIDEWALK SPECIFICATIONS. HOWEVER EXPANSION JOINTS WITHIN THE SIDEWALK RAMP AREA WILL BE AVOIDED WHEREVER POSSIBLE.
15. E.O.P. = EDGE OF PAVEMENT
16. THE PUBLIC SIDEWALK CURB RAMP STANDARDS DEPICTED HERE MAY NOT BE APPROPRIATE FOR ALL LOCATIONS. FIELD CONDITIONS AT INDIVIDUAL LOCATIONS MAY REQUIRE SPECIFIC DESIGNS. DESIGNS MUST BE CONSISTENT WITH THE PROVISIONS OF THIS SHEET TO THE MAXIMUM EXTENT FEASIBLE ON ALTERATION PROJECTS AND WHEN STRUCTURALLY PRACTICABLE ON NEW CONSTRUCTION PROJECTS AS REQUIRED BY THE AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES.

SIDEWALK RAMP TYPE 6

NARROW SIDEWALK PARALLEL RAMPS AND LEVEL LANDINGS WITHIN WALKWAY



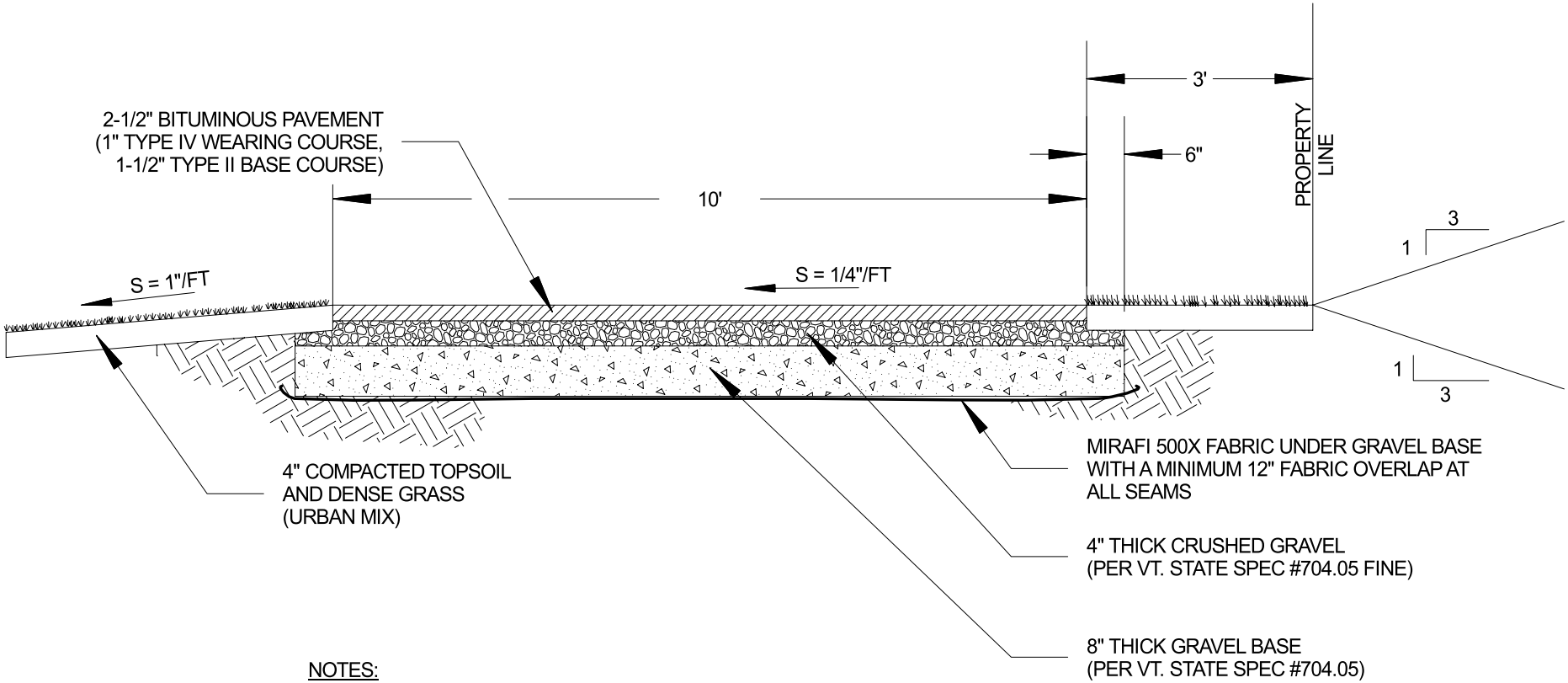
* WHERE A 4' MINIMUM SEPARATION BETWEEN RAMPS CANNOT BE ATTAINED, THE SIDEWALK SHOULD REMAIN AT THE SAME ELEVATION AS ADJOINING LEVEL LANDINGS.

SECTION B-B

SECTION C-C

SIDEWALK RAMPS AND MEDIAN ISLANDS

Figure 3.16



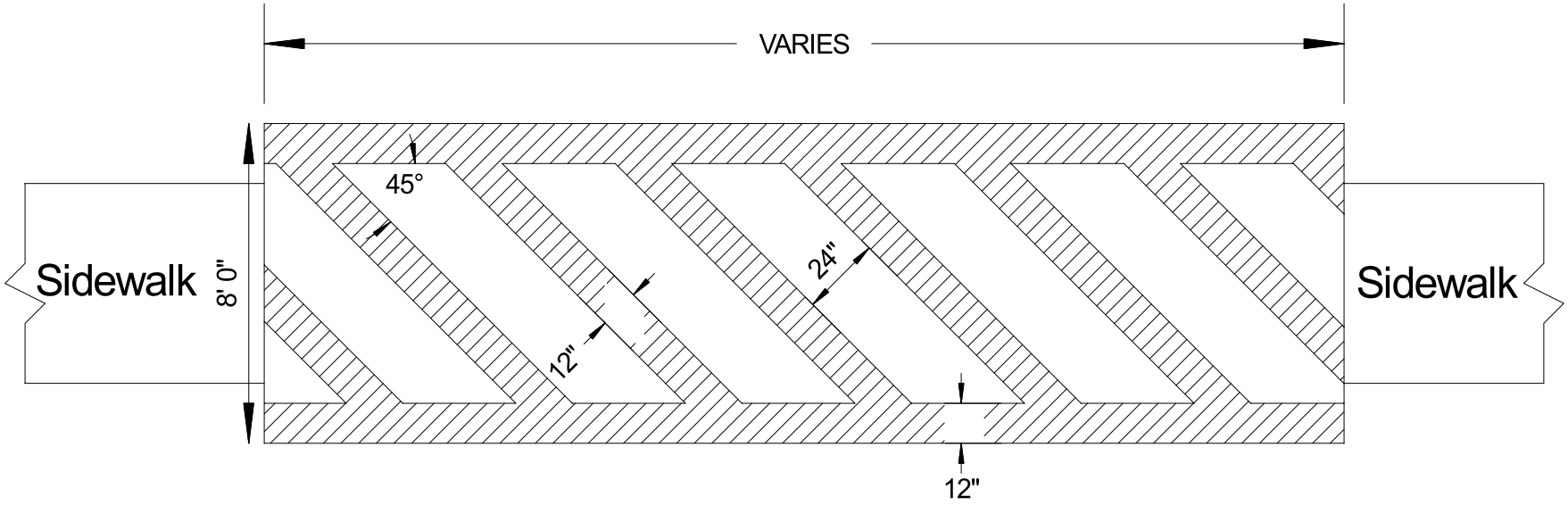
NOTES:

1) VERTICAL CLEARANCE 8' MINIMUM FROM HIGHEST SECTION OF PATH.

2) ANY TREE ROOTS ENCOUNTERED WITHIN THE EXCAVATION LIMITS SHALL BE SAWCUT AND REMOVED.

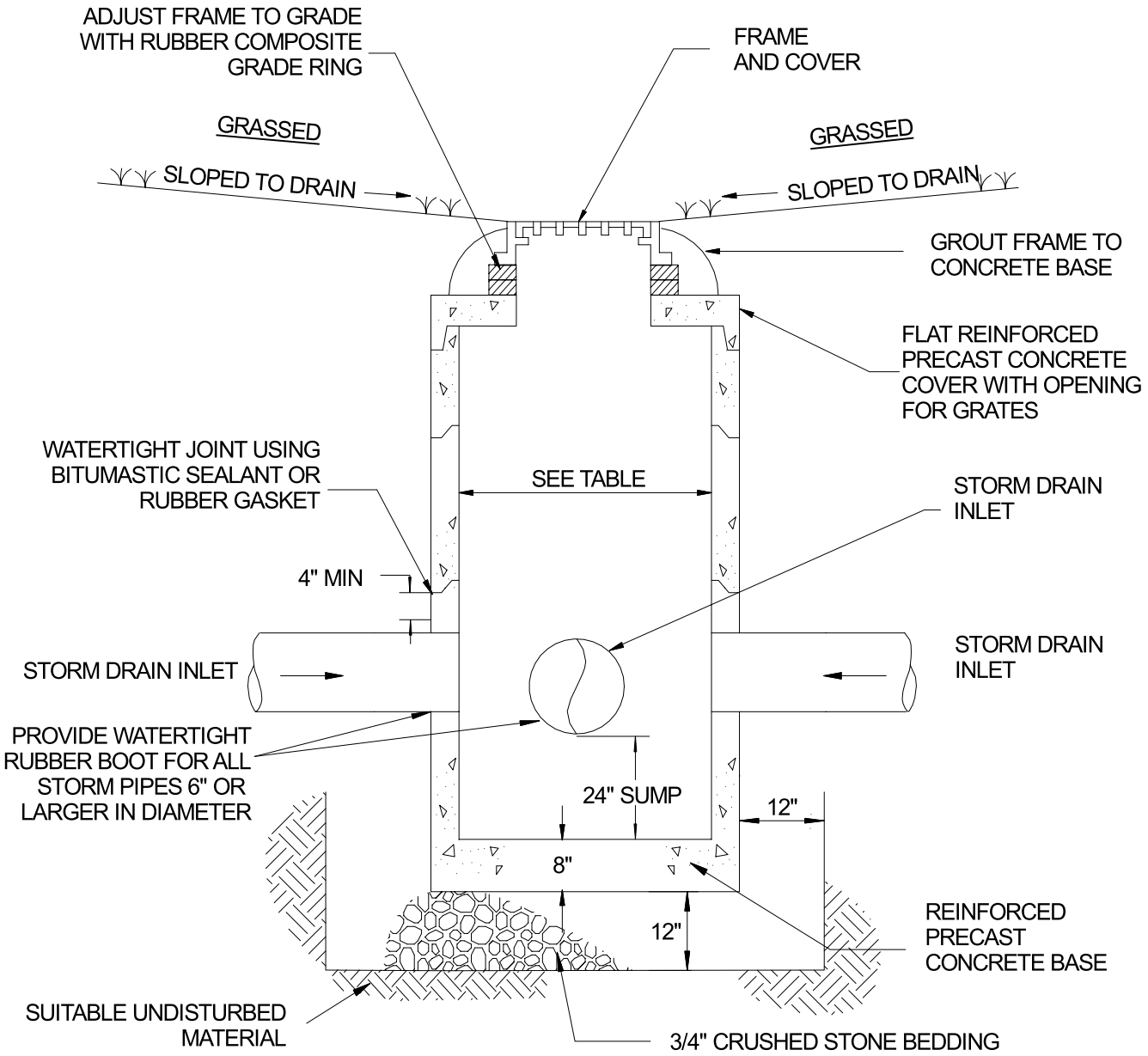
BITUMINOUS CONCRETE MULTI-USE PATH

Figure 3.17



CROSSWALK DETAIL

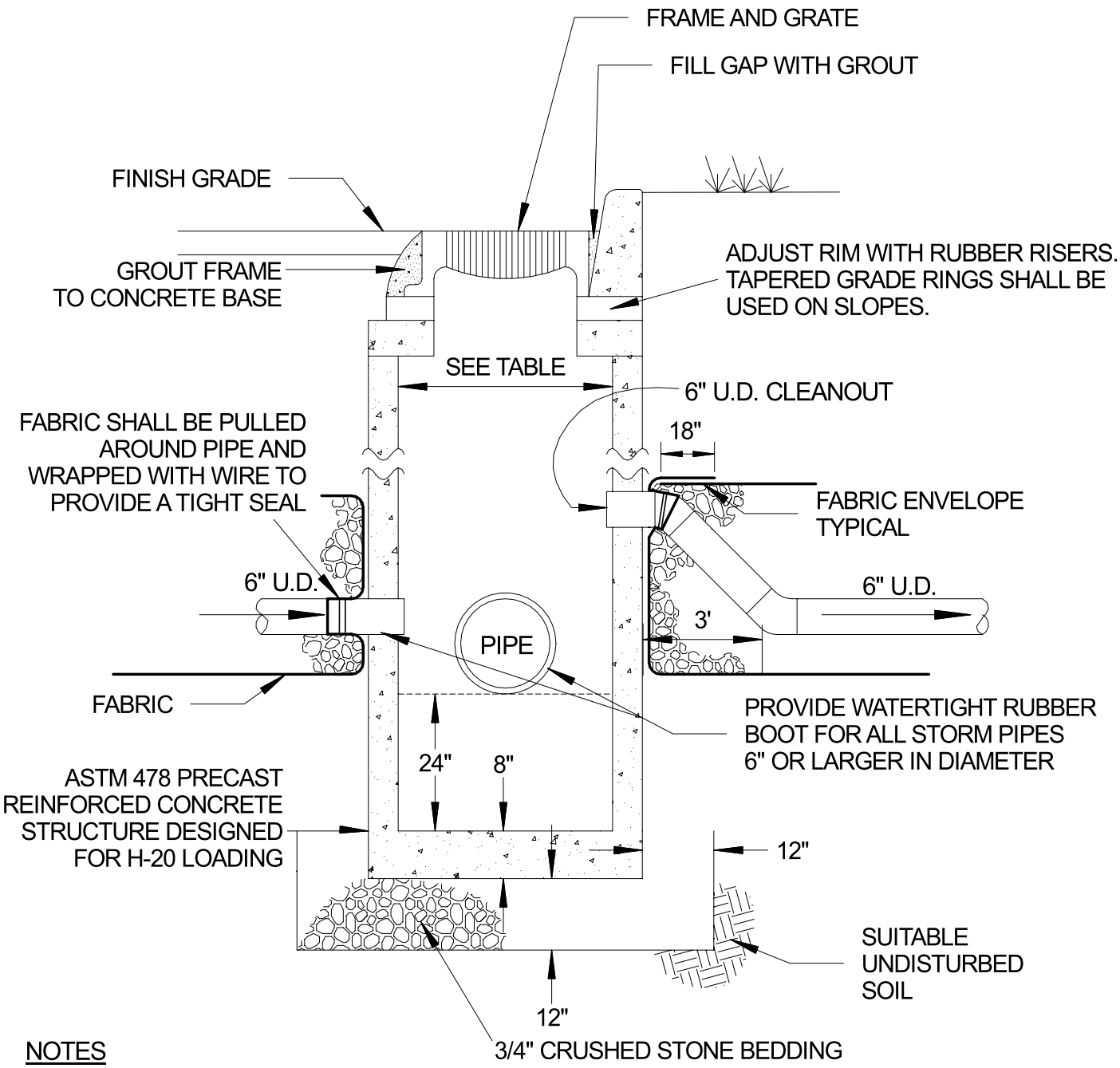
Figure 3.18



TYPE	CATCH BASIN DIAMETER	LARGEST PIPE DIA. ALLOWED	SIDEWALL THICKNESS	CONCRETE COVER THICKNESS
I	36"	18"	4"	6"
II	48"	30"	5"	10"
III	60"	36"	6"	12"
IV	72"	48"	7"	18"

PRECAST CATCH BASIN FOR SHALLOW SWALE OPEN DRAINAGE

Figure 4.1



NOTES

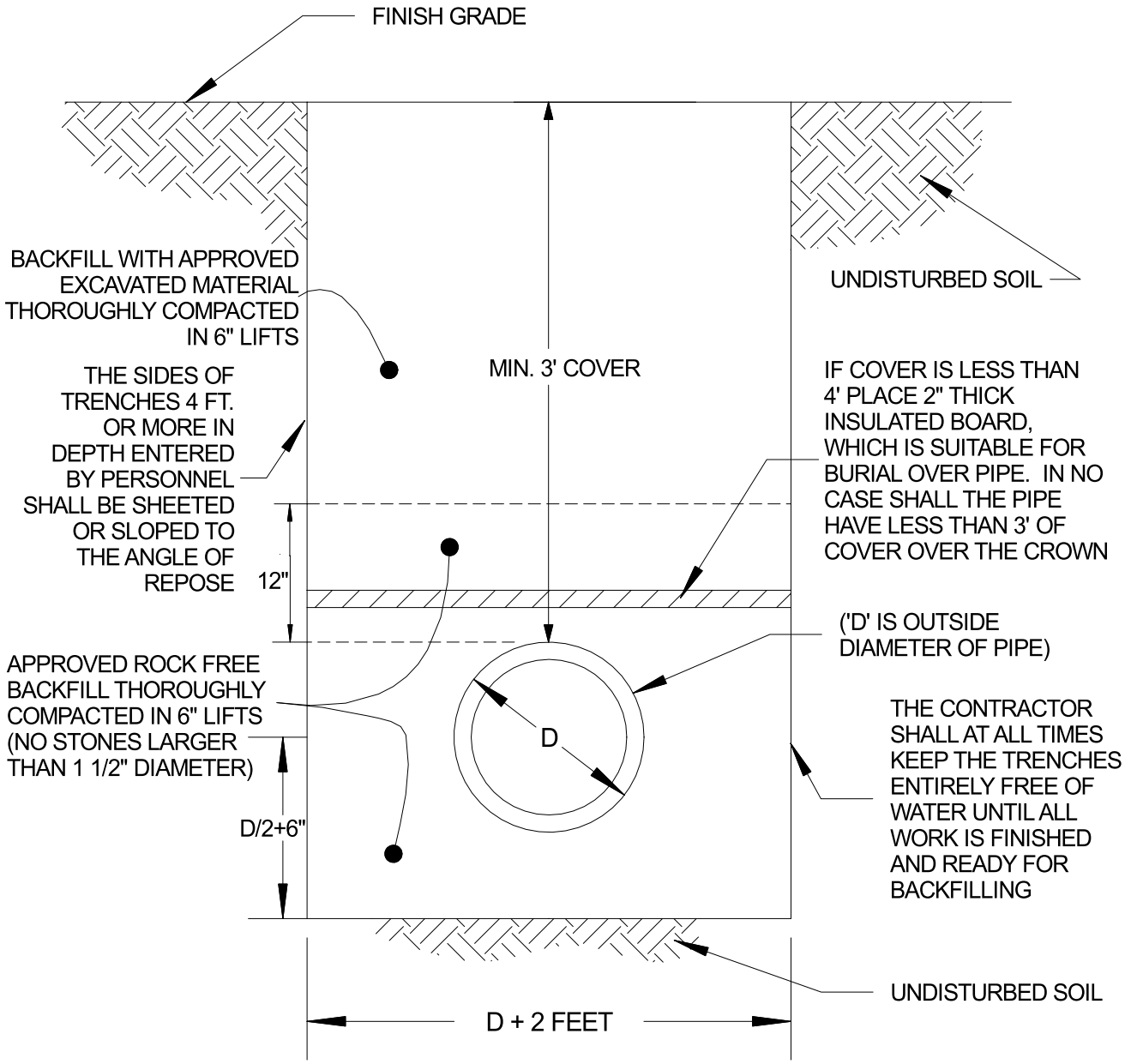
1. THE MIRAFI 140N FABRIC SHALL COMPLETELY ENVELOPE THE STONE UNDERDRAIN TRENCH ON THE SIDES, BOTTOM, TOP AND ENDS.

2. THE 6" UNDERDRAIN PIPES ARE TO BE INSTALLED PARALLEL TO THE CURB OR EDGE OF ROADWAY.

TYPE	CATCH BASIN DIAMETER	LARGEST PIPE DIA. ALLOWED	SIDEWALL THICKNESS	CONCRETE COVER THICKNESS
I	36"	18"	4"	6"
II	48"	30"	5"	10"
III	60"	36"	6"	12"
IV	72"	48"	7"	18"

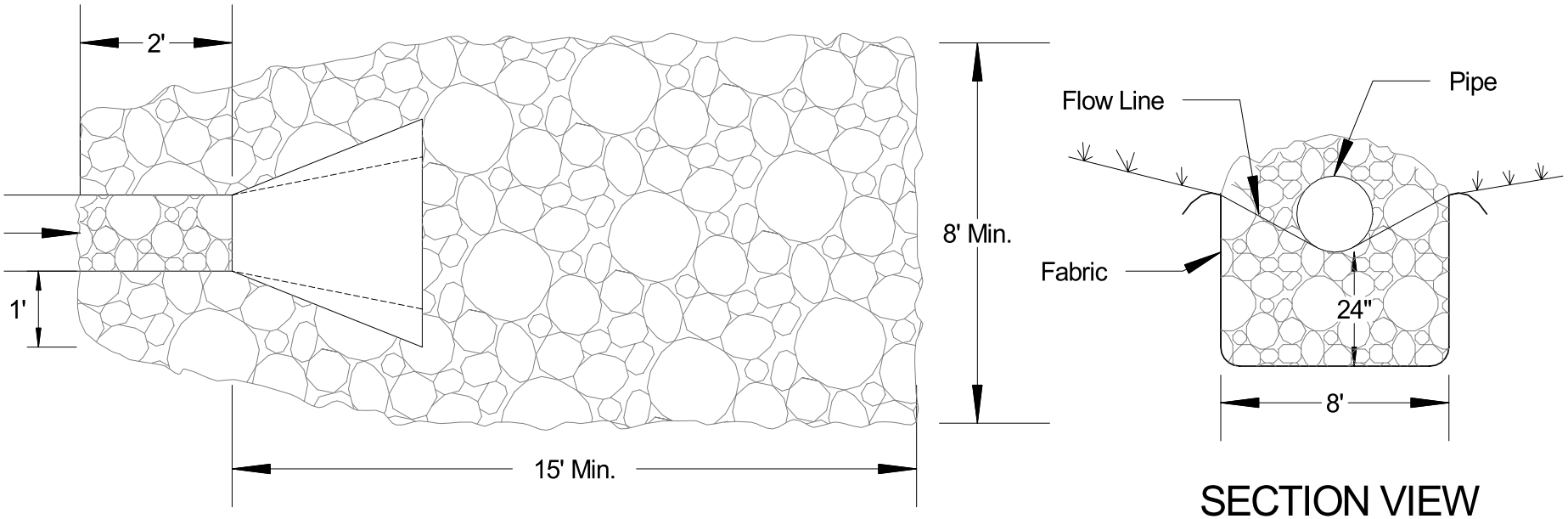
PRECAST CATCH BASIN w/ UNDERDRAIN and/or CURB

Figure 4.2



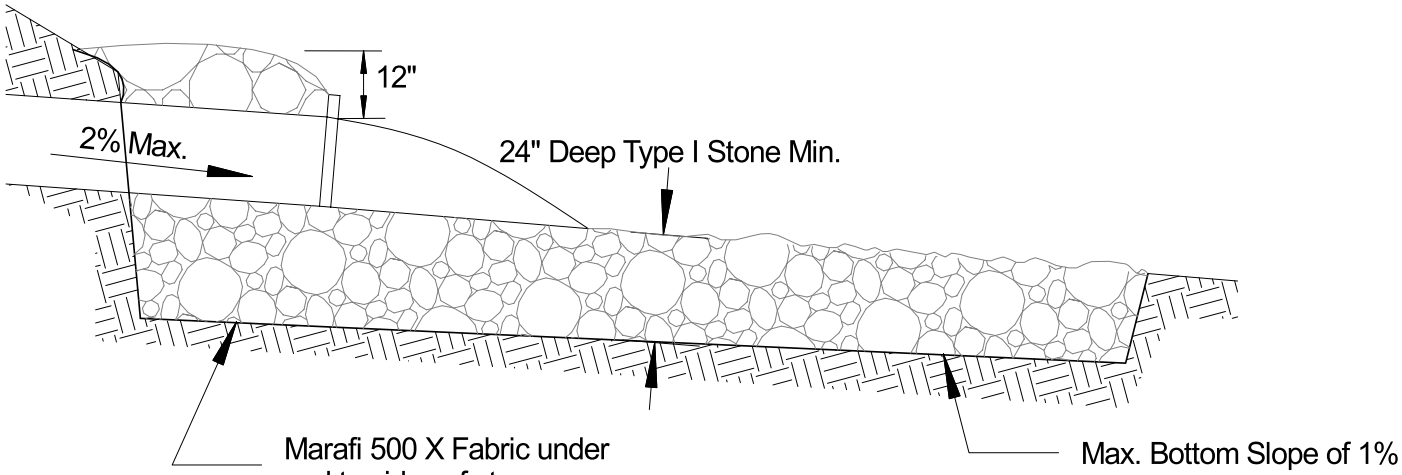
TYPICAL STORM SEWER TRENCH

Figure 4.3



PLAN VIEW

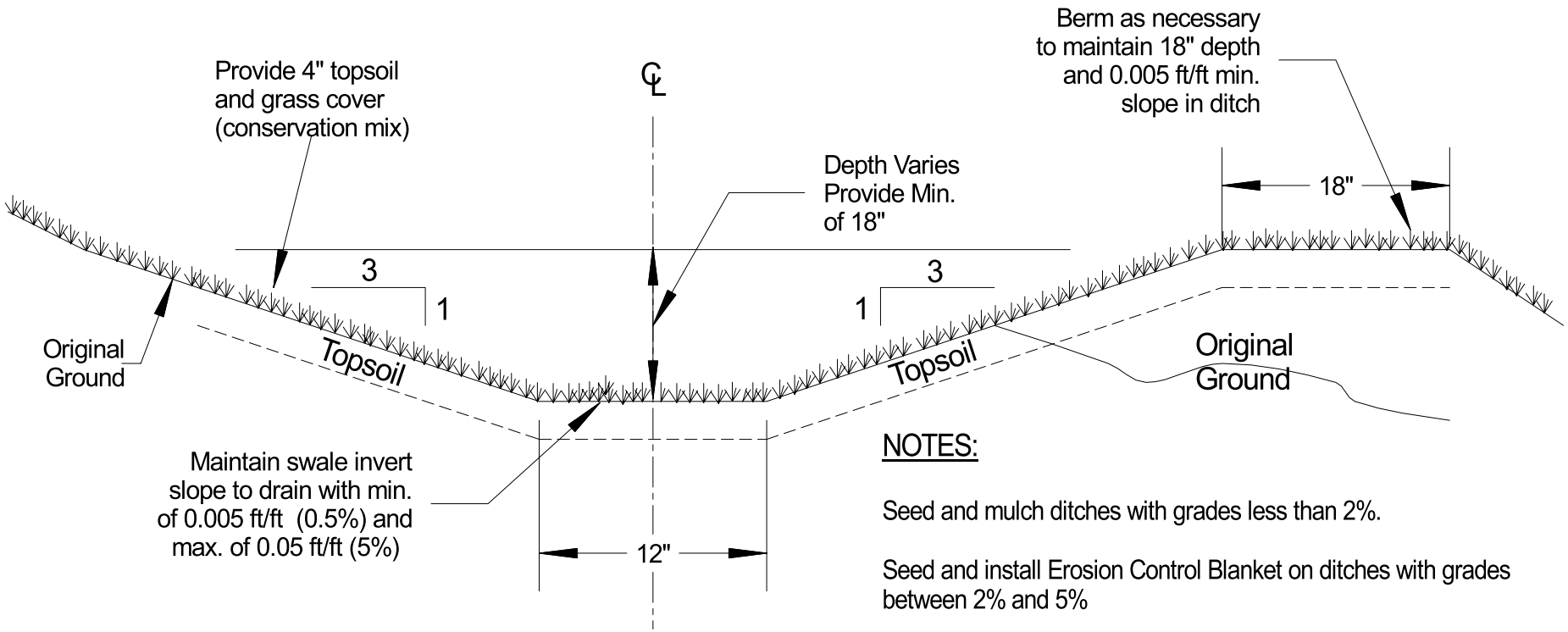
SECTION VIEW



CROSS-SECTION

STORM OUTFALL

Figure 4.4



NOTES:

Seed and mulch ditches with grades less than 2%.

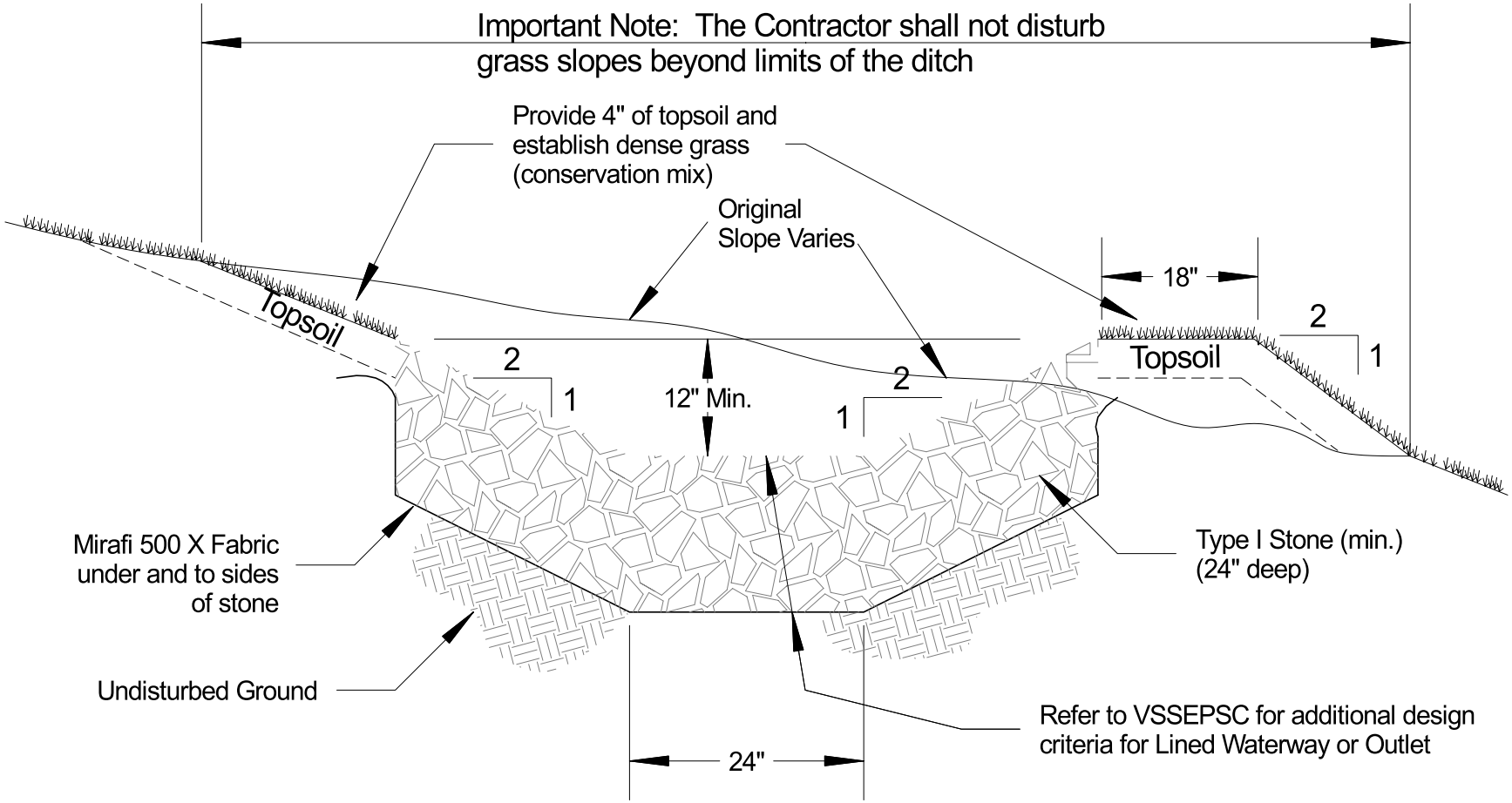
Seed and install Erosion Control Blanket on ditches with grades between 2% and 5%

Use Stone Lined Ditch for grades in excess of 5% (see Fig. 4.6)

Ditches shall be turned out to avoid direct outlet into surface waters. There must be adequate outlet protection at the end of the turnout, either a structural (rock) or vegitative filtering area.

TYPICAL DRAINAGE SWALE

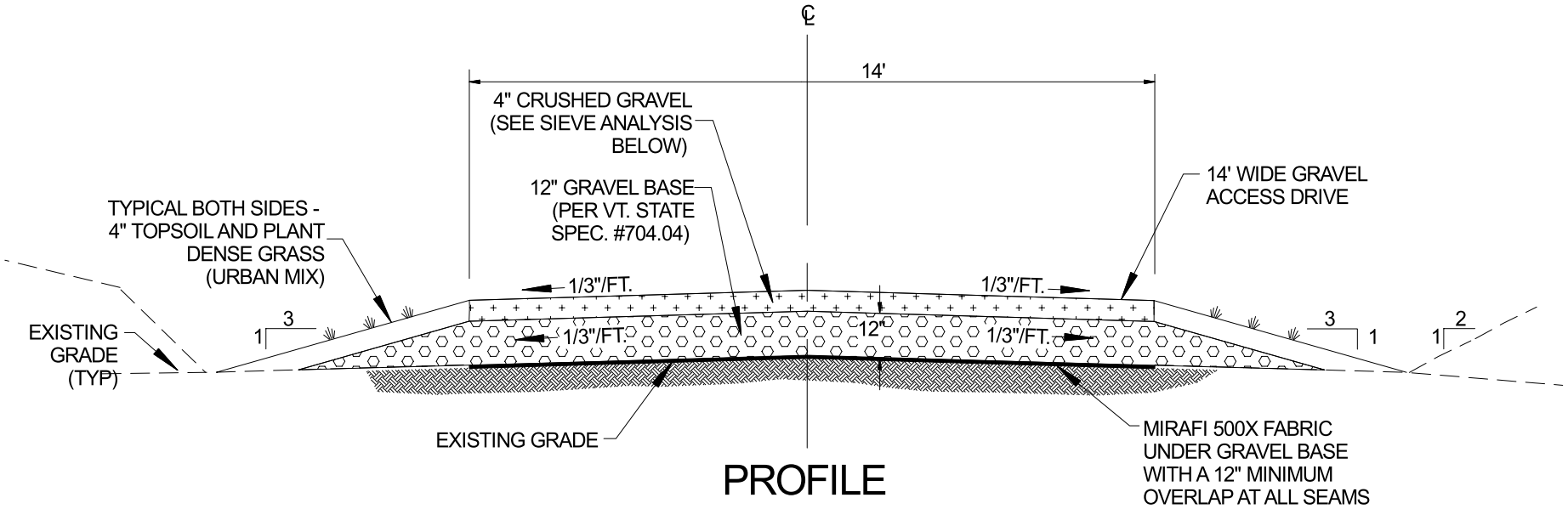
Figure 4.5



Ditches shall be turned out to avoid direct outlet into surface waters. There must be adequate outlet protection at the end of the turnout, either a structural (rock) or vegitative filtering area.

TYPICAL STONE LINED DITCH

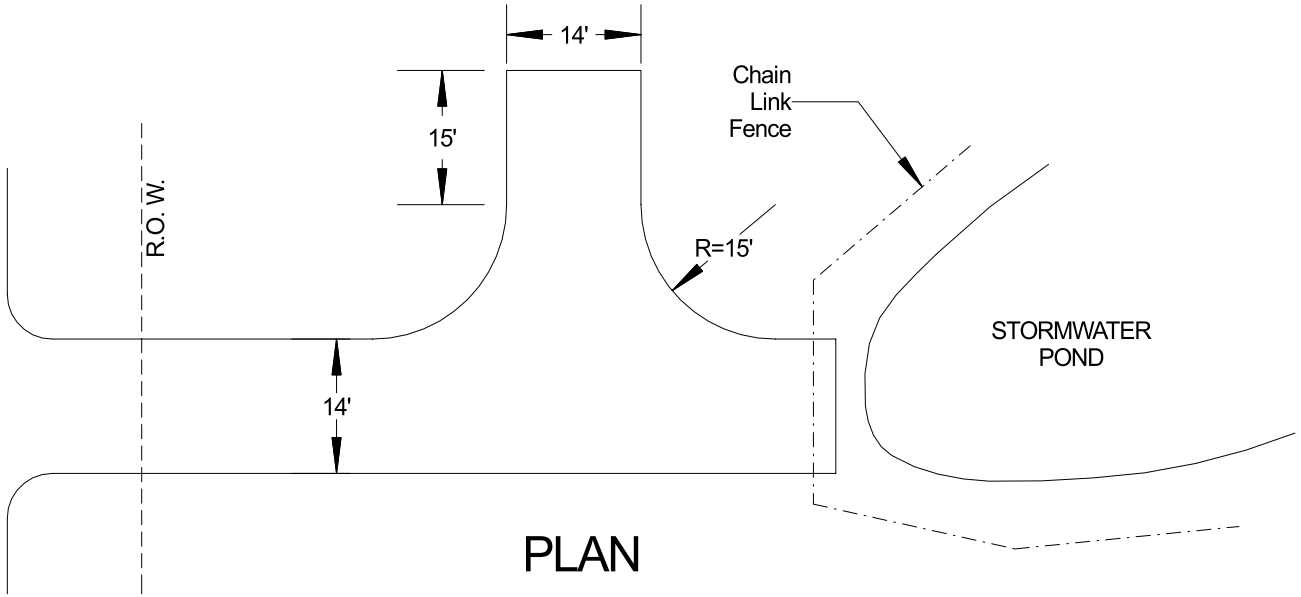
Figure 4.6



PROFILE

Crushed Gravel Top Coat

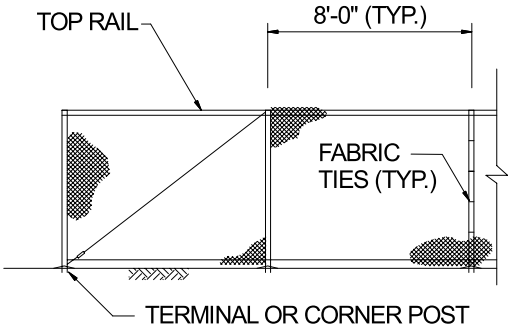
Sieve Size	Percent Finer
1"	100
#40	40 - 60
#16	20 - 30
#30	10 - 20
#50	5 - 15
#100	5 - 15
#200	4 - 6



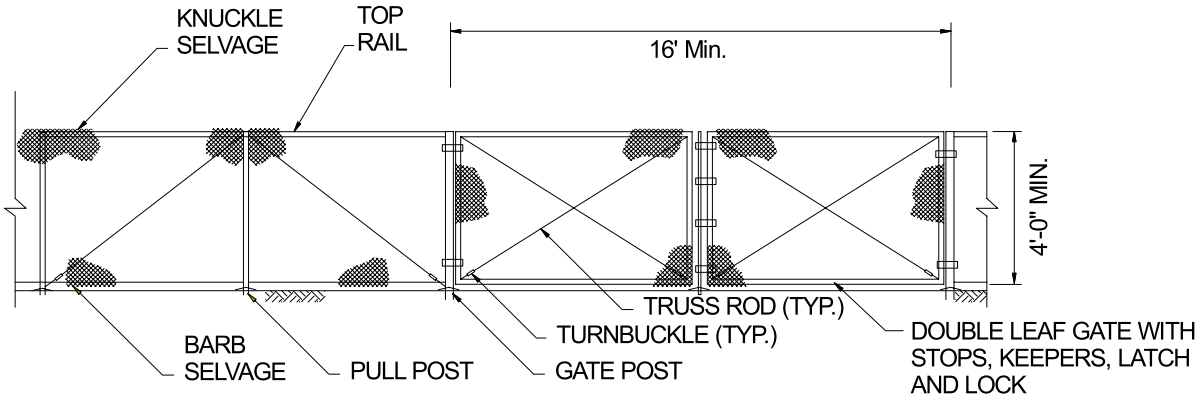
PLAN

STORMWATER POND ACCESS ROAD

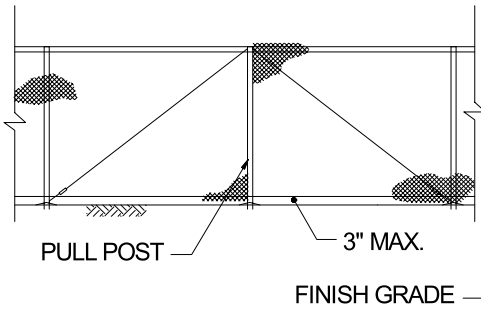
Figure 4.7



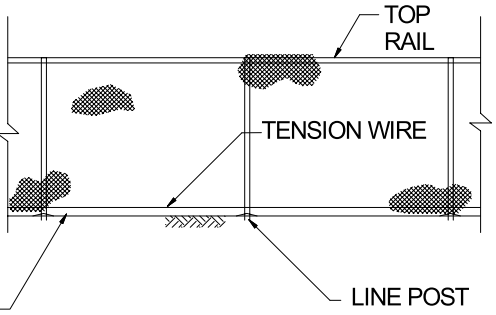
TERMINAL OR CORNER FENCE ELEVATION



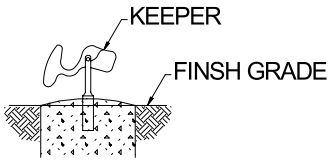
GATE AND ADJACENT FENCE ELEVATION



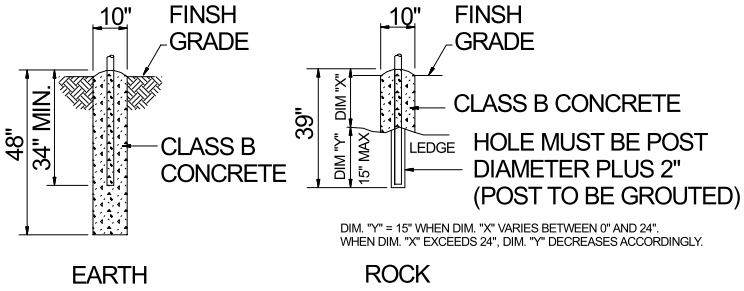
PULL POST FENCE ELEVATION



LINE FENCE ELEVATION



KEEPER DETAIL



POST ANCHOR DETAIL

CHAIN LINK FENCE AND DOUBLE GATE DETAIL

Figure 4.8

MINIMUM AREA IN SQUARE FEET OF BEARING SURFACE REQUIRED FOR CONCRETE THRUST BLOCKS

3"				4"				6"				8"				12"				16"				SOIL CONDITIONS	SAFE BEARING LOAD (PSF)
ENDS &TEES	90° ELB	45° ELB	22.5° ELB	ENDS &TEES	90° ELB	45° ELB	22.5° ELB	ENDS &TEES	90° ELB	45° ELB	22.5° ELB	ENDS &TEES	90° ELB	45° ELB	22.5° ELB	ENDS &TEES	90° ELB	45° ELB	22.5° ELB	ENDS &TEES	90° ELB	45° ELB	22.5° ELB		
0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	1.5	1.0	0.5	2.0	2.5	1.5	1.0	4.0	5.5	3.0	1.5	8.0	10.0	5.0	4.0	SOUND SHALE	10,000
1.0	1.0	1.0	0.5	1.5	2.0	1.0	0.5	3.0	4.0	2.0	1.0	4.5	6.5	3.5	2.0	10.0	14.0	7.5	4.0	25.0	30.0	15.0	12.0	CEMENTED GRAVEL & SAND	4,000
1.0	1.5	1.0	1.5	2.0	2.5	1.5	1.0	3.5	5.0	3.0	1.5	6.0	8.5	5.0	2.5	13.0	18.5	10.0	5.0	30.0	35.0	20.0	15.0	COURSE & FINE COMPACT SAND	3,000
1.5	2.5	1.5	1.0	2.5	3.5	2.0	1.0	5.5	7.5	4.0	2.0	9.0	13.0	7.0	3.5	20.0	27.5	15.0	8.0	40.0	45.0	25.0	20.0	MEDIUM CLAY (CAN BE SPADED)	2,000
3.0	4.5	2.5	1.5	5.0	7.0	4.0	2.0	10.5	15.0	8.0	4.0	18.0	25.0	14.0	7.0	39.0	55.0	30.0	15.0	80.0	90.0	50.0	40.0	SOFT CLAY	1,000

MAXIMUM WATER PRESSURE = 300 PSI

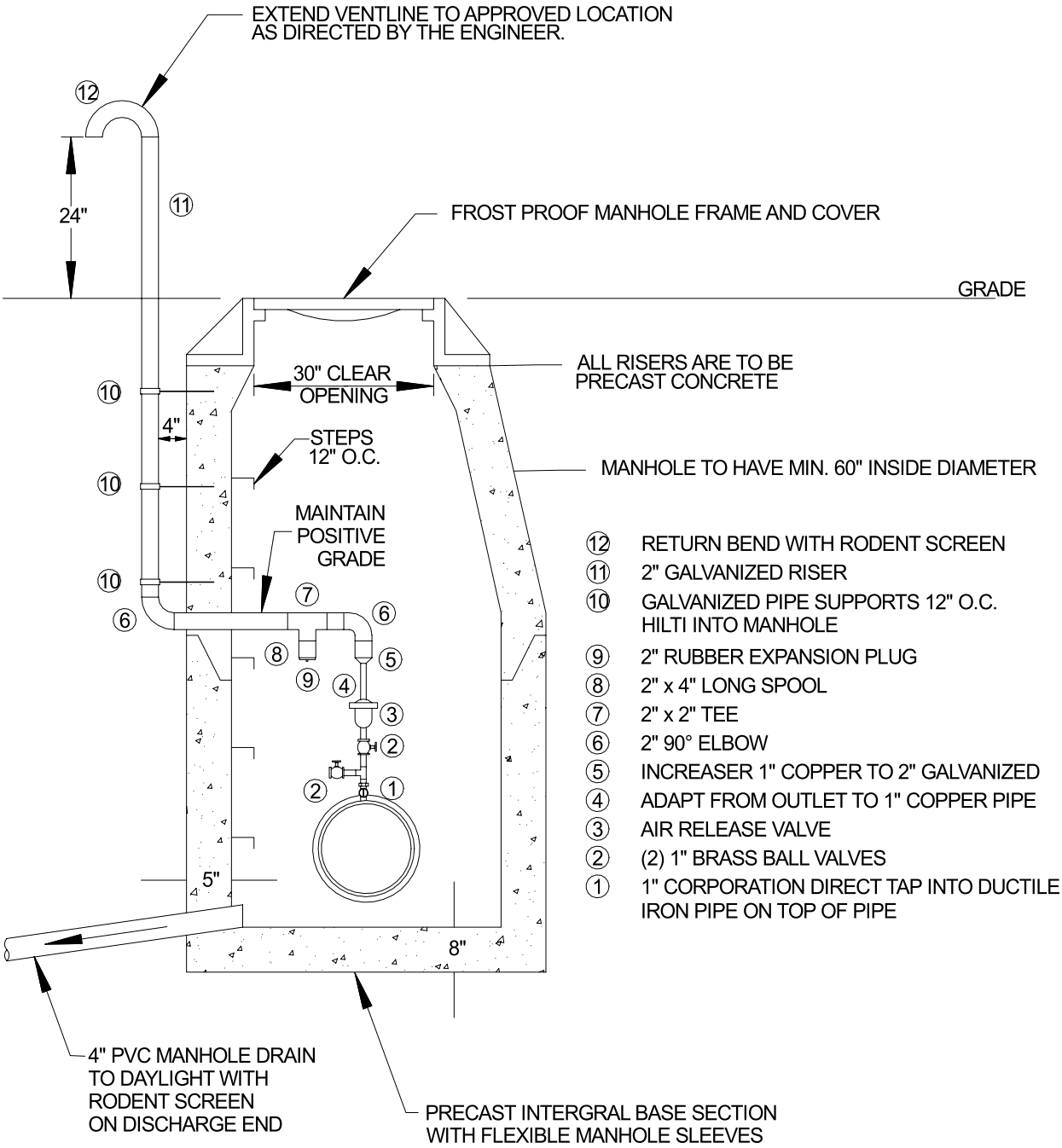
NOTE: REDUCER BEARING AREA = 45° BEND, LARGER PIPE

NOTE:

THRUST BLOCKS ON PIPE LARGER THAN 16" DIA.
ARE TO BE DESIGNED BY A PROFESSIONAL ENGINEER.

CONCRETE THRUST BLOCK DATA

Figure 5.1

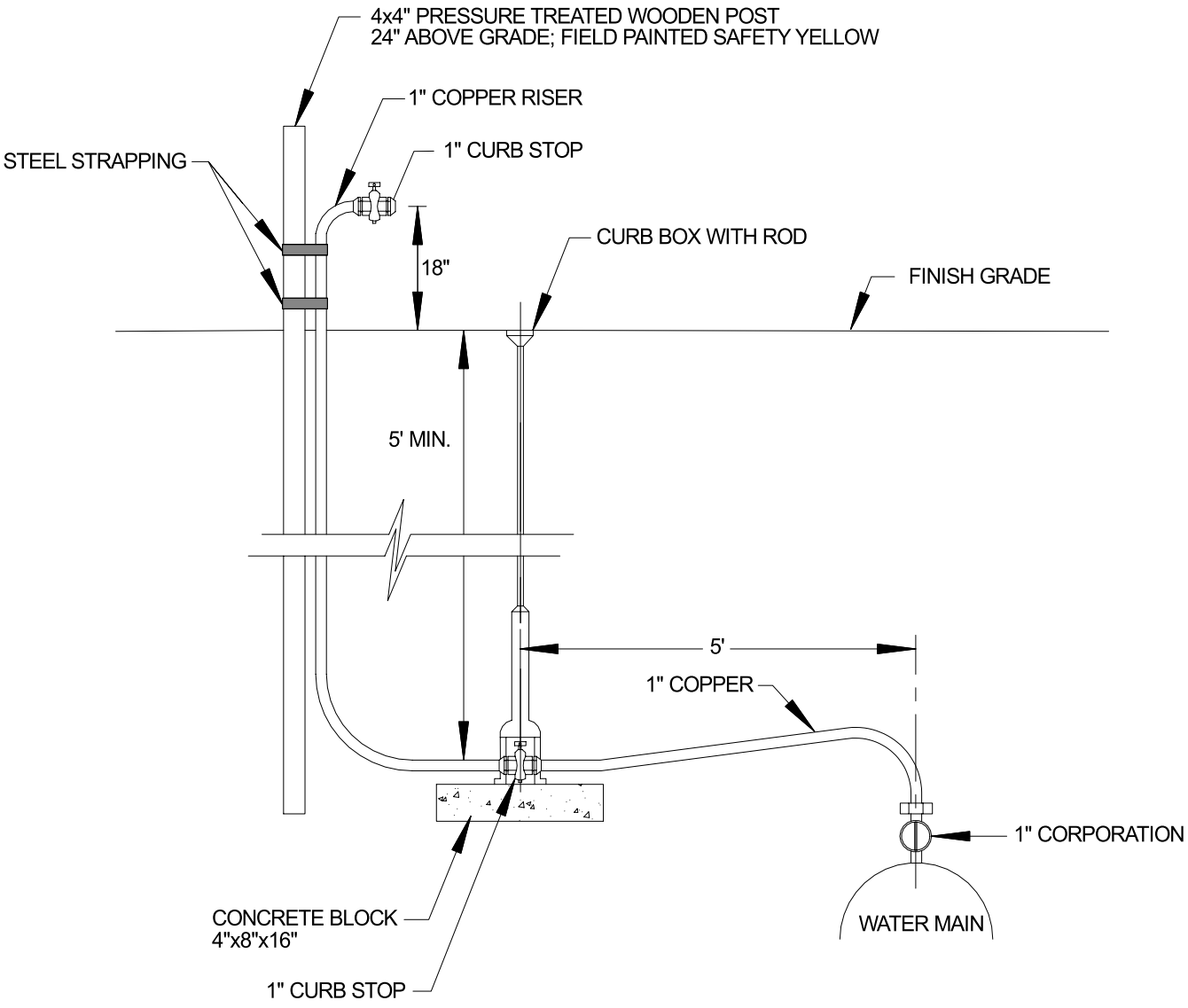


⑫ RETURN BEND WITH RODENT SCREEN
⑪ 2" GALVANIZED RISER
⑩ GALVANIZED PIPE SUPPORTS 12" O.C. HILTI INTO MANHOLE
⑨ 2" RUBBER EXPANSION PLUG
⑧ 2" x 4" LONG SPOOL
⑦ 2" x 2" TEE
⑥ 2" 90° ELBOW
⑤ INCREASER 1" COPPER TO 2" GALVANIZED
④ ADAPT FROM OUTLET TO 1" COPPER PIPE
③ AIR RELEASE VALVE
② (2) 1" BRASS BALL VALVES
① 1" CORPORATION DIRECT TAP INTO DUCTILE IRON PIPE ON TOP OF PIPE

NOTE
1) ALL 1" PIPE & FITTINGS TO BE BRASS AND COPPER
2) ALL 2" PIPE & FITTINGS TO BE GALVANIZED UNLESS OTHERWISE NOTED.
3) MAXIMUM MH COVER RISER COURSE HEIGHT 12"
4) ALL MH PENETRATIONS TO BE PRECAST WITH RUBBER PIPE BOOTS.

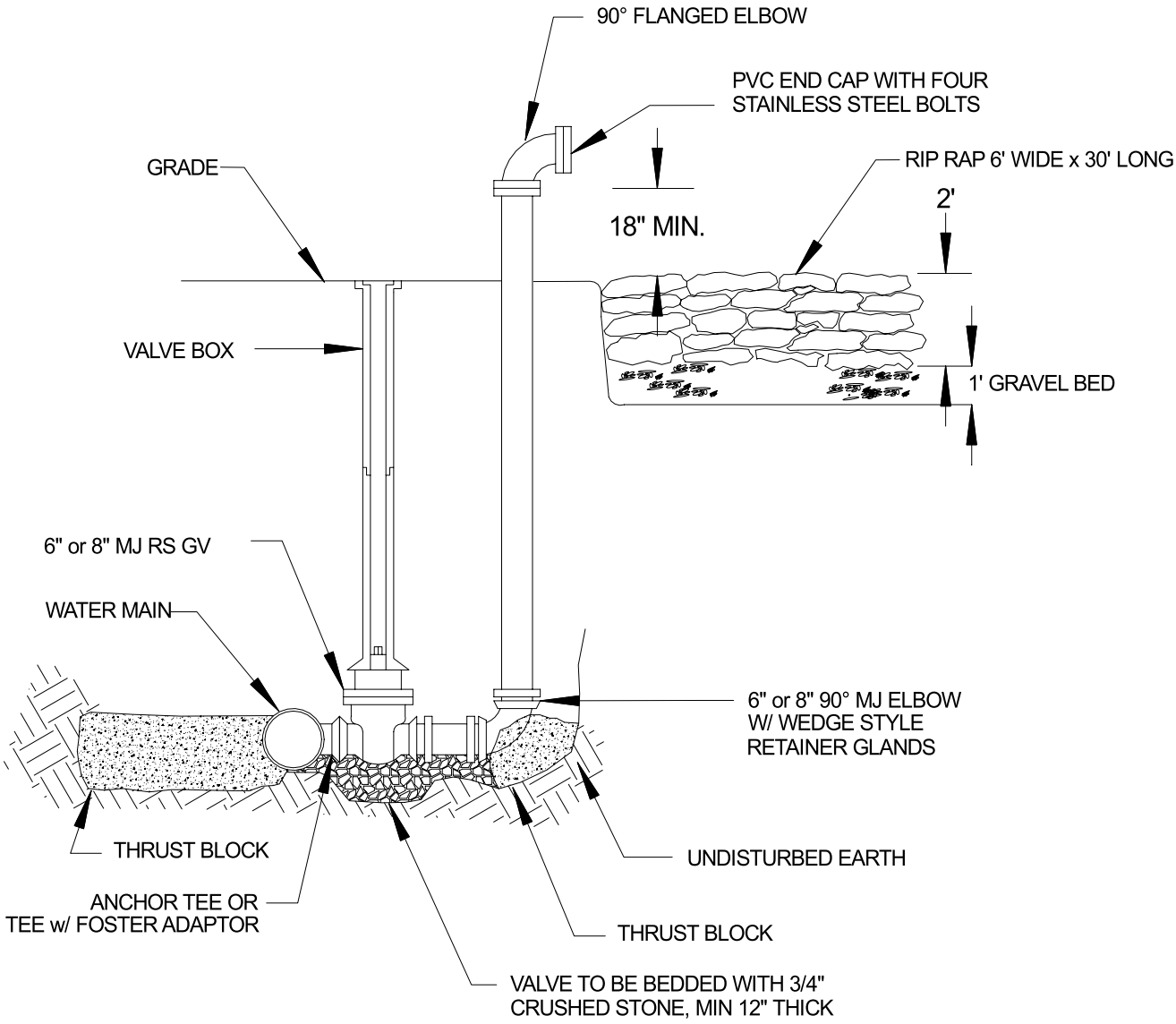
AIR RELEASE MANHOLE

Figure 5.2



MANUAL AIR RELEASE and / or PERMANENT CHLORINATION INJECTION INSTALLATION

Figure 5.3



NOTES

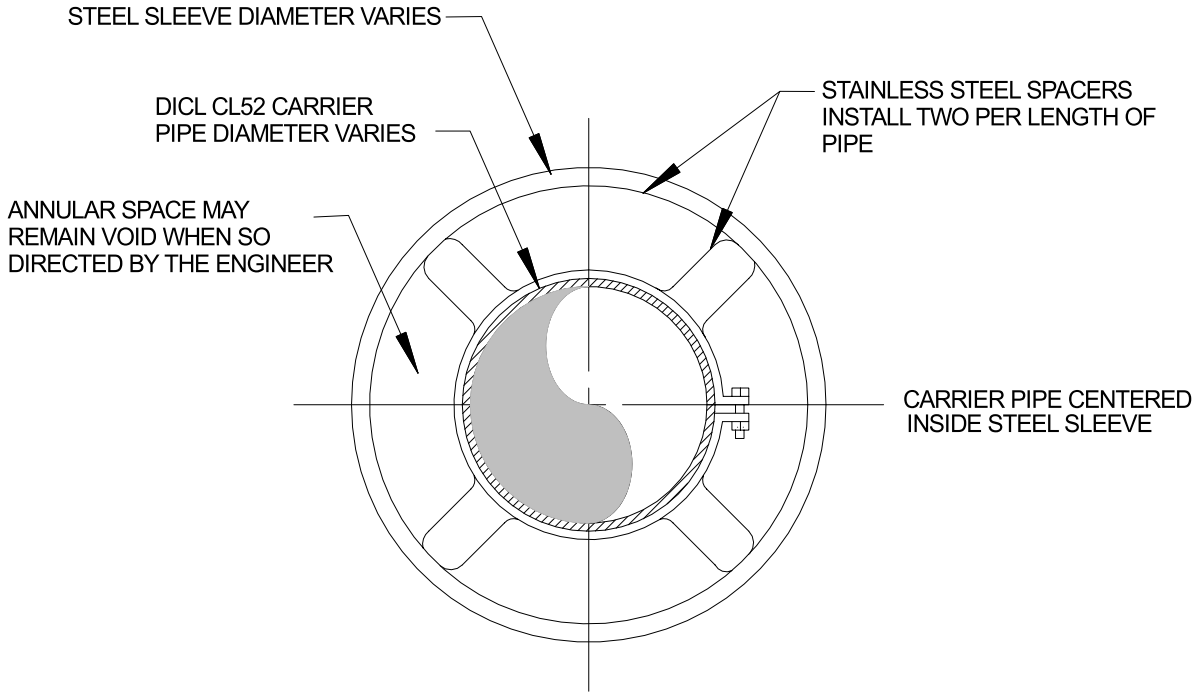
1) PRIOR TO POURING THRUST BLOCKS, ALL FITTING ARE TO BE WRAPPED IN 4 mil. POLYETHYLENE.

2) MEGA-LUG RETAINER GLANDS ARE TO BE USED ON ALL MJ FITTINGS.

3) THIS ASSEMBLY IS TYPICAL OF TRANSMISSION SYSTEM.

6" or 8" BLOWOFF ASSEMBLY

Figure 5.4



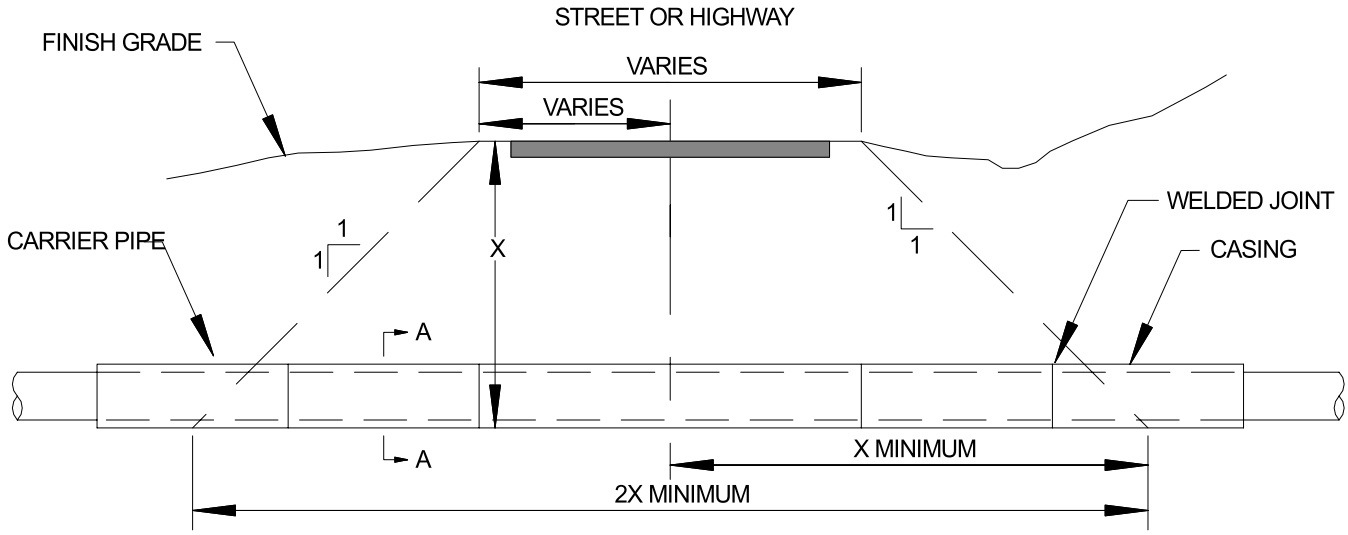
SECTION A - A

NOTE

1) SEAL BOTH ENDS OF THE SLEEVE TO PREVENT INFILTRATION

STEEL SLEEVE CASING SPACER DETAIL

Figure 5.5



NOTES

1) SEE FIGURE 5.7 FOR JOINT WELD DETAIL.

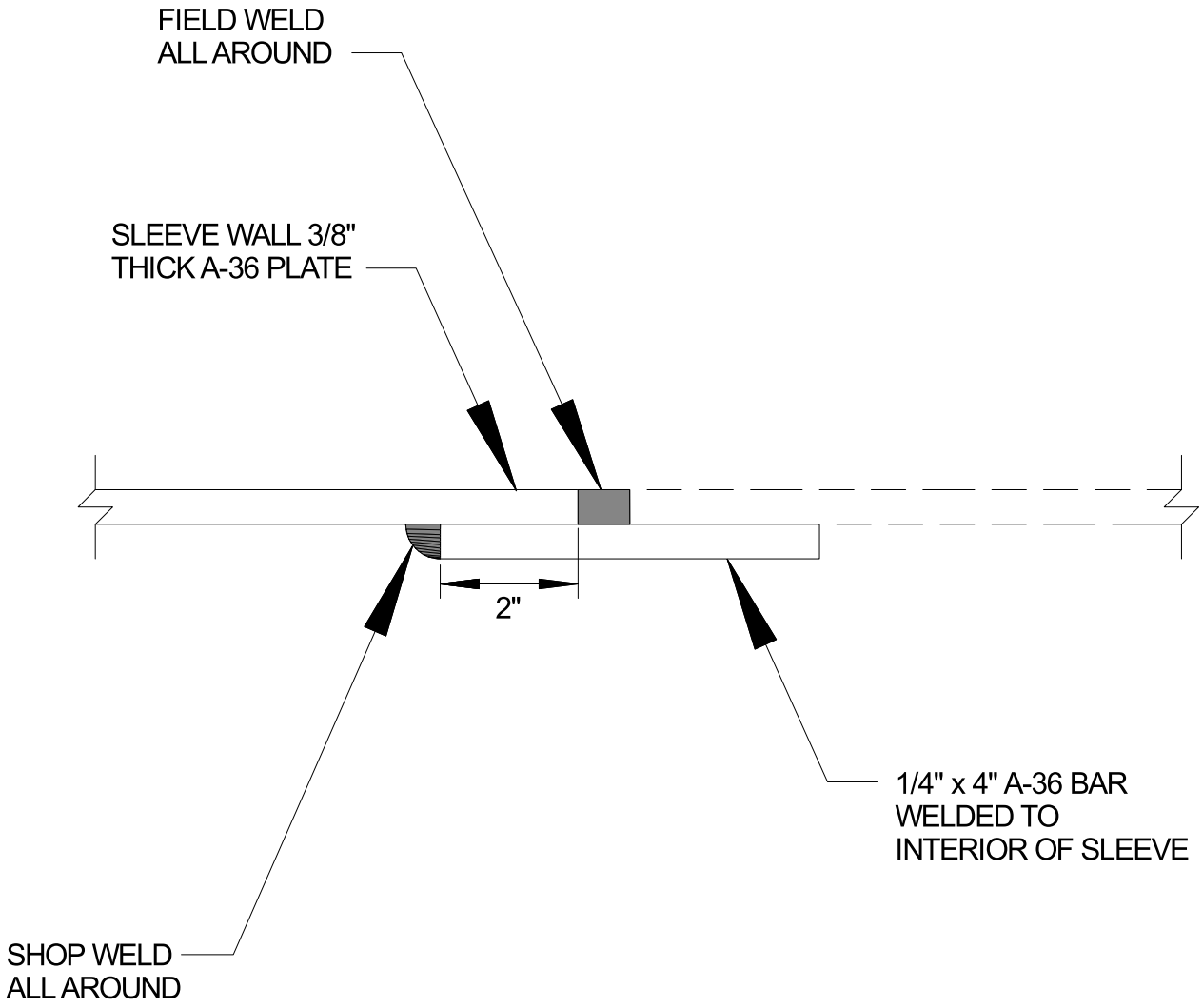
2) MINIMUM LENGTH OF CASING ON ROADWAY BORES IS DETERMINED FROM SHOULDER POINT OF ROAD AT A ONE ON ONE SLOPE.

3) SEAL BOTH ENDS OF SLEEVE TO PREVENT INFILTRATION.

4) A WEEP HOLE SHALL BE INSTALLED IN THE LOWER END OF THE SLEEVE FOR DRAINAGE.

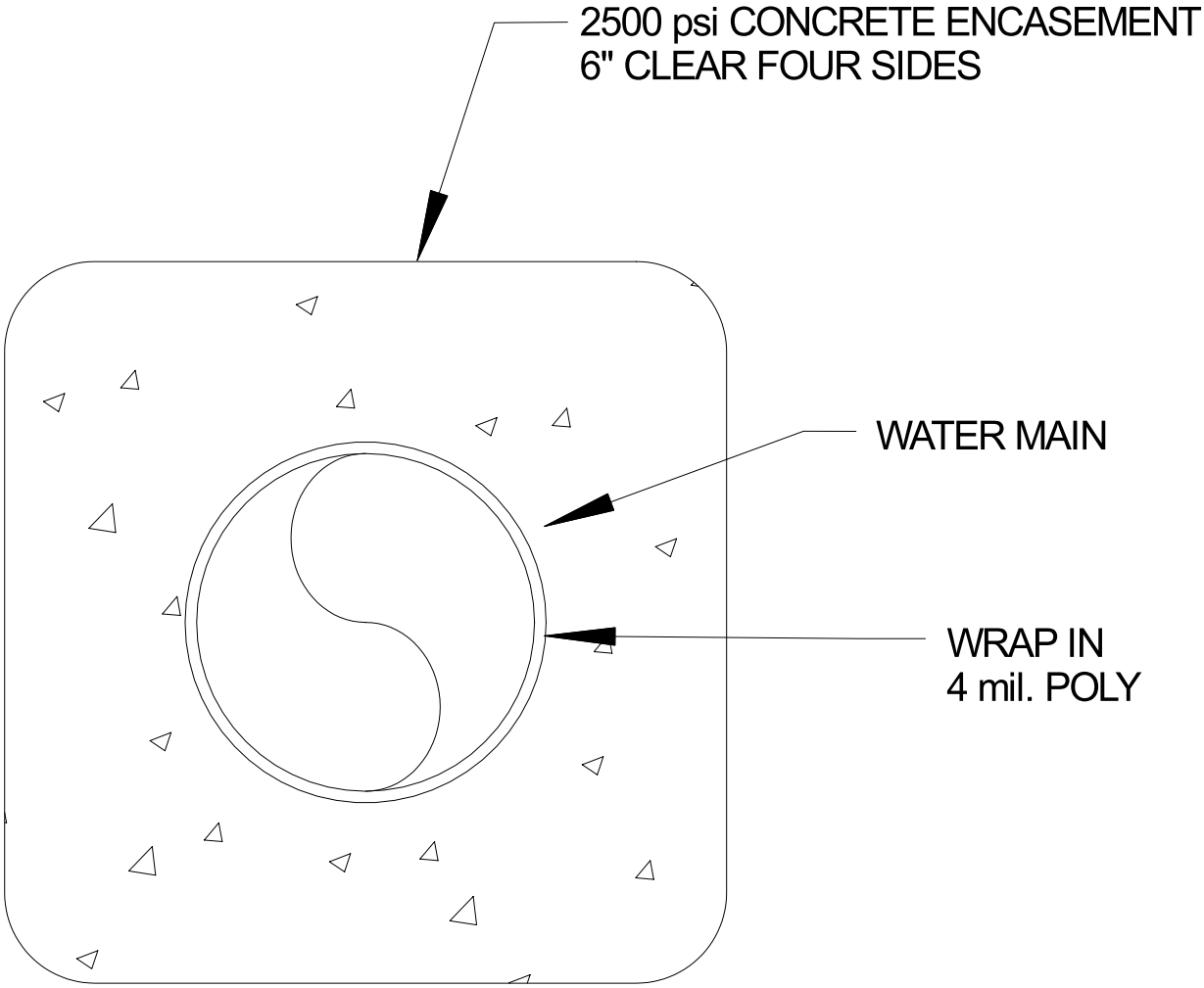
STEEL SLEEVE ENCASEMENT

Figure 5.6



STEEL SLEEVE ENCASEMENT
JOINT WELD DETAIL

Figure 5.7

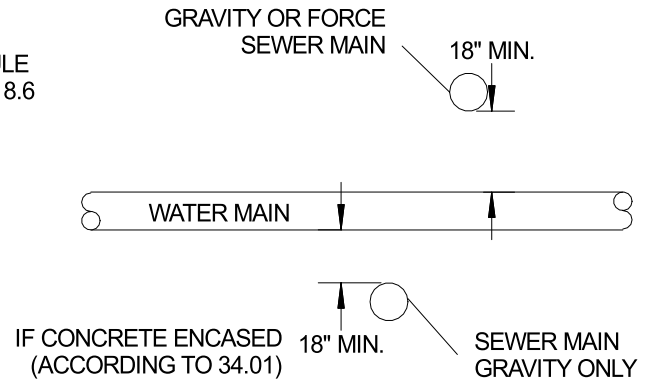


CONCRETE ENCASEMENT

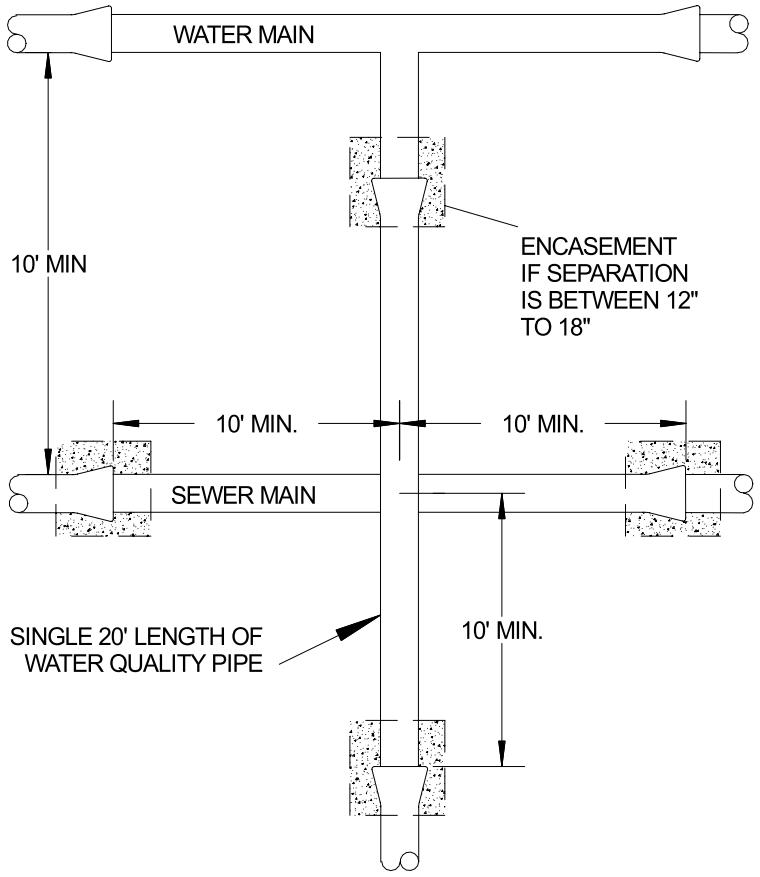
Figure 5.8

PROFILE VIEW

REFERENCE:
VT. WATER SUPPLY RULE
CHAPTER 21 SECTION 8.6

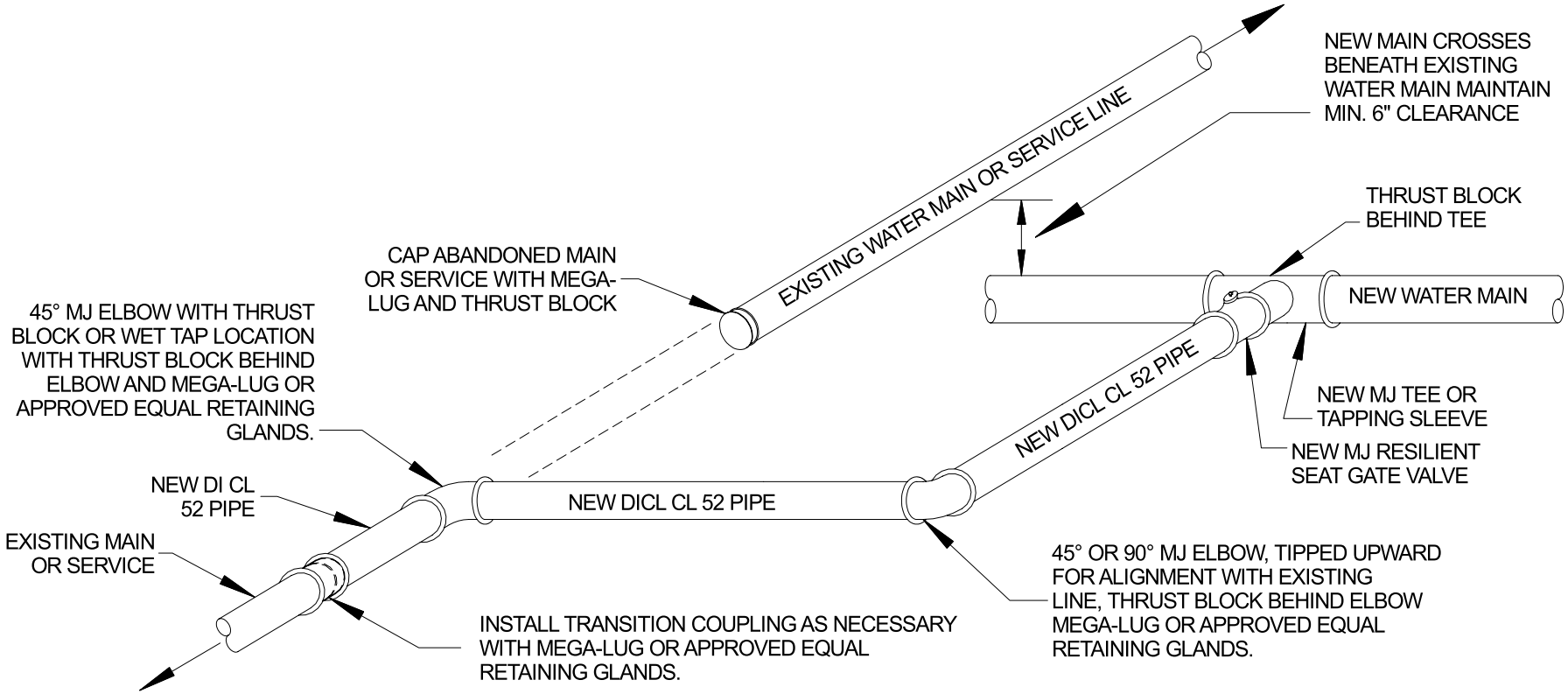


PLAN VIEW



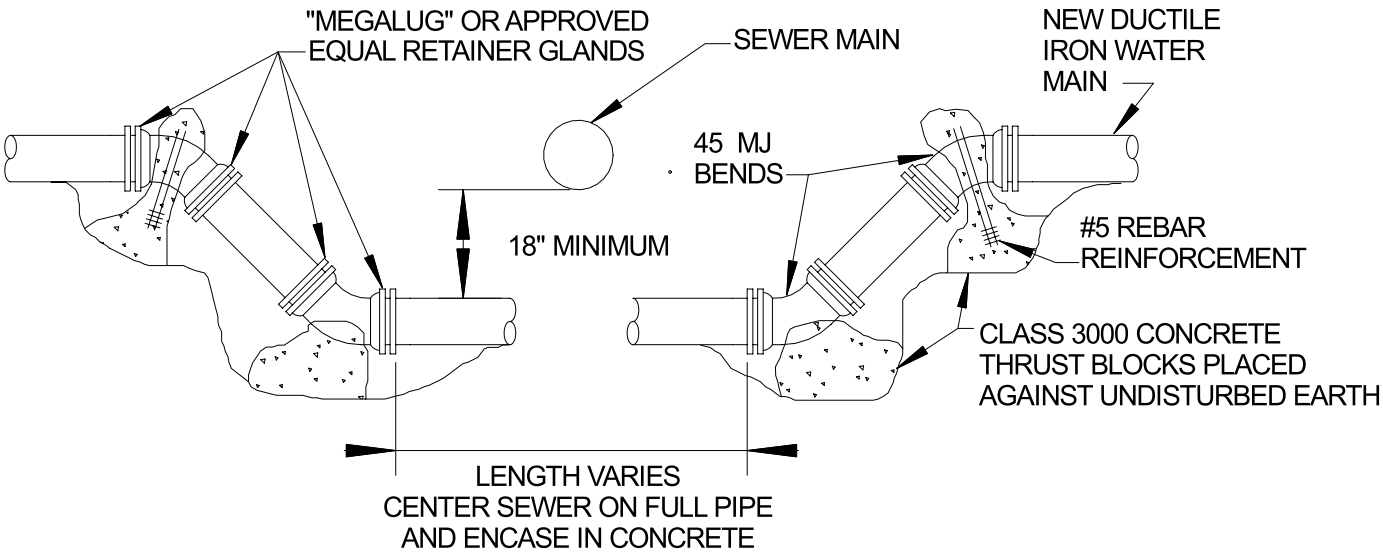
WATER / SEWER LINE CROSSING

Figure 5.9



TYPICAL TIE-IN TO EXISTING WATER MAIN OR LARGE DIAMETER SERVICE

Figure 5.10



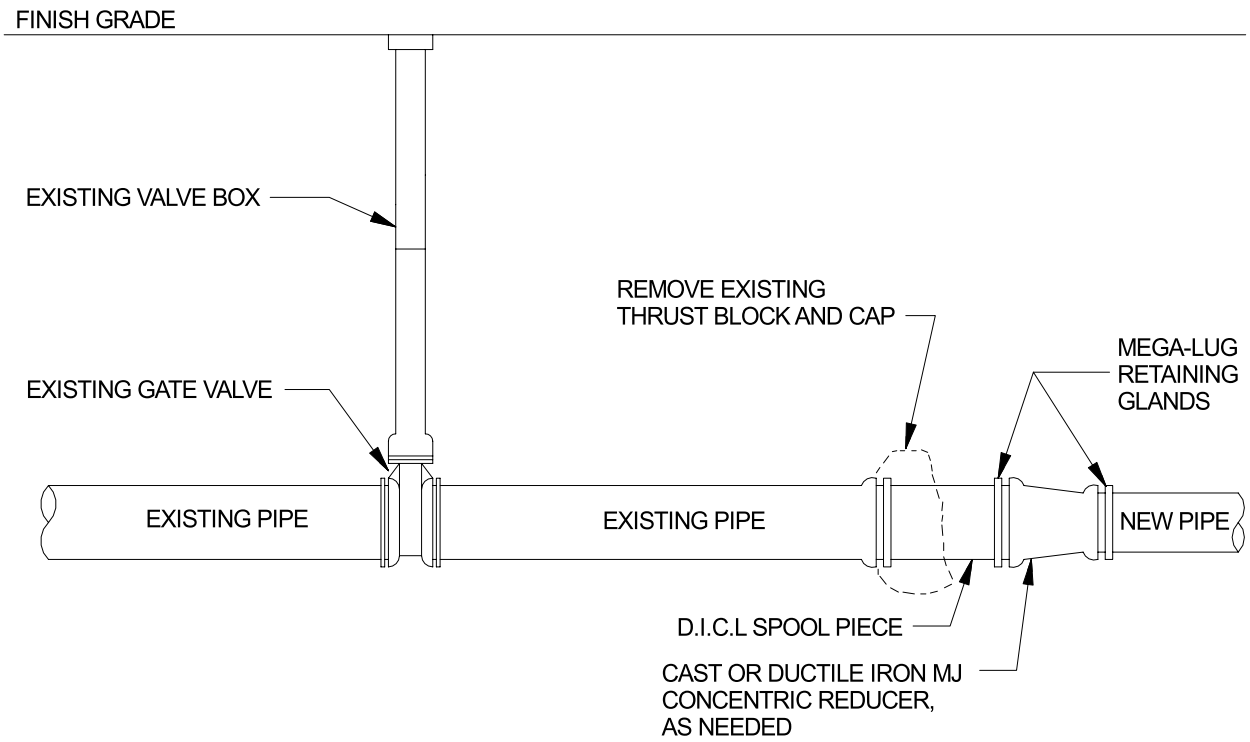
NOTES:

1) DETAIL TO BE EMPLOYED WHEN WATER CANNOT CROSS ABOVE SEWER LINE

2) PRIOR TO POURING THRUST BLOCKS, ALL FITTINGS ARE TO BE WRAPPED WITH 4 mil. POLYETHYLENE.

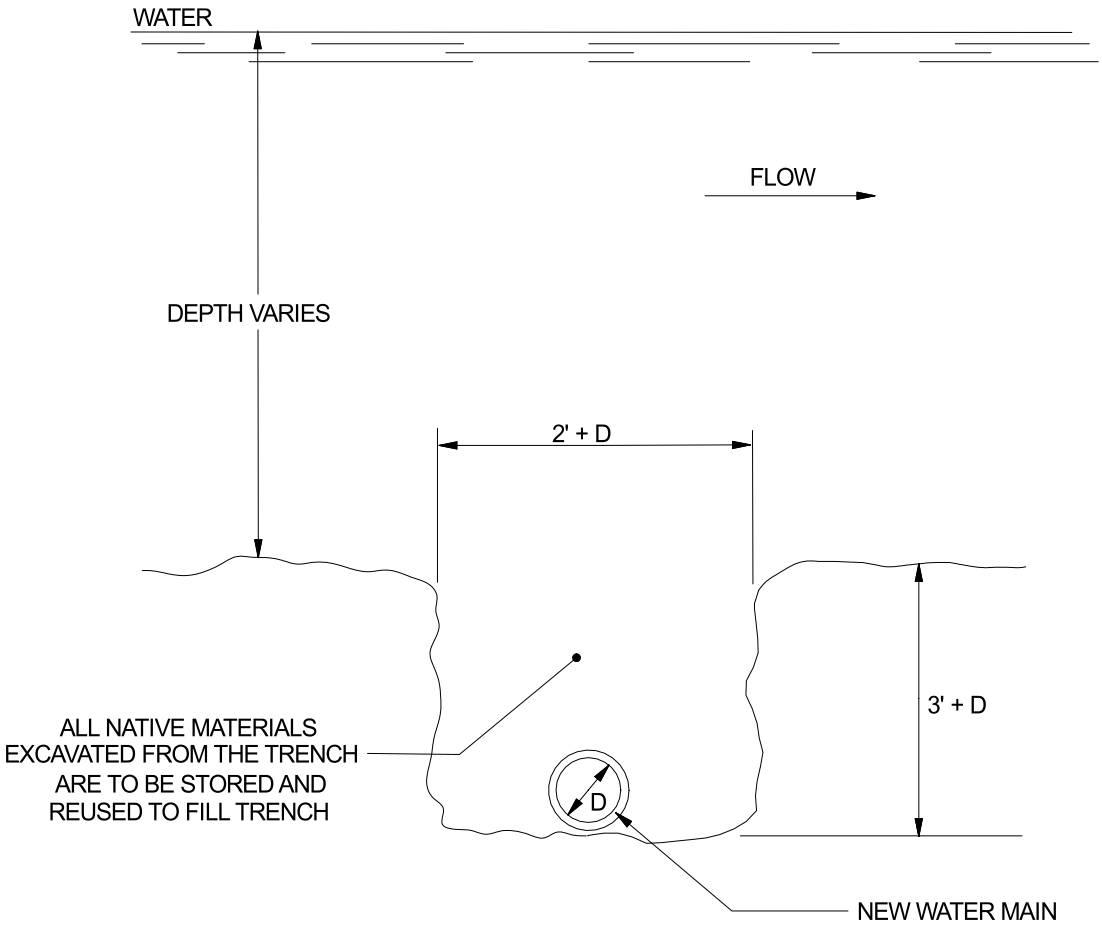
WATER UNDER SEWER LINE CROSSING

Figure 5.11



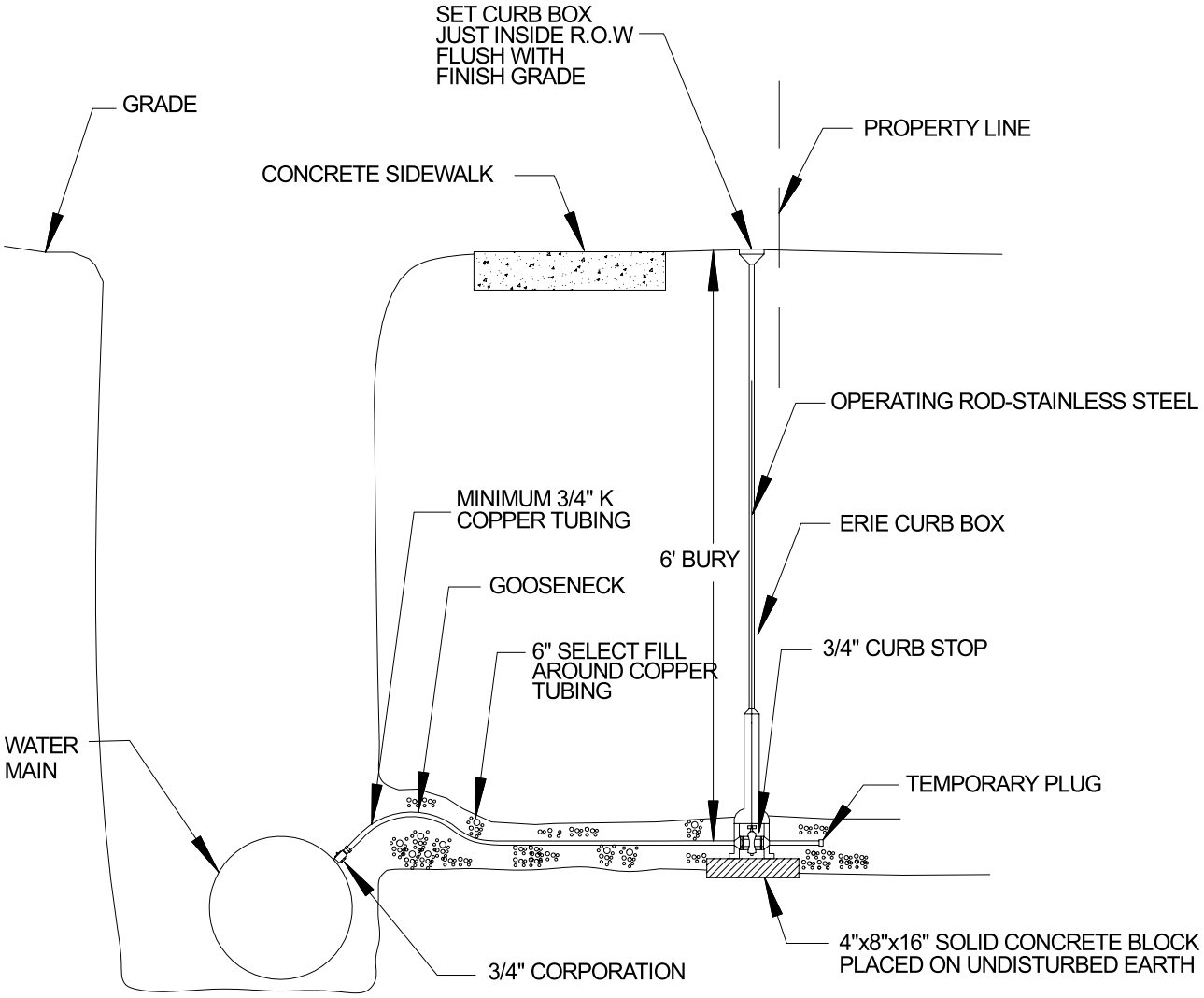
TIE-IN DETAIL

Figure 5.12



RIVER CROSSING TRENCH DETAIL

Figure 5.13

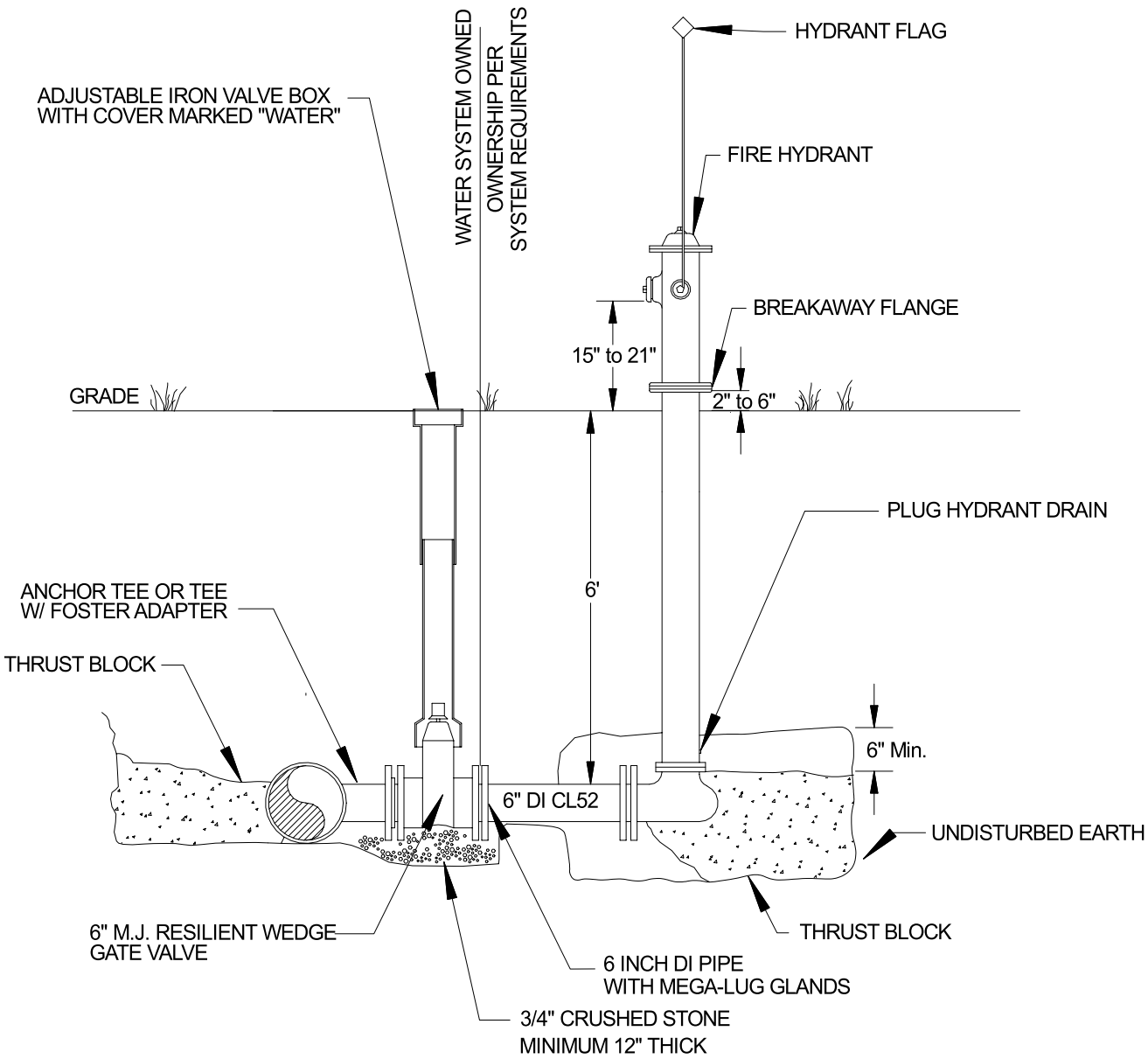


NOTE

- SEE SPECIFICATIONS FOR TAPPING SADDLE, CORPORATION, AND CURBSTOP REQUIREMENTS

WATER SERVICE CONNECTION

Figure 5.14



NOTES

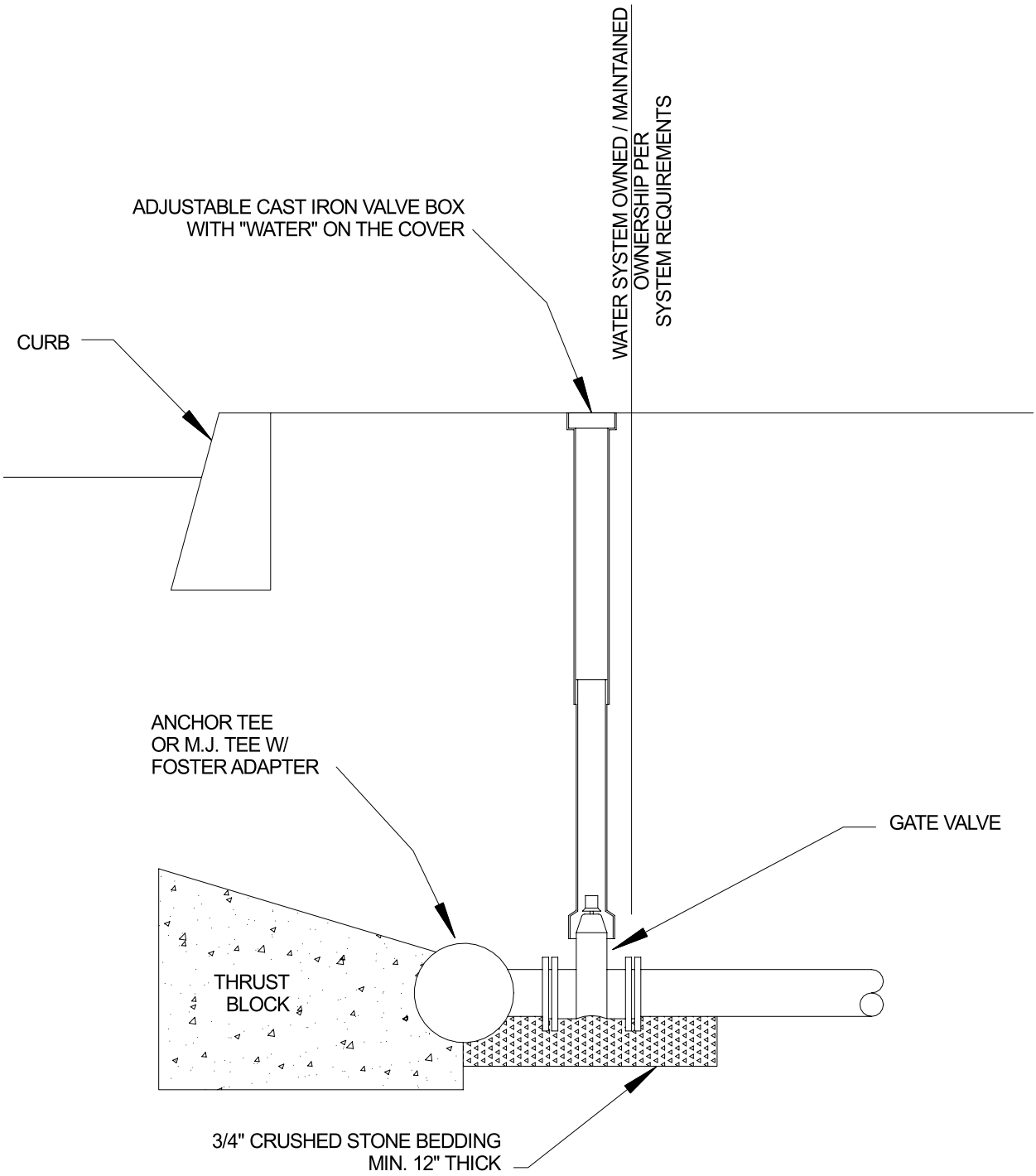
1) ALL FITTINGS ARE TO HAVE WEDGE STYLE RETAINING GLANDS.

2) PRIOR TO POURING THRUST BLOCKS ALL FITTINGS ARE TO BE WRAPPED WITH 4 mil. POLYETHYLENE.

3) OWNERSHIP BEYOND THE GATE VALVE SHALL BE IN ACCORDANCE WITH THE WATER SYSTEM REQUIREMENTS.

HYDRANT ASSEMBLY DETAIL

Figure 5.15

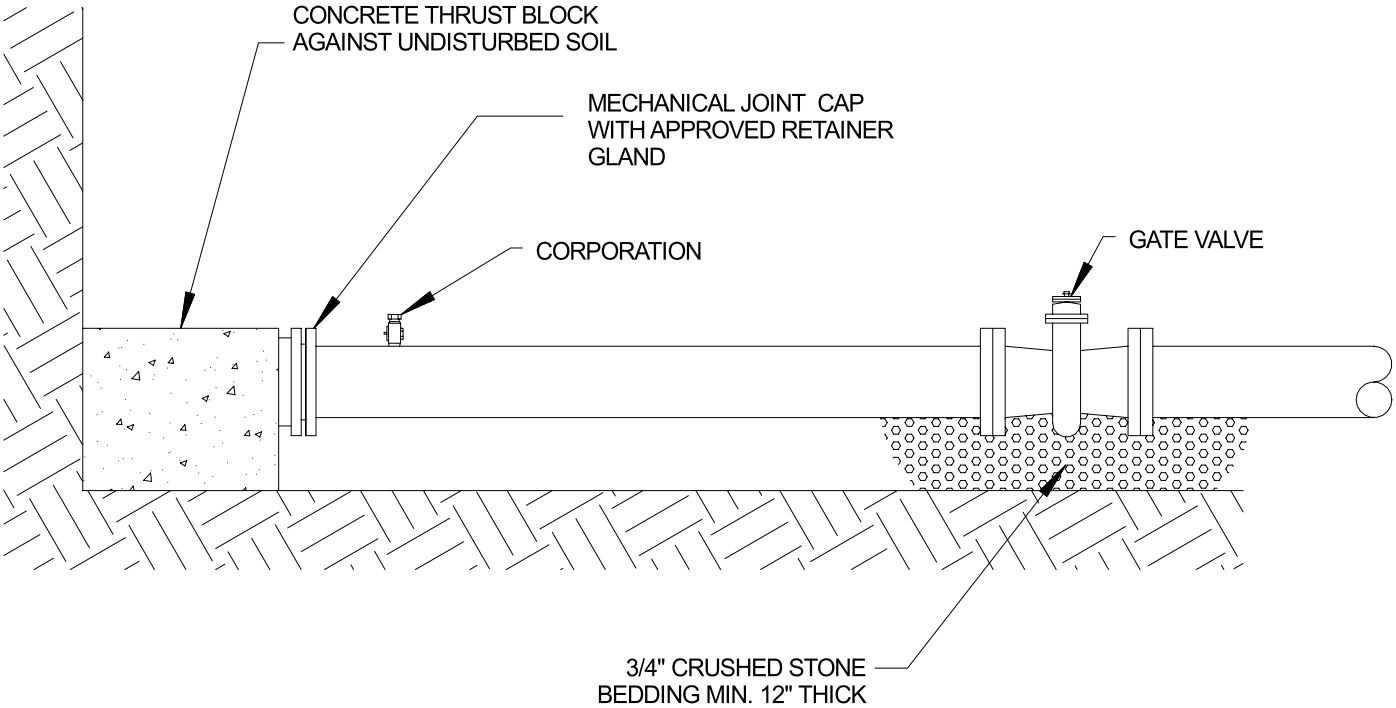


NOTES:

1) OWNERSHIP BEYOND THE GATE VALVE SHALL BE IN ACCORDANCE WITH THE WATER SYSTEM REQUIREMENTS.

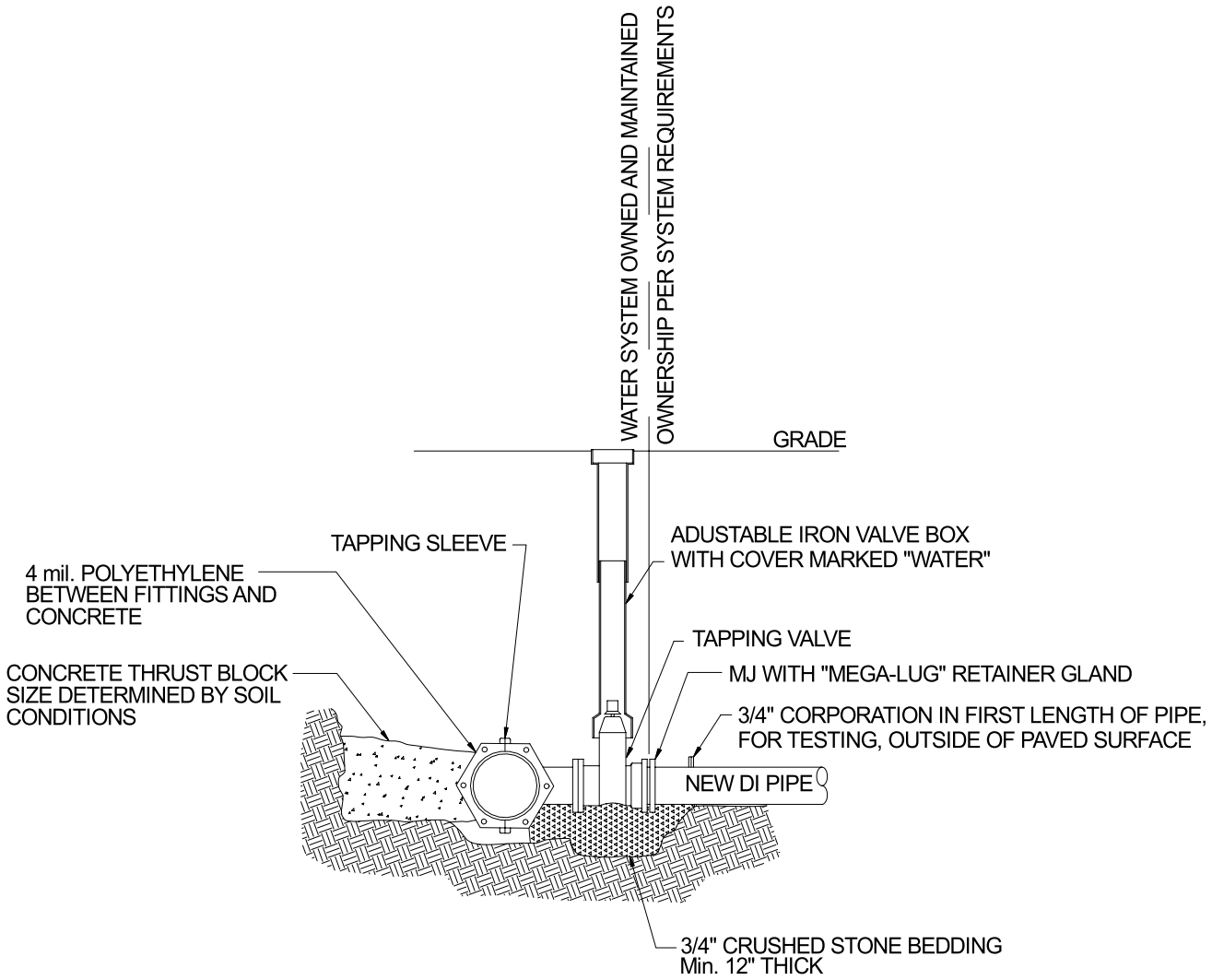
TYPICAL FIRE SERVICE CONNECTION DETAIL

Figure 5.16



TYPICAL END OF LINE PIPE ANCHOR

Figure 5.17



NOTES

1) WET TAPS SHALL BE PERFORMED BY PRE-APPROVED FIRMS ONLY. POSSESSING A CURRENT CERTIFICATE OF INSURANCE.

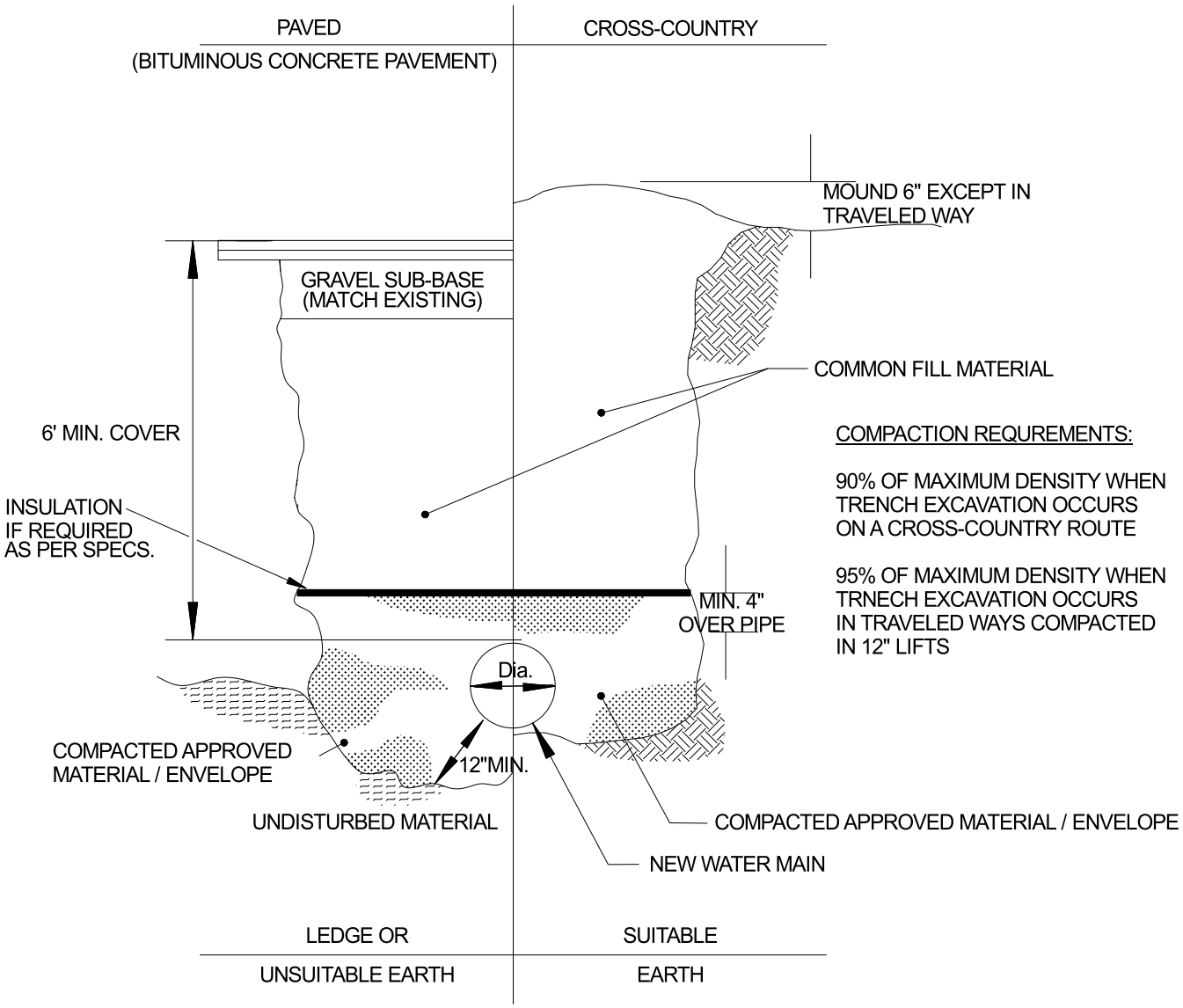
2) ALL FITTINGS THAT ARE TO HAVE CONCRETE POURED AROUND THEM ARE TO BE WRAPPED WITH 4 mil. POLYETHYLENE PRIOR TO CONCRETE PLACEMENT.

3) WHEN TAPPING TRANSMISSION MAIN THE INDICATED OWNERSHIP DESIGNATION SHALL APPLY.

4) WHEN TAPPING THE TRANSMISSION MAIN OR WATER SYSTEM DISTRIBUTION MAIN, OWNERSHIP BEYOND THE TAPPING VALVE SHALL BE IN ACCORDANCE WITH THE WATER SYSTEM REQUIREMENTS.

TAPPING SLEEVE AND VALVE DETAIL

Figure 5.18



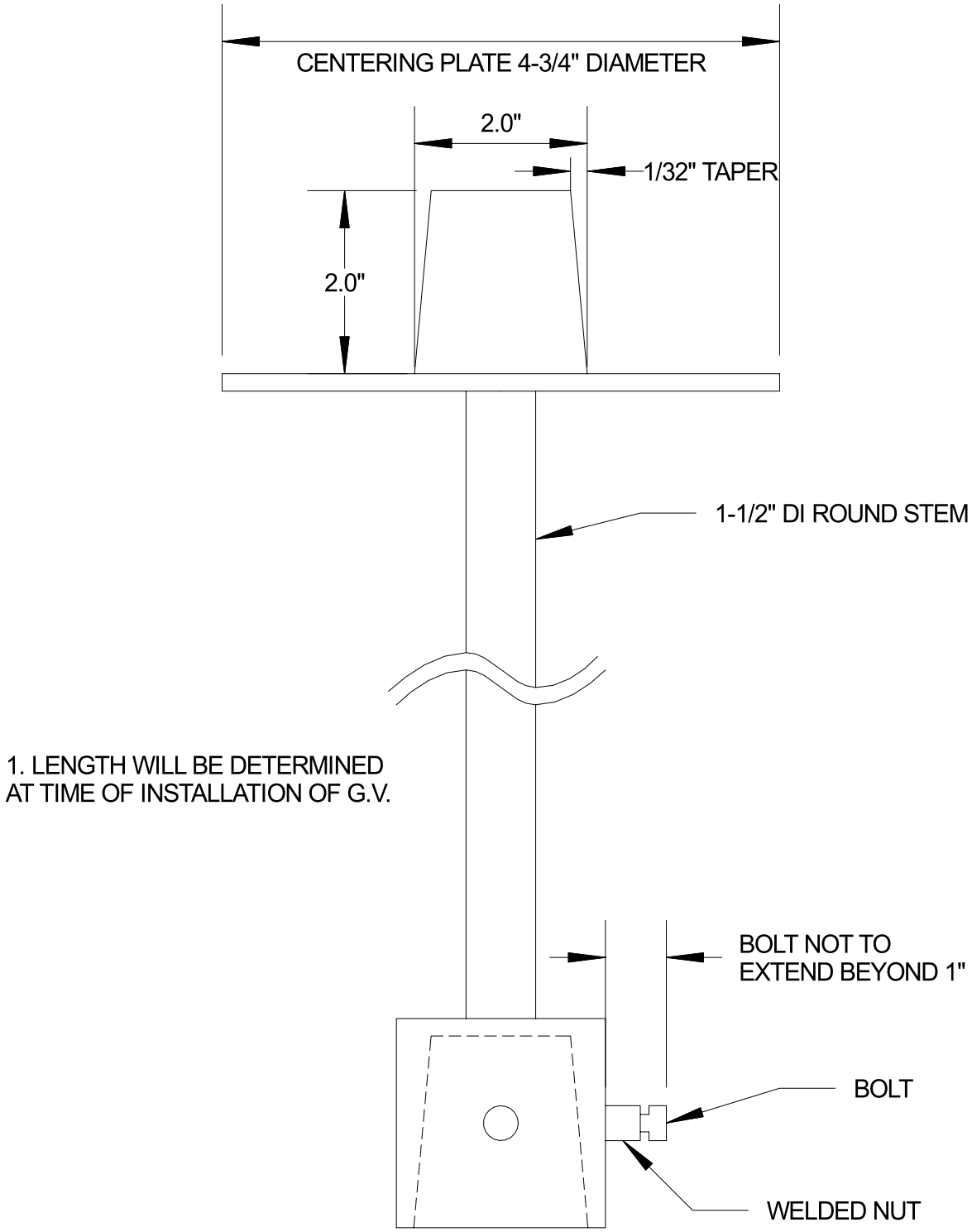
NOTES

1) ALL TRENCHES SHALL MEET VOSHA STANDARDS PRIOR TO ANY PERSONNEL ENTERING A TRENCH.

2) A MINIMUM OF 4" RIGID INSULATION SHALL BE INSTALLED WHEREVER MINIMUM COVER CAN NOT BE MAINTAINED.

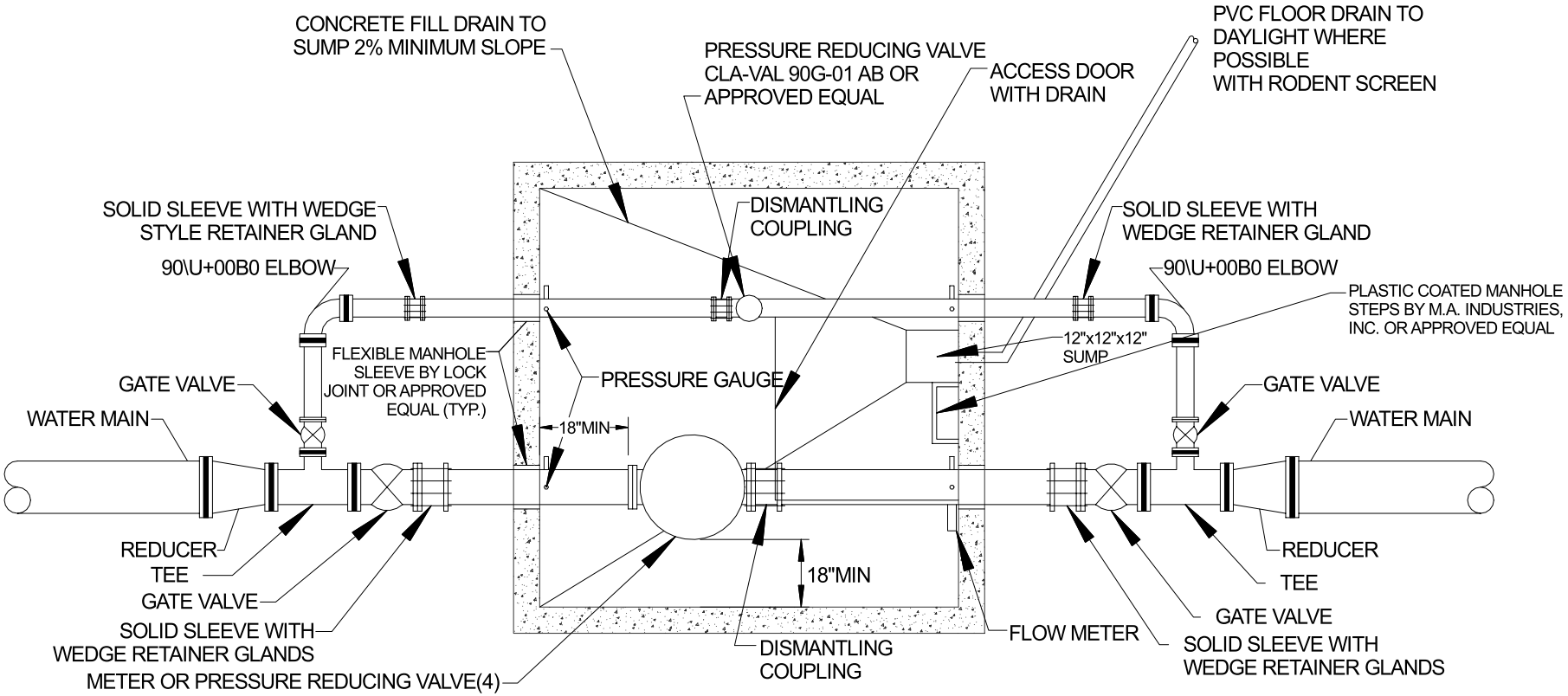
TYPICAL TRENCH DETAIL

Figure 5.19



STAINLESS STEEL VALVE STEM EXTENSION

Figure 5.20



NOTES:

1) ALL INTERIOR FITTINGS AND VALVES SHALL BE FLANGED. NO FLANGE OR FITTING SHALL BE WITHIN 18" OF ANY WALL OR FLOOR.

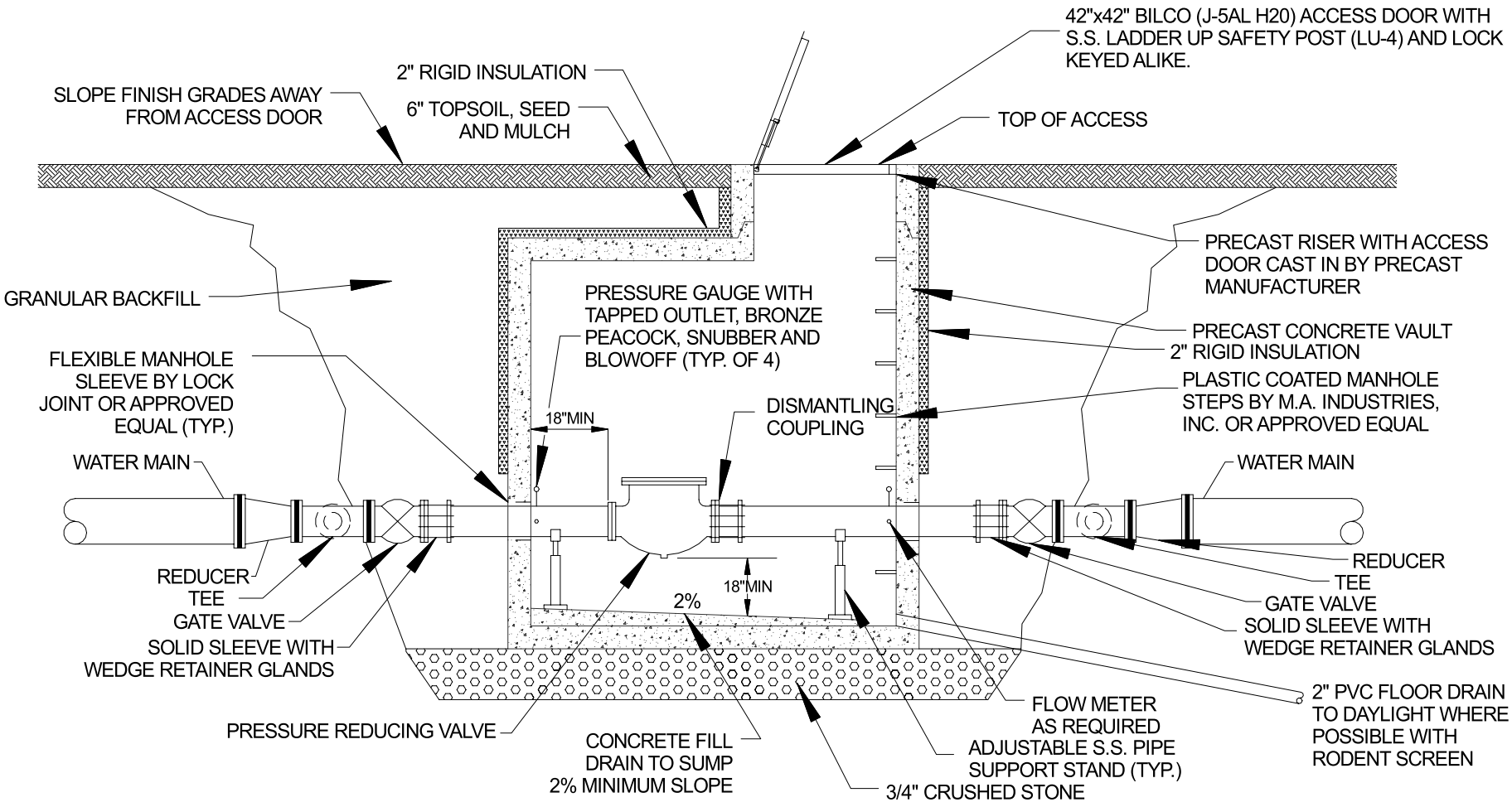
2) BURIED FITTINGS SHALL BE MECHANICAL JOINT WITH WEDGE STYLE RETAINER GLANDS.

3) TO PREVENT FOULING OF THE PRESSURE REDUCING VALVES DURING WATER MAIN FILLING AND FLUSHING, A TEMPORARY SPOOL PIECE SHALL BE INSTALLED IN PLACE OF THE PRESSURE REDUCING VALVE.

4) PRV'S SHALL BE CLA-VAL 90-01/690-01 WITH POSITIONING SYSTEMS.

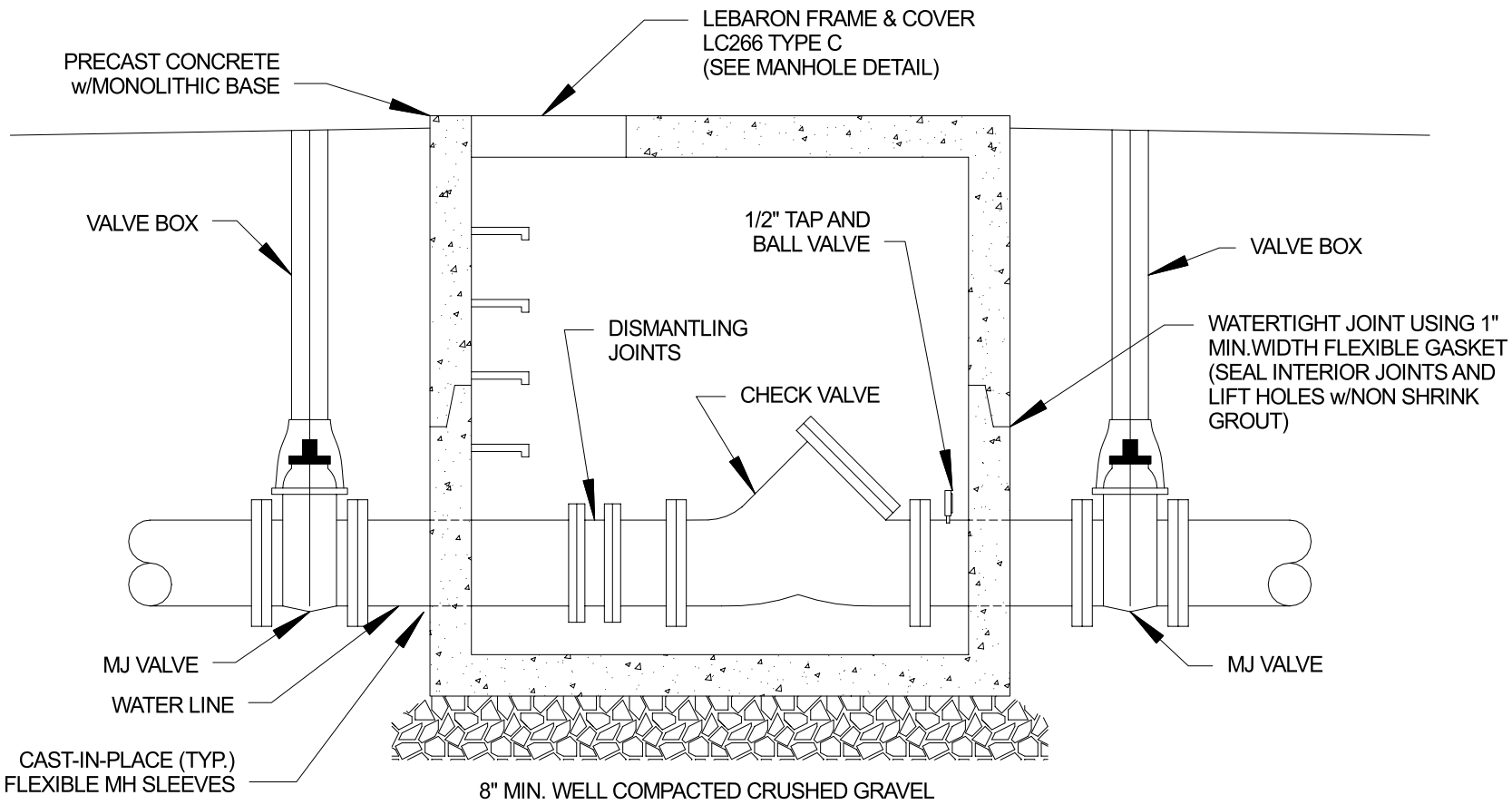
METER OR PRESSURE REDUCING VALVE VAULT PLAN

Figure 5.21



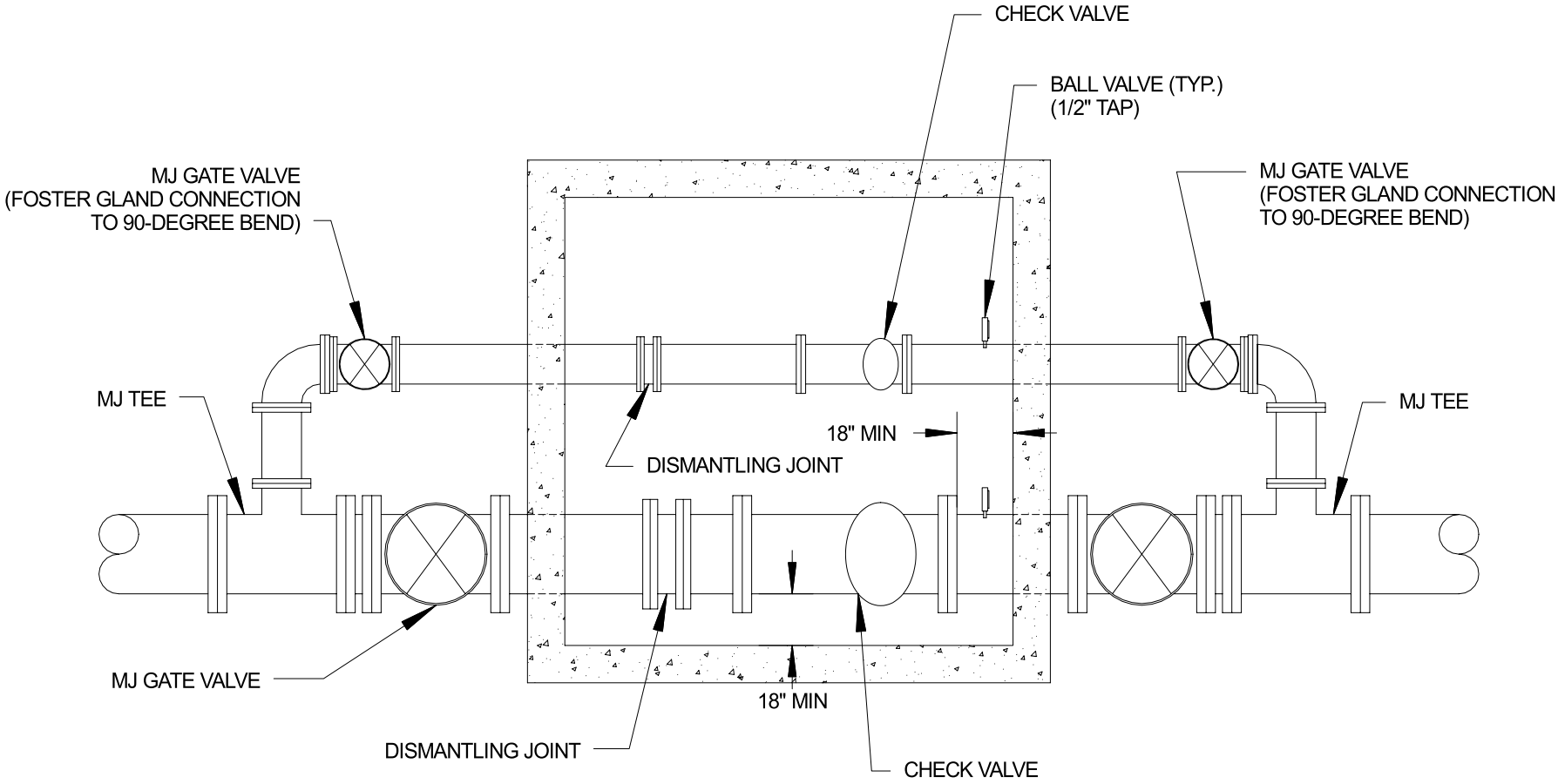
METER OR PRESSURE REDUCING VALVE VAULT PROFILE

Figure 5.22



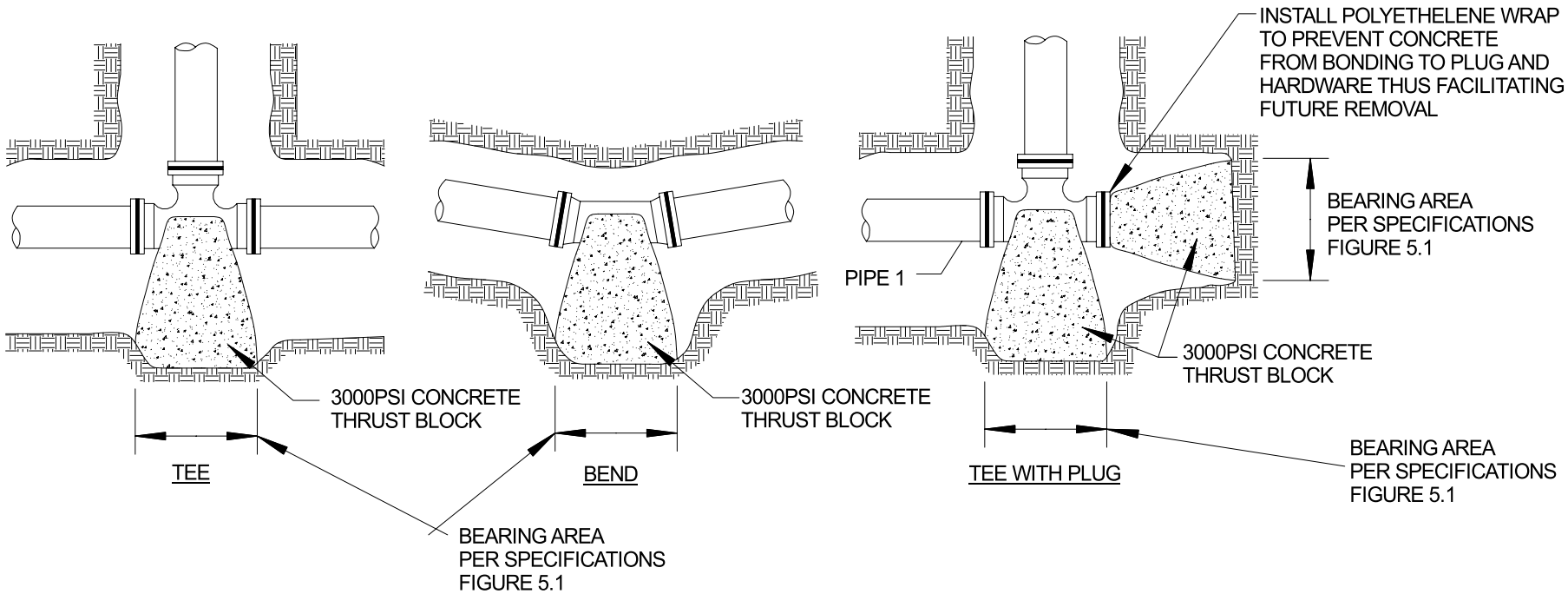
CHECK VALVE VAULT PROFILE

Figure 5.23



CHECK VALVE VAULT PLAN

Figure 5.24



NOTES:

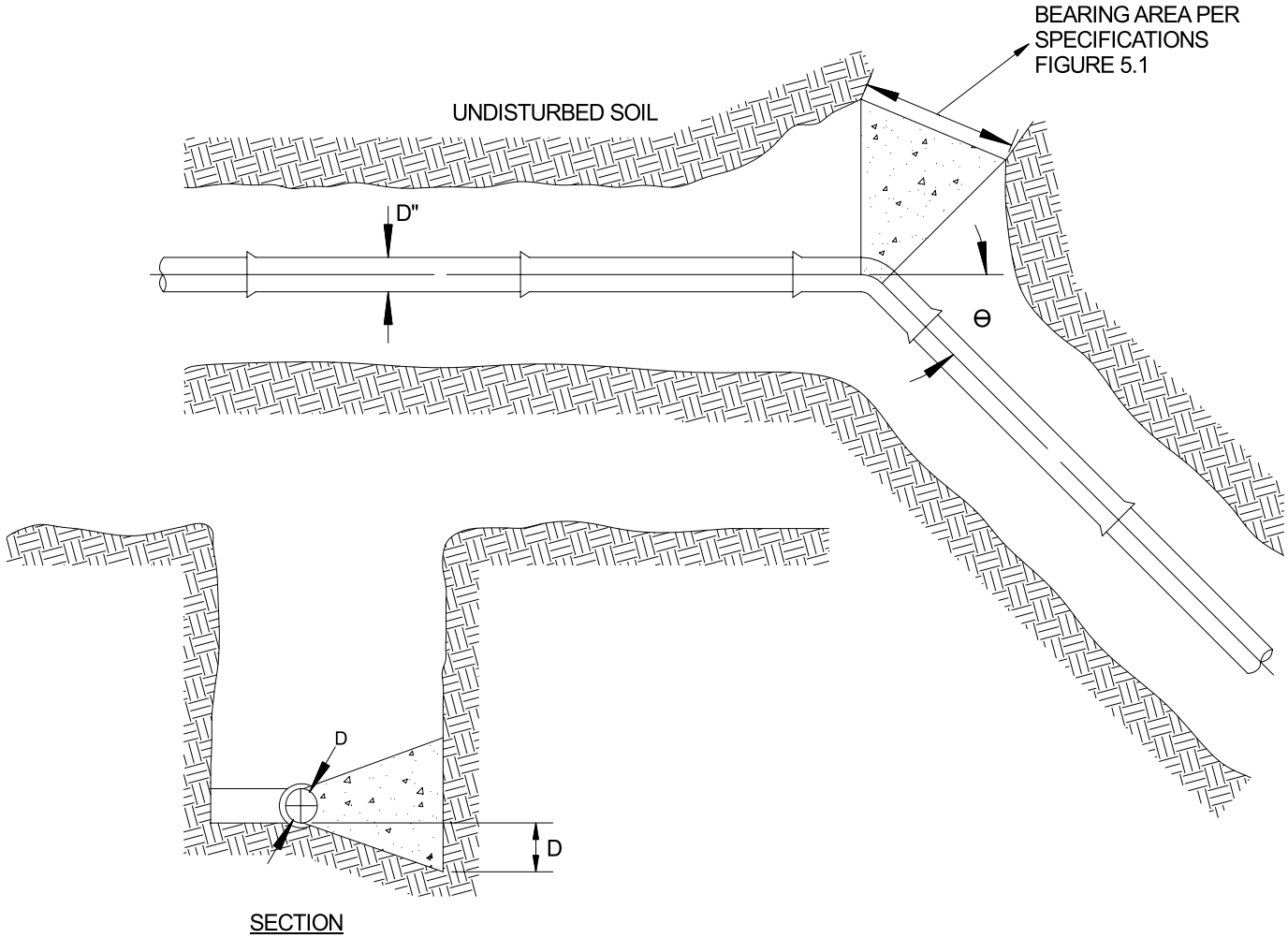
1. CONCRETE NOT TO OVERLAP ANY JOINT.

2. CONCRETE TO BE PLACED SO AS NOT TO INTERFERE WITH REMOVING OR INSTALLING ANY OF THE JOINTING HARDWARE.

3. ALL MECHANICAL JOINT FITTINGS TO HAVE RETAINER GLANDS.

TYPICAL CONCRETE THRUST BLOCK DETAILS

Figure 5.25



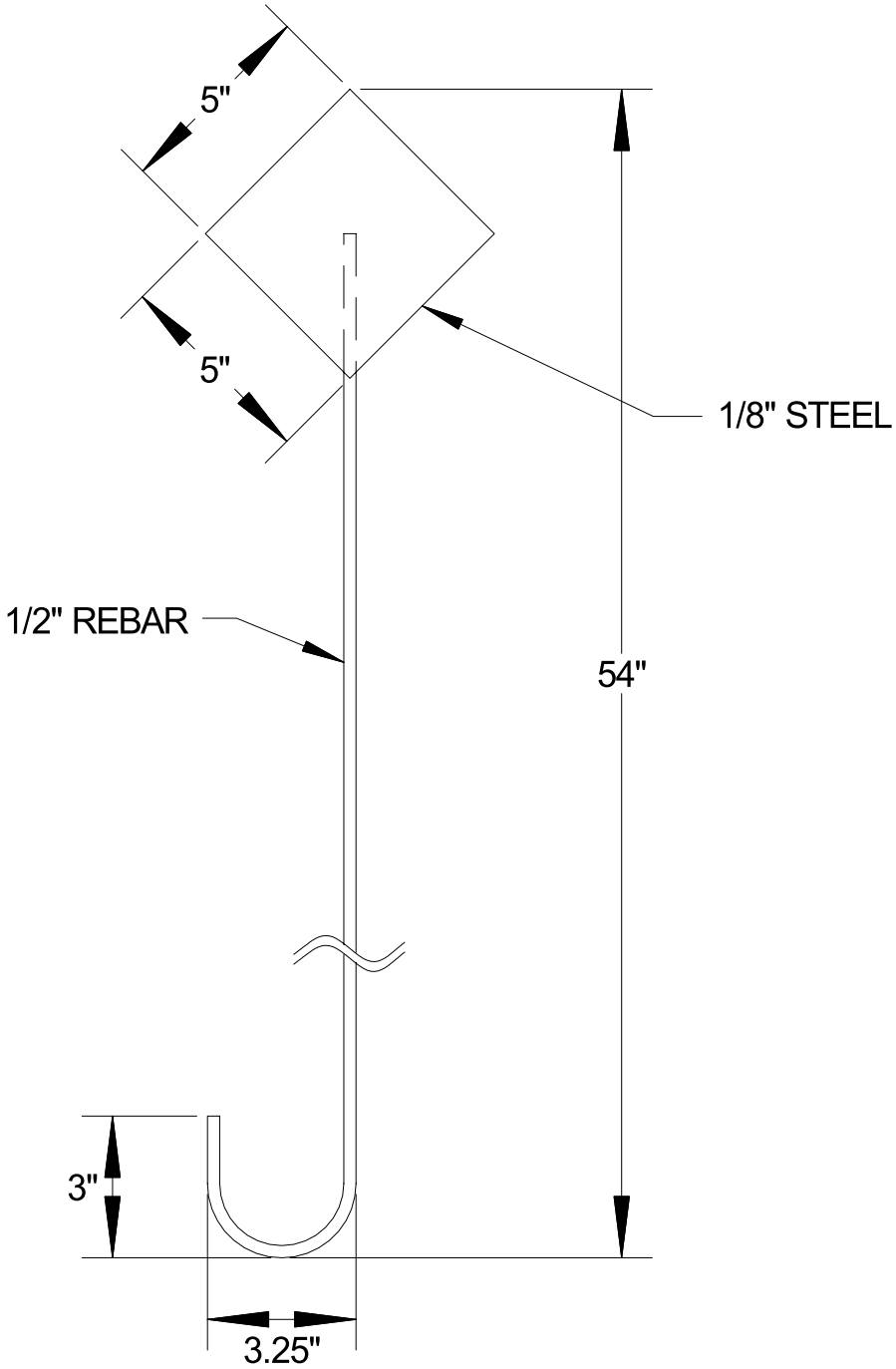
NOTES:

1) BEARING SURFACE SHOULD, WHERE POSSIBLE BE PLACED AGAINST UNDISTURBED SOIL. WHERE IT IS NOT POSSIBLE, THE FILL BETWEEN THE BEARING SURFACE AND UNDISTURBED SOIL MUST BE COMPACTED TO AT LEAST 90% MODIFIED PROCTOR DENSITY.

2) BLOCK HEIGHT SHUOLD BE CHOSEN SUCH THAT THE CALCULATED BLOCK WIDTH VARIES BETWEEN ONE AND TWO TIMES THE HEIGHT.

BEARING BLOCK DETAILS

Figure 5.26



NOTE

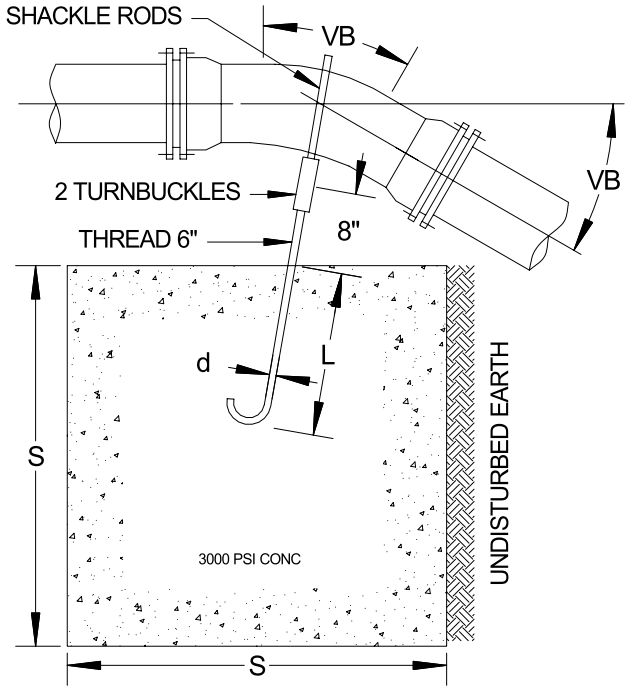
1) HYDRANT FLAGS TO BE PAINTED RED

Hydrant Flag

Figure 5.27

TYPE A BLOCKING FOR 11 1/2 - 22 1/2 VERTICAL BENDS					
	VB		S	d	L
PIPE SIZE NOM DIA (INCHES)	VERTICAL BEND DEGREES	NO. OF CUFT OF CONC BLOCKING	SIDE OF CUBE (FEET)	DIA OF SHACKLE RODS(2)* (INCHES)	DEPTH OF RODS IN CONC. (FEET)
4"	11 1/4	8	2.0	3/4"	1.6
	22 1/2	16	2.5		
8"	11 1/4	16	2.5	3/4"	1.6
	22 1/2	32	322		
16"	11 1/4	28	3.0	3/4"	1.6
	22 1/2	55	3.8		
12"	11 1/4	60	3.9	3/4"	1.6
	22 1/2	118	4.9	7/8"	2.2
16"	11 1/4	104	4.7	7/8"	2.2
	22 1/2	205	5.9	1 1/8"	3.7

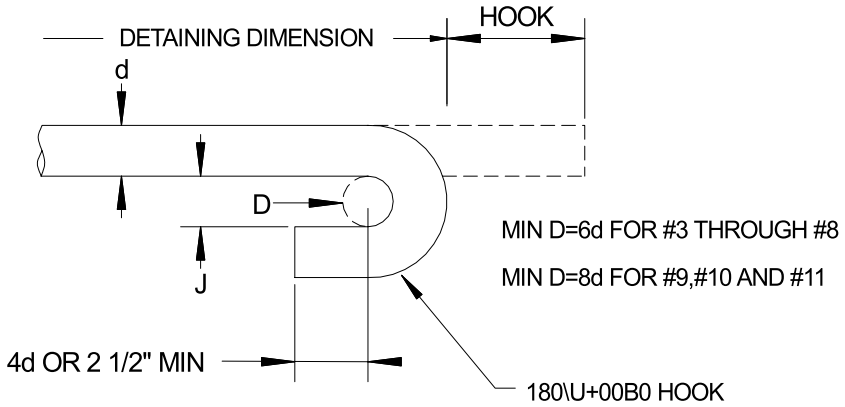
* FOR 60 KSI THREADED REBAR



TYPE A BLOCKING
FOR 11 1/2 - 22 1/2 VERTICAL BENDS

RECOMMENDED 180\U+00B0
END HOOK DIMS

BAR SIZE	J (IN)
#6	6
#7	7
#8	8
#9	11 1/4
#10	12 3/4
#11	14 1/4



ACI STANDARD HOOKS

NOTES:

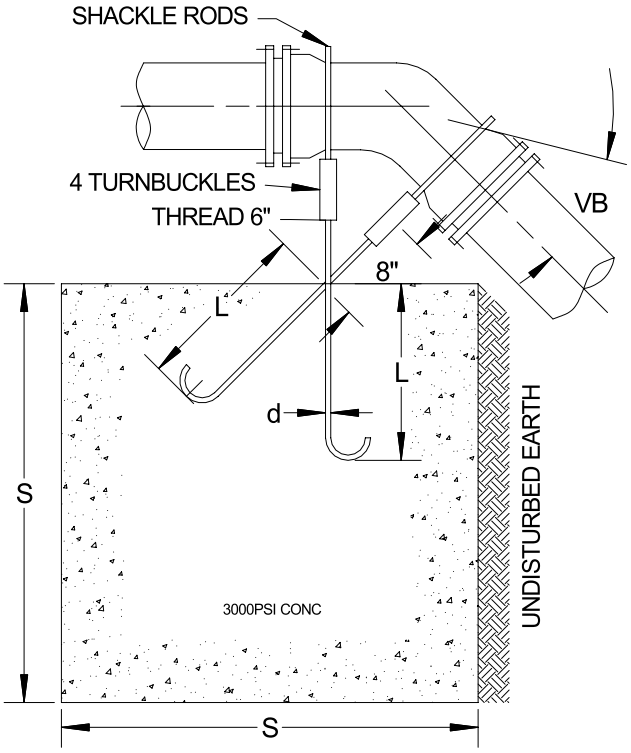
1) FOR DI BENDS ONLY

2) FOR VERTICAL BENDS ONLY

GRAVITY THRUST BLOCK DETAILS

Figure 5.28

TYPE B BLOCKING FOR 45\U+00B0 VERTICAL BENDS				
		S	d	L
PIPE SIZE NOM DIA(INCHES	NO. OF CUFT OF CONC BLOCKING	SIDE OF CUBE (FEET)	DIA OF SHACKLE RODS(2) (INCHES)	DEPTH OF RODS IN CONC (FEET)
4"	29	3.1	3/4"	1.6
6"	59	3.9		
8"	102"	4.7		
12"	218	6.0		
16"	378	7.2	1 1/8"	3.7



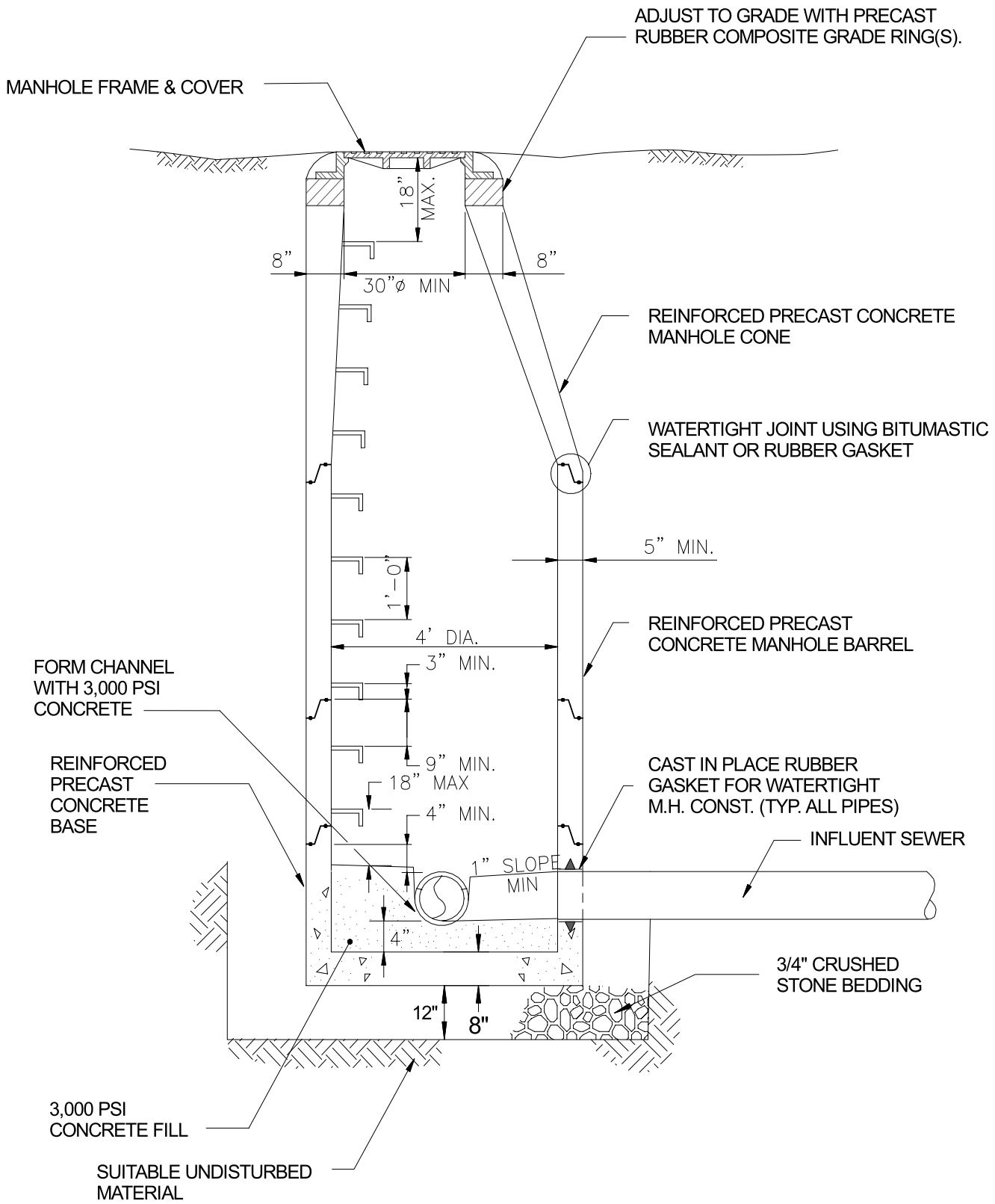
TYPE B BLOCKING
FOR 45\U+00B0 VERTICAL BENDS

NOTES:

1) FOR DI BENDS ONLY

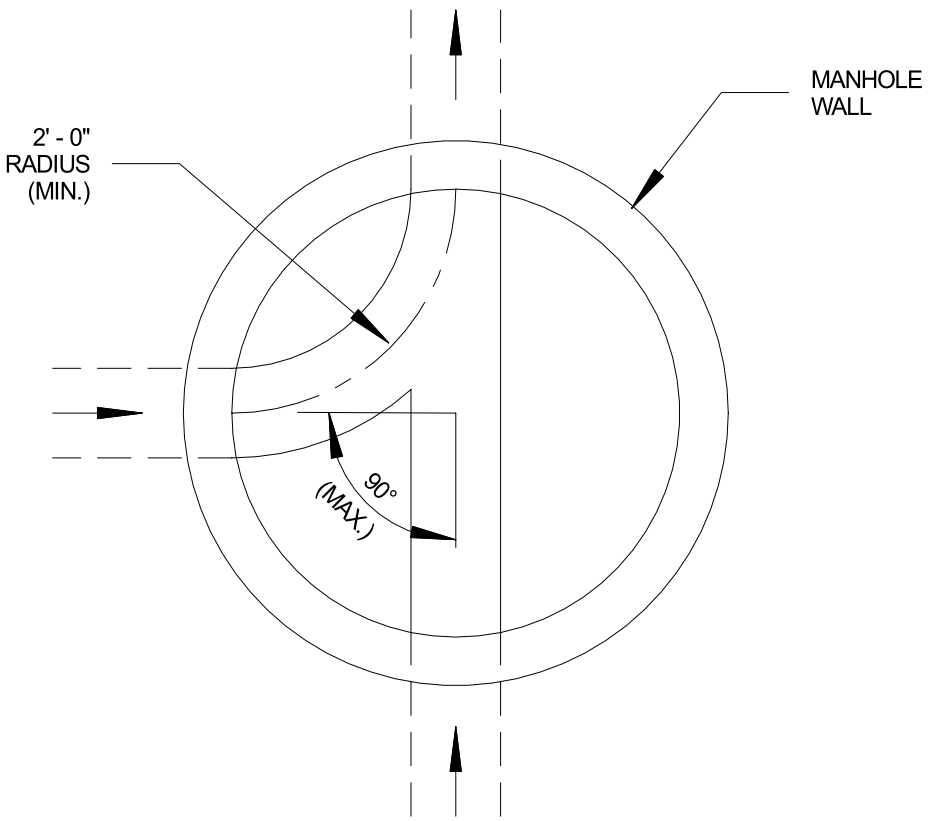
GRAVITY THRUST BLOCK DETAILS

Figure 5.29

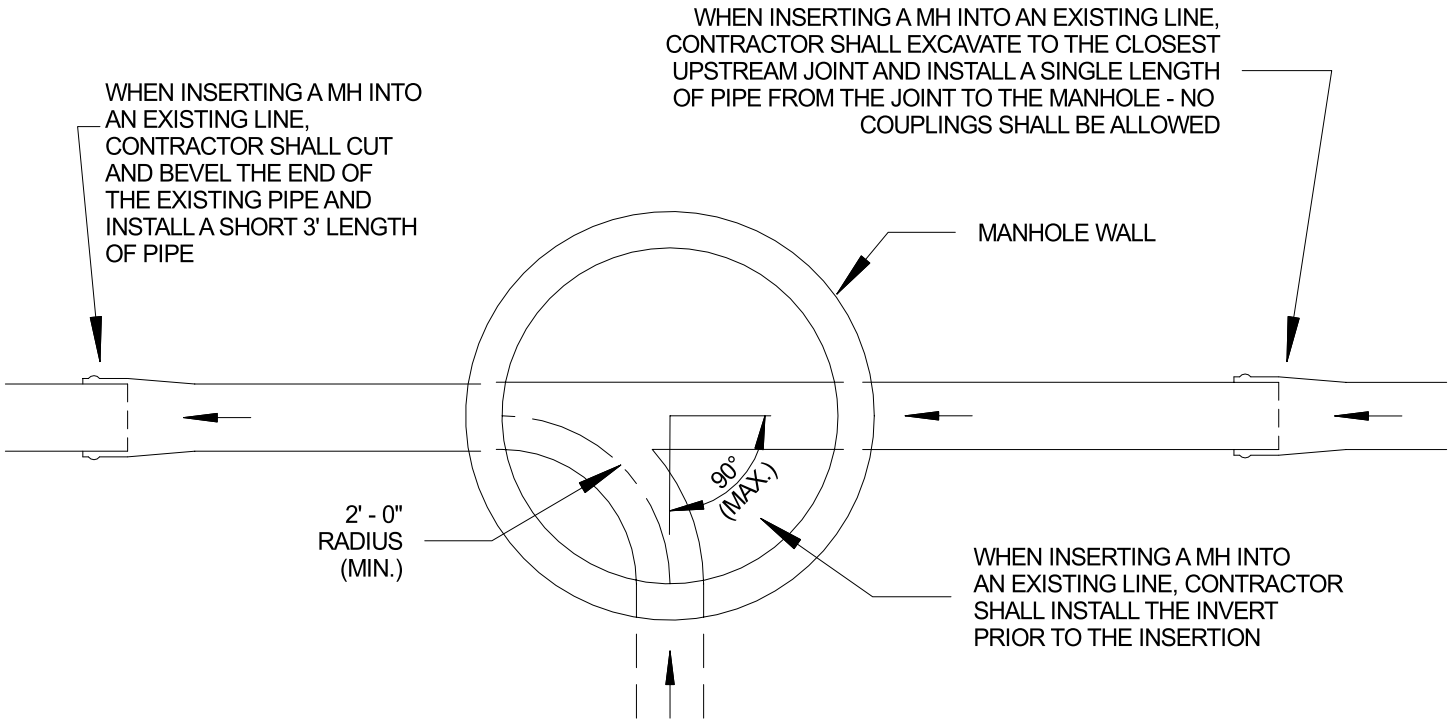


SANITARY / STORM MANHOLE DETAIL

Figure 6.1

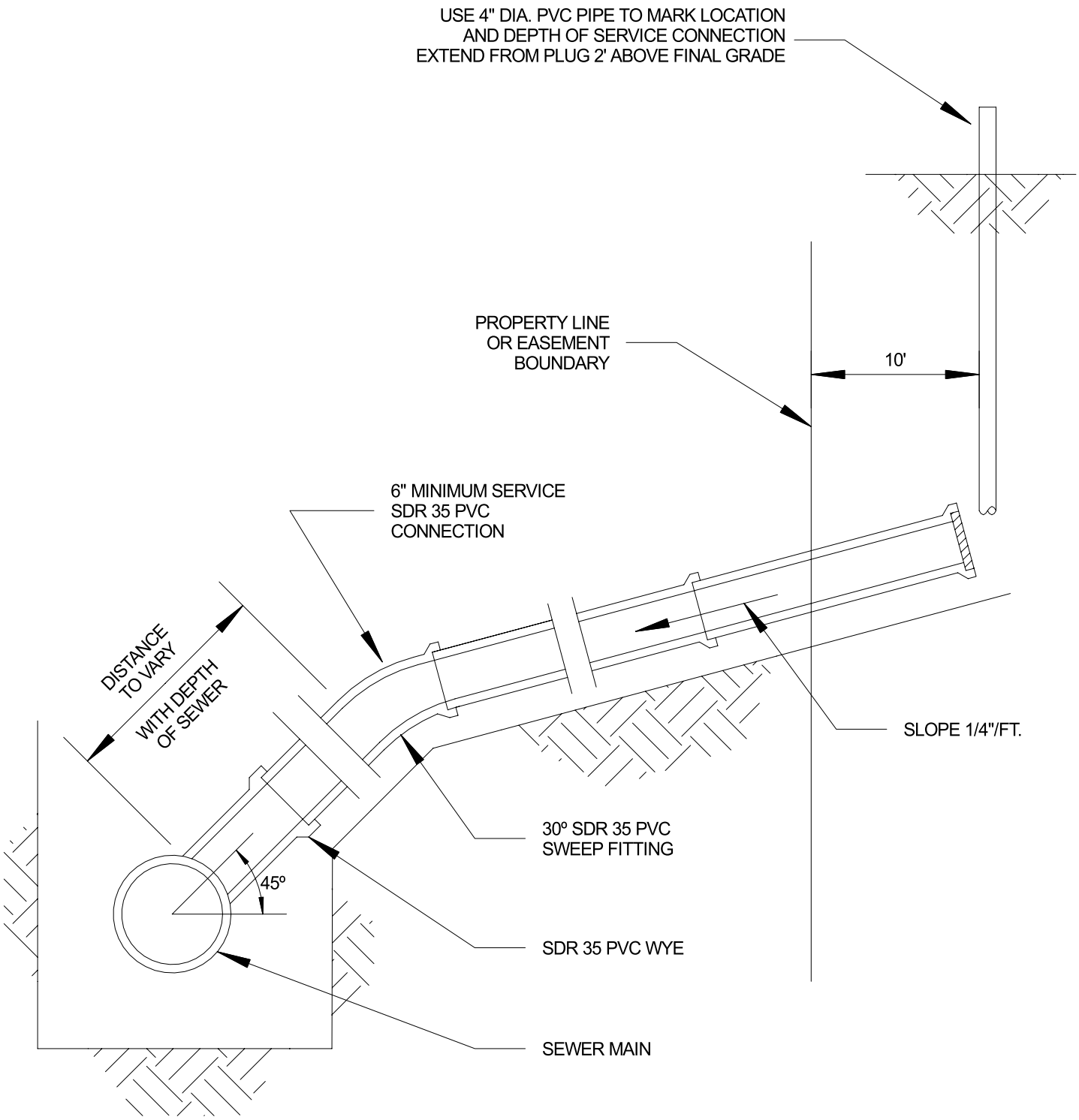


MANHOLE CHANNEL



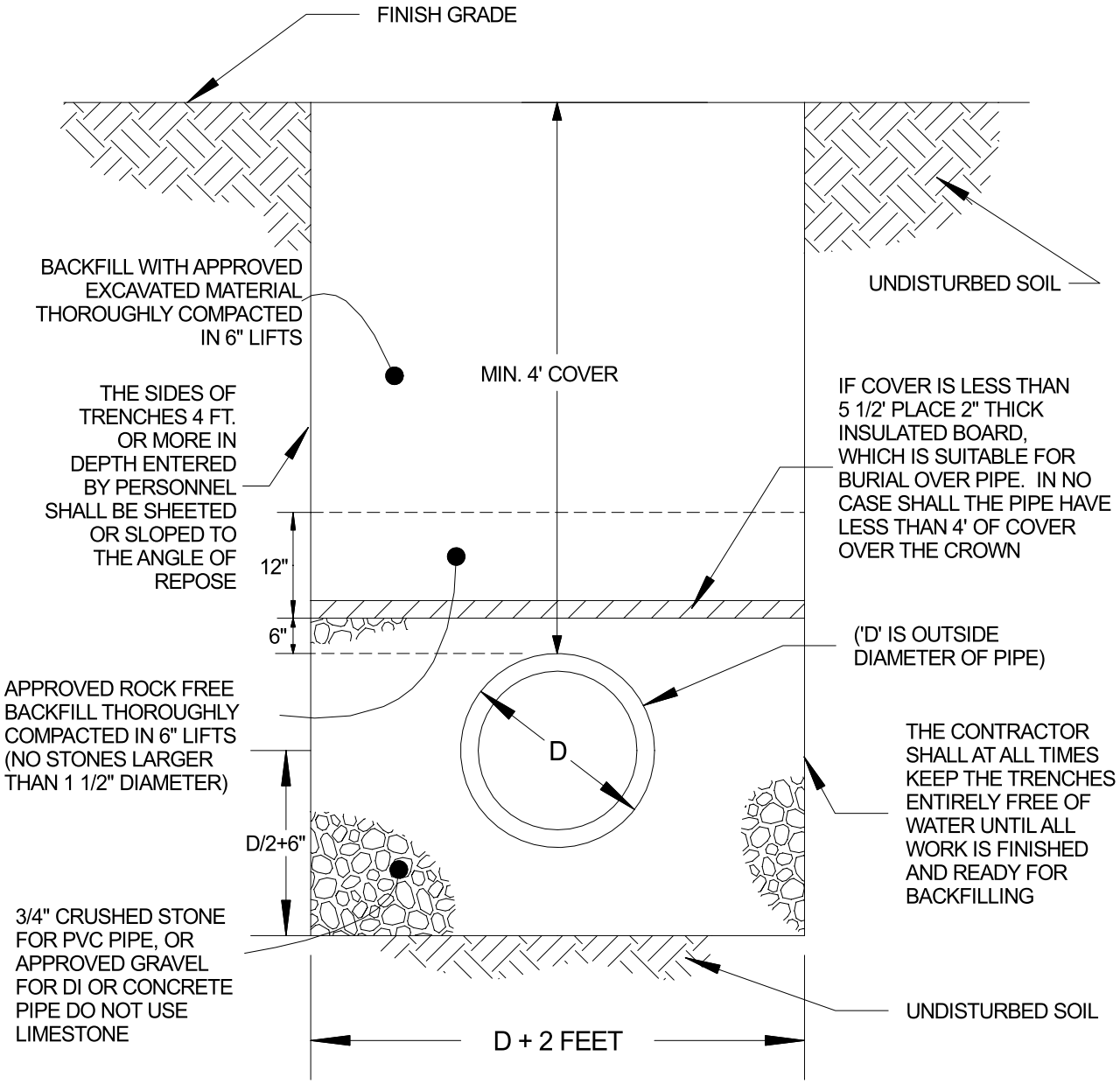
MANHOLE CHANNEL / INSERTION DETAIL

Figure 6.2



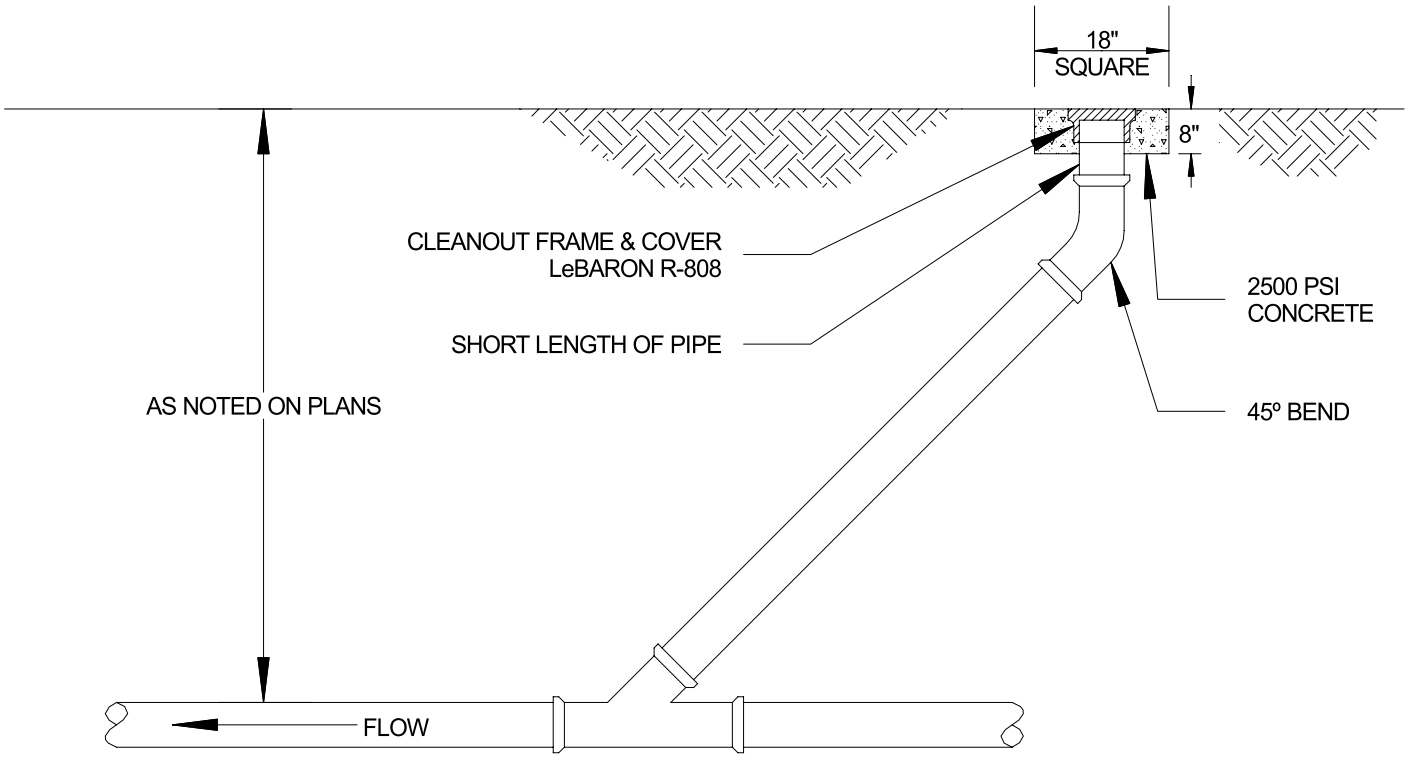
SANITARY SEWER
SERVICE CONNECTION

Figure 6.3



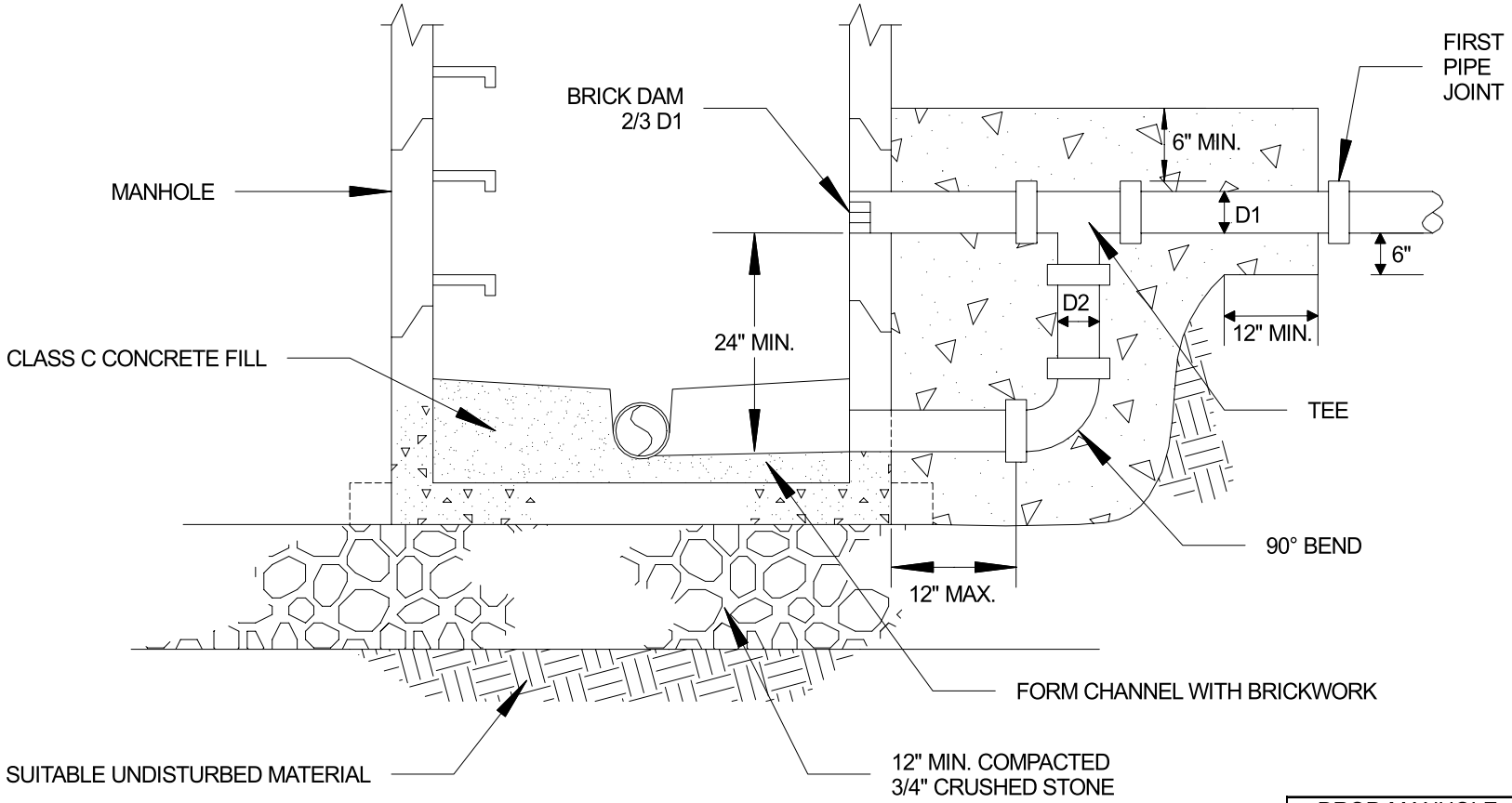
TYPICAL SANITARY SEWER TRENCH

Figure 6.4



CLEANOUT DETAIL (STORM and SANITARY)

Figure 6.5



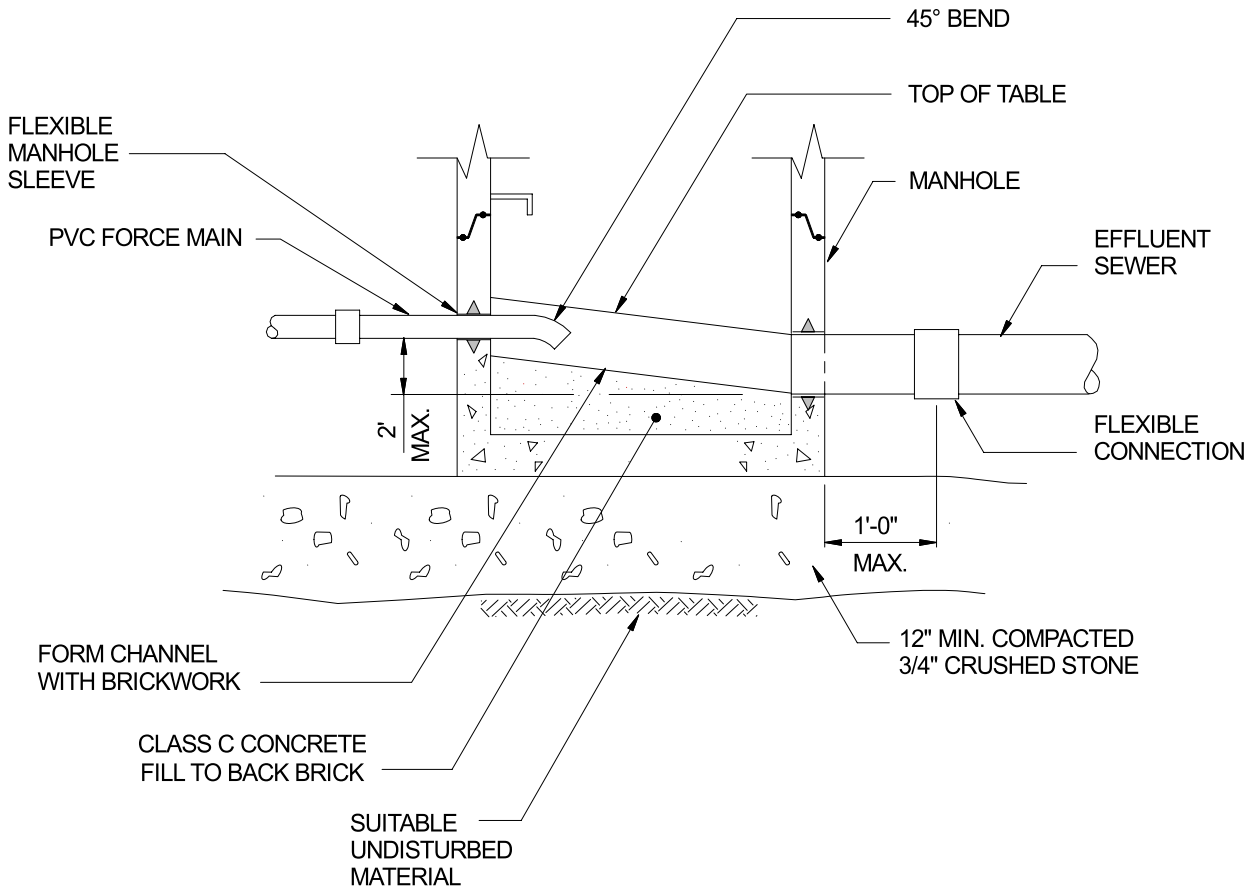
DROP MANHOLE	
Sewer Dia.	Sewer Dia.
D1	D2
8"	8"
10"	10"
12"	12"
15"	12"
18"	15"
21"	15"
24"	18"

NOTE:

1) CONCRETE ENCASEMENT TO BE EXTENDED TO FIRST PIPE JOINT LOCATED AT LEAST 12 INCHES BEYOND EXCAVATION FOR DROP CONNECTION.

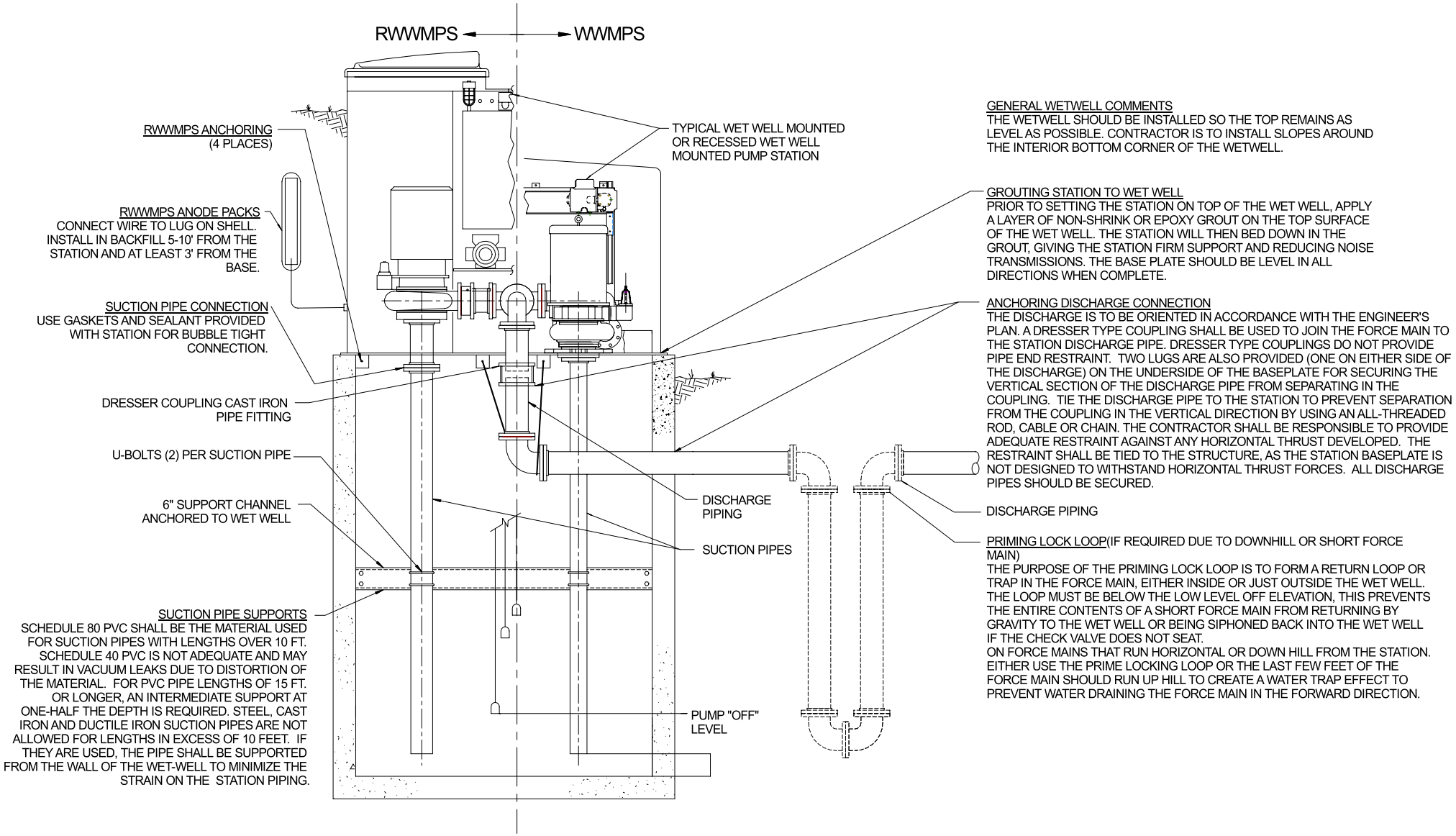
TYPICAL DROP MANHOLE

Figure 6.6



FORCE MAIN INTO MANHOLE DETAIL

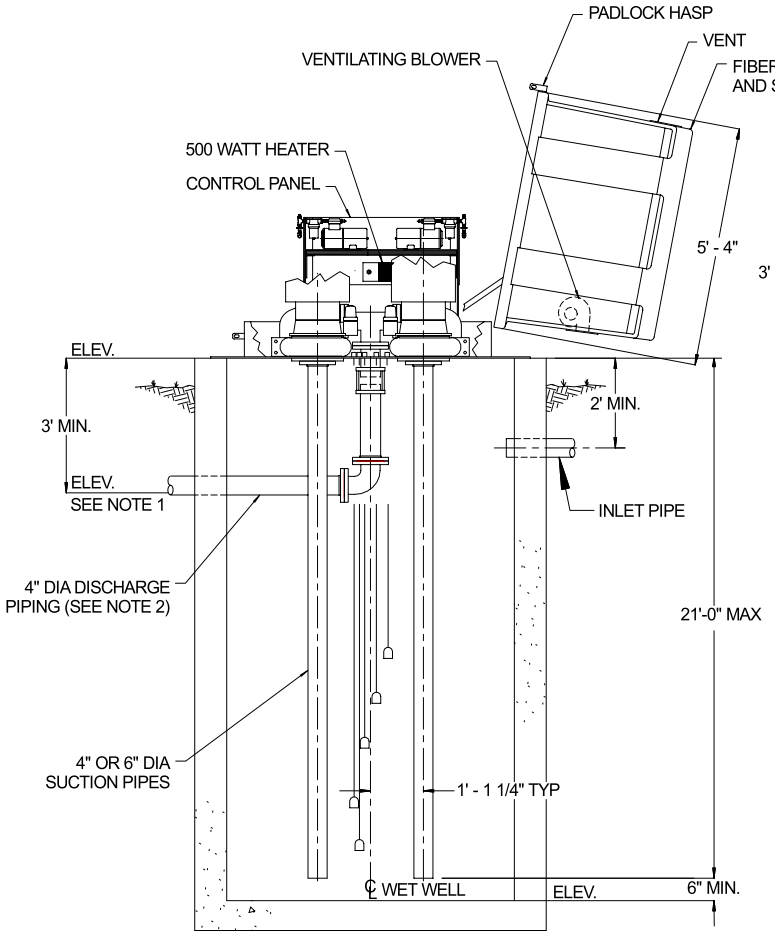
Figure 6.7



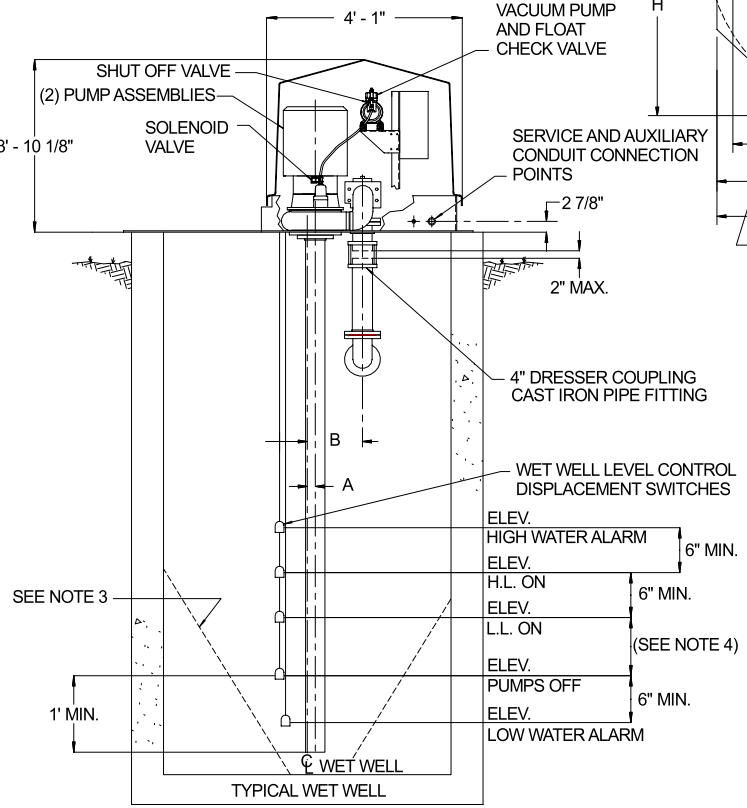
WET WELL MOUNTED PUMP STATION

Figure 7.1

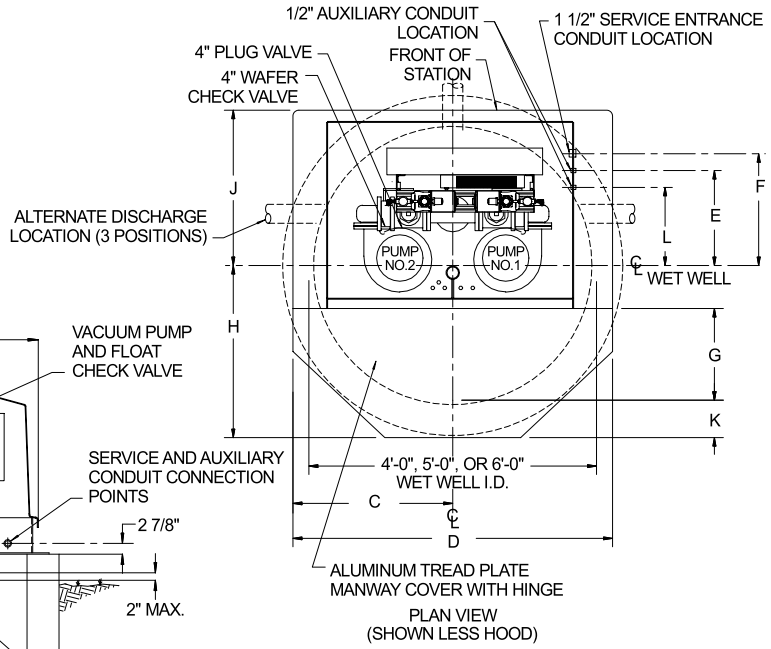
WET WELL DIAMETER	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	DIM J	DIM K	DIM L
4'-0"	4"	1'-3 13/16"	2'-9"	5'-6"	2'-1 7/8"	2'-6 3/8"	1'-2 1/2"	2'-9 1/2"	3'-7 1/2"	9 1/2"	1'-9 3/8"
5'-0"	8"	1'-7 13/16"	2'-10"	5'-8"	2'-7 3/8"	2'-11 7/8"	1'-8"	3'-4"	3'-11 1/2"	10"	2'-2 7/8"
6'-0"	2"	1'-1 13/16"	3'-4"	6'-8"	2'-1 3/8"	2'-5 7/8"	1'-8"	3'-10"	3'-5 1/2"	10"	1'-8 7/8"



SECTIONAL ELEVATION



CROSS SECTION



PLAN VIEW
(SHOWN LESS HOOD)

NOTES:

1) IF END OF DISCHARGE LINE IS BELOW ELEVATION OF DISCHARGE LINE AT POINT OF LEAVING WET WELL A PRIMING LOCK LOOP MAY BE REQUIRED.

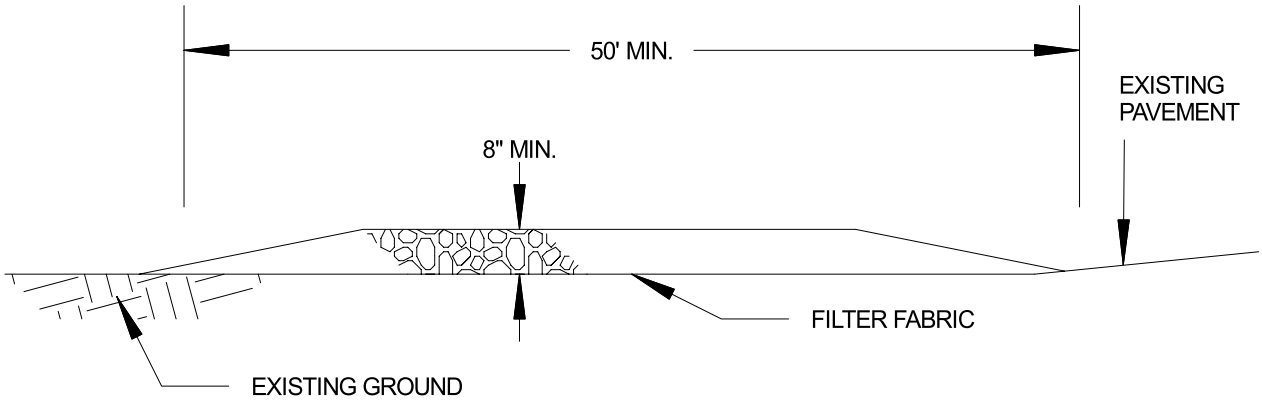
2) IF DISCHARGE LINE IS LESS THAN 200 FEET IN LENGTH, AN ADDITIONAL CHECK VALVE OR PRIMING LOCK LOOP MAY BE REQUIRED.

3) PROVIDE 60° SLOPE IN WET WELL, AS REQUIRED.

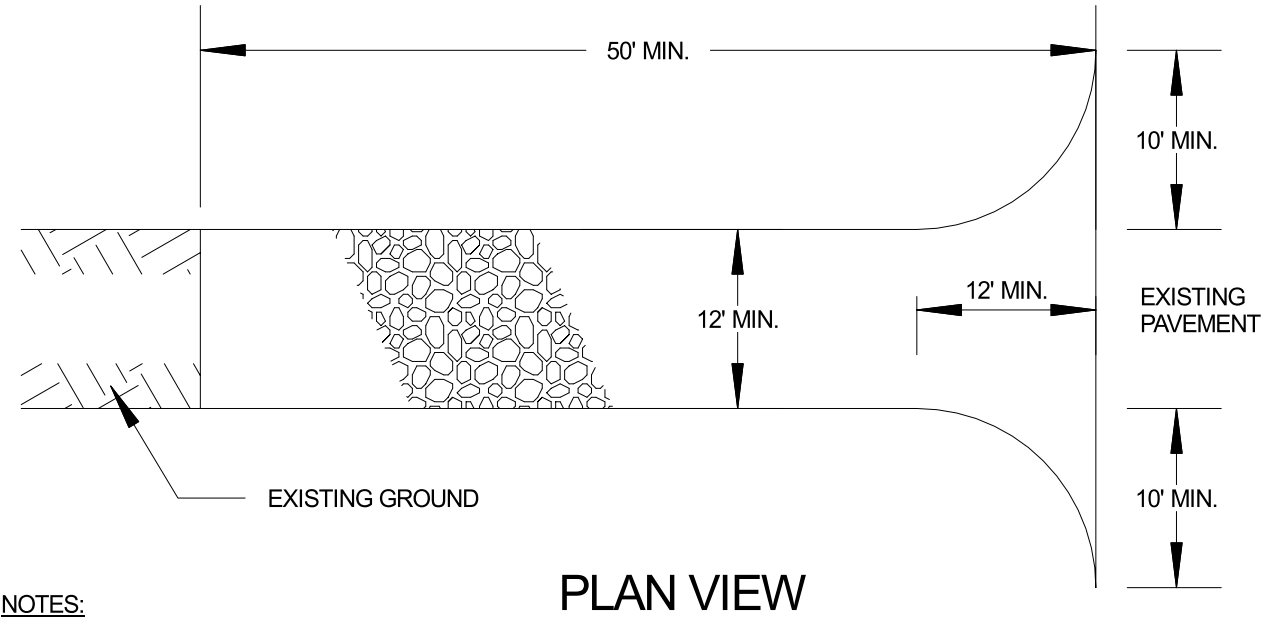
4) VOLUME IN GALLONS BETWEEN L.L. ON AND L.L. OFF SHOULD BE EQUAL TO OR GREATER THAN THE PUMPING RATE IN GPM.

WET WELL MOUNTED PUMP STATION DETAILS

Figure 7.2



PROFILE



PLAN VIEW

NOTES:

1) STONE SIZE - USE 1" - 4" STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.

2) LENGTH - NOT LESS THAN 50 FEET (EXCEPT ON A SINGLE RESIDENCE LOT WHERE A 30' MINIMUM LENGTH APPLIES).

3) THICKNESS - NOT LESS THAN EIGHT (8) INCHES.

4) WIDTH - TWELVE (12) FOOT MINIMUM, BUT NOT LESS THAN FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS. TWENTY-FOUR (24) FOOT IF SINGLE ENTRANCE TO SITE.

5) GEOTEXTILE MUST BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.

6) SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPES WILL BE PERMITTED.

7) MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO THE PUBLIC RIGHT-OF-WAY, ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO THE PUBLIC RIGHT-OF-WAY MUST BE REMOVED IMMEDIATELY.

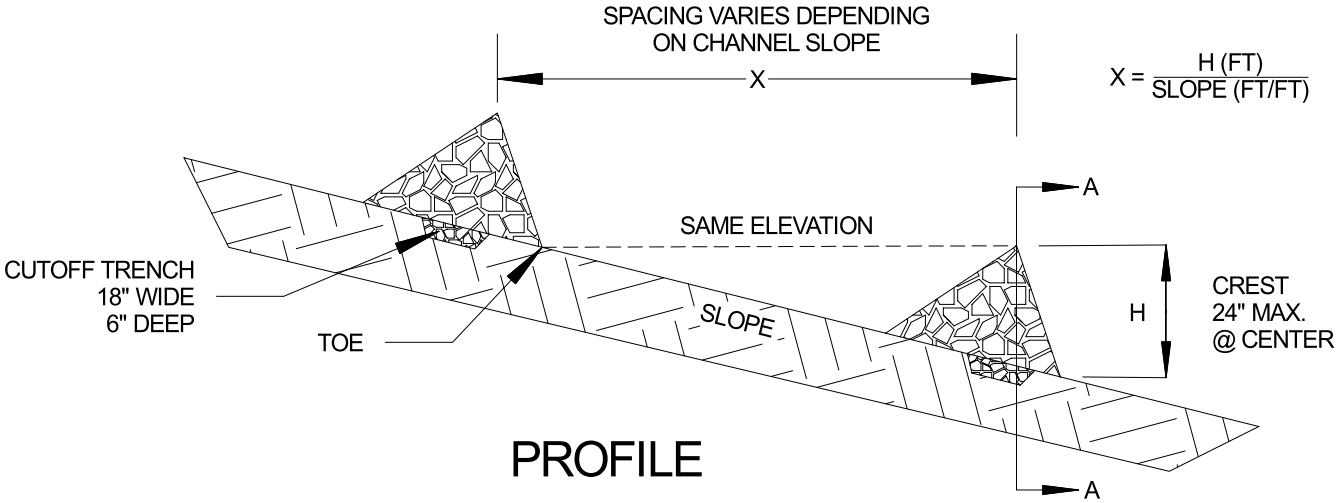
8) WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON A AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.

STABILIZED CONSTRUCTION ENTRANCE

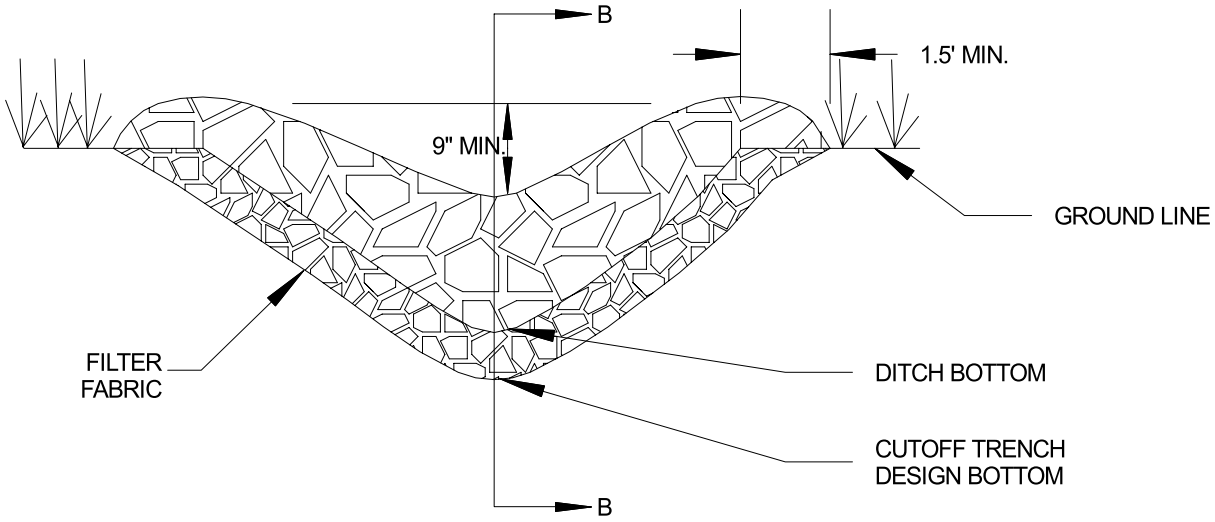
Figure 8.1

Mulch Material	Quality Standards	Per 1000 Sq. Ft.	Per Acre	Depth of Application	Remarks
Wood chips or shavings	Air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2-7”	Used primarily around shrub and tree plantings and recreation trails to inhibit weed competition. Resistant to wind blowing. Decomposes slowly.
Wood fiber cellulose (partly digested wood fibers)	Made from natural wood usually with green due and dispersing agent	50 lbs.	2,000 lbs.		Apply with hydromulcher. No tie down required. Less erosion control provided than 2 tons of hay or straw.
Gravel, Crushed Stone or Slag	Washed; Size 2B or 3A – 1 ½”	9 cu. yds.	405 cu. yds.	3”	Excellent mulch for short slopes and around plants and ornamentals. Use 2B where subject to traffic. (Approximately 2,000 lbs/cu. yd.). Frequently used over filter fabric for better weed control.
Hay or Straw	Air-dried. Free of undesirable seeds & coarse materials	90-100 lbs. 2-3 bales	2 tons (100-120 bales)	Cover about 90% surface	Use small grain straw where mulch is maintained for more than three months. Subject to wind blowing unless anchored. Most commonly used mulching material. Provides the best micro-environment for germinating seeds.
Jute twisted yarn	Undyed, unbleached plain weave. Warp 78 ends/yd., Weft 41 ends/yd. 60-90 lbs./roll	48”x 50 yds. or 48”x75 yds.	48”x 50 yds. or 48”x75 yds.		Use without additional mulch. Tie down as per manufacturer’s specifications. Good for centerline of concentrated water flow.
Excelsior wood fiber mats	Interlocking web of excelsior fibers with photodegradable plastic netting	8”x100” 2-sided plastic, 48”x180” 1-sided plastic	8”x100” 2-sided plastic, 48”x180” 1-sided plastic		Use without additional mulch. Excellent for seeding establishment. Approximately 72 lbs./roll for excelsior with plastic on both sides. Use 2-sided plastic for centerline of waterways.
Compost	Up to 3” pieces, moderately to highly stable	3-9 cu. yds.	134-402 cu. yds.	1-3”	Coarser textrured mulches may be more effective in reducing weed growth and wind erosion.
Straw or coconut fiber, or combination	Photodegradable plastic net on one or two sides	Ost are 6.5 ft. x 3.5 ft.	81 rolls		Designed to tolerate higher velocity water flow, centerlines of waterways, 60 sq. yds. per roll.

Guide to Mulch Materials, Rates, and Uses



PROFILE

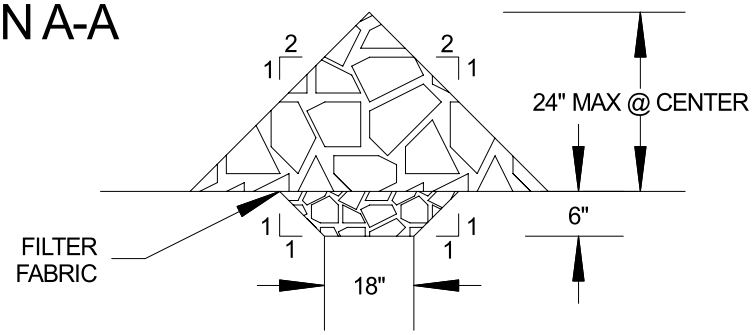


SECTION A-A

NOTES:

1) PROTECT THE CHANNEL DOWNSTREAM OF THE LWOEST CHECK DAM FROM SCOUR AND EROSION WITH STONE OR LINER AS APPROPRIATE.

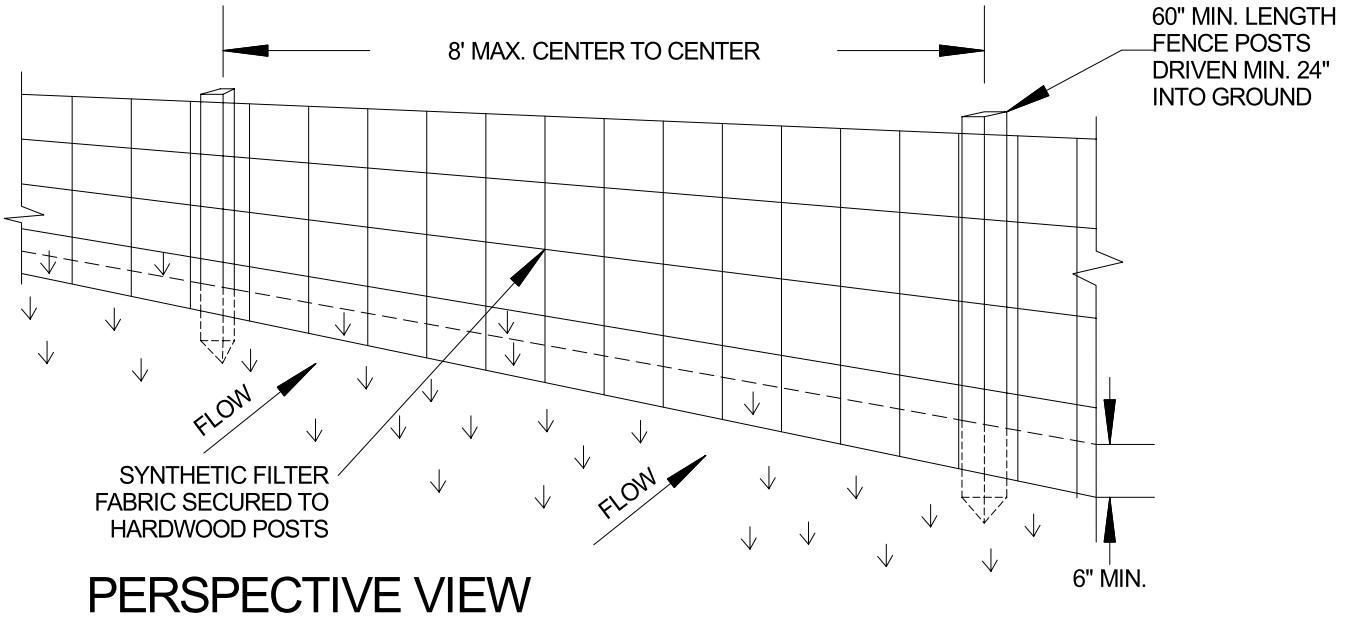
2) ENSURE THAT CHANNEL APPURTENANCES SUCH AS CULVERT ENTRANCES BELOW CHECK DAMS ARE NOT SUBJECT TO DAMAGE OR BLOCKAGE FROM DISPLACED STONE.

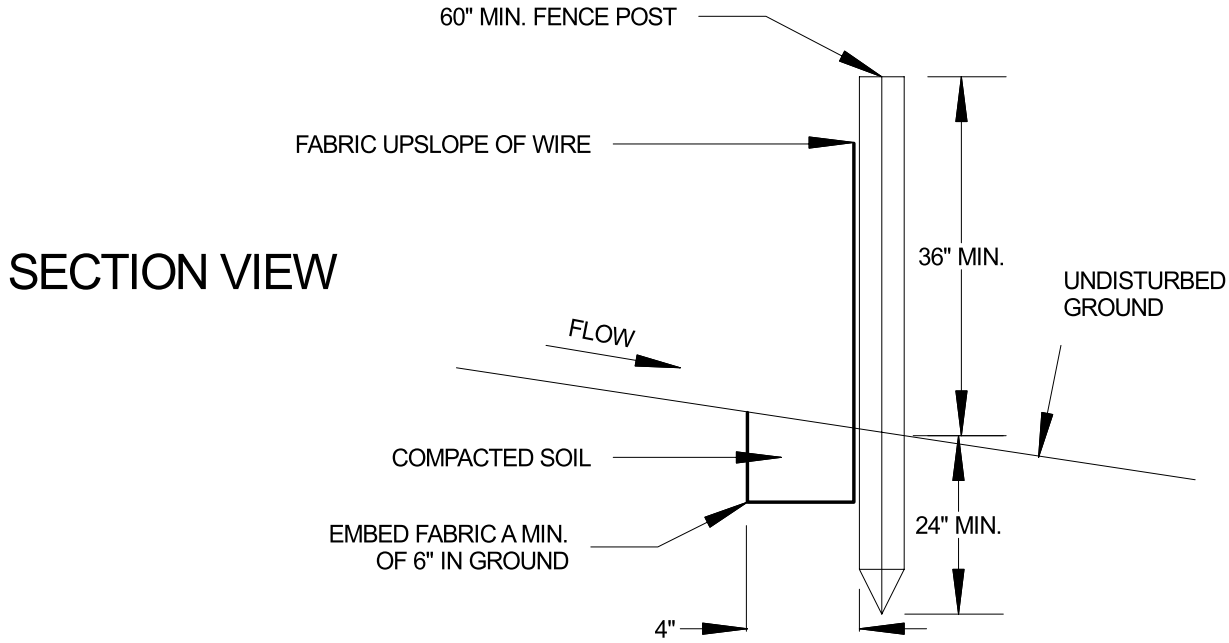


SECTION B-B

CHECK DAM

Figure 8.3





NOTES:

1) SILT FENCE SHALL BE INSTALLED & MAINTAINED DOWNSLOPE OF ALL DISTURBED AREAS & MATERIAL STOCKPILES TO PROTECT UNDISTURBED GRASSED OR LANDSCAPED AREAS, ROADWAYS OR WALKWAYS.

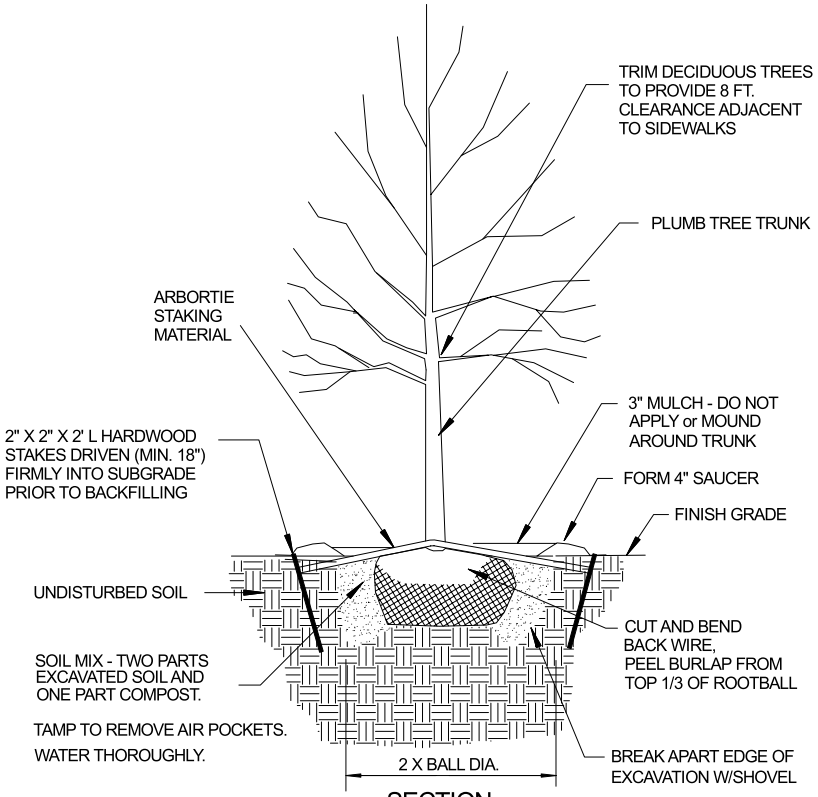
2) NO CONSTRUCTION ACTIVITY OR TRAFFIC SHALL BE ALLOWED DOWNSLOPE OF INSTALLED FENCES.

3) END SECTIONS OF FENCE SHALL BE ANGLED UPSLOPE & SHALL EXTEND BEYOND THE DISTURBED AREA SUCH THAT ALL SEDIMENT, SILT OR DEBRIS IS CONTAINED.

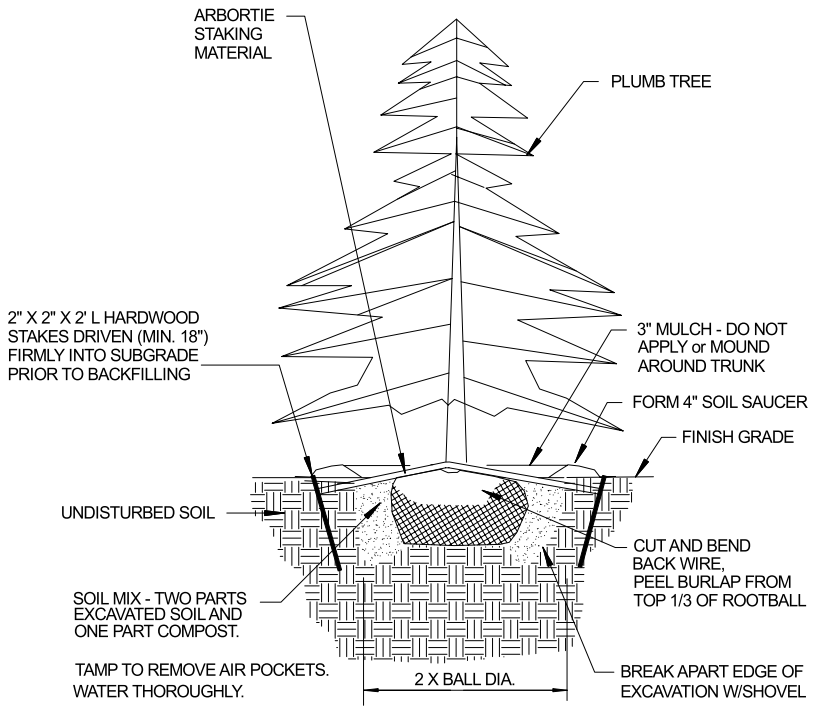
4) INSPECTIONS & MAINTENANCE SHALL BE PERFORMED AS REQUIRED UNTIL PERMANENT VEGITATION IS IN PLACE & THERE IS NO DANGER OF FURTHER EROSION.

SILT FENCE

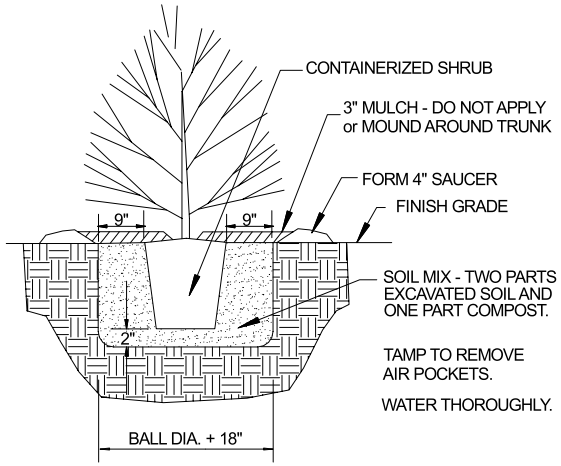
Figure 8.4



SECTION



SECTION



SECTION

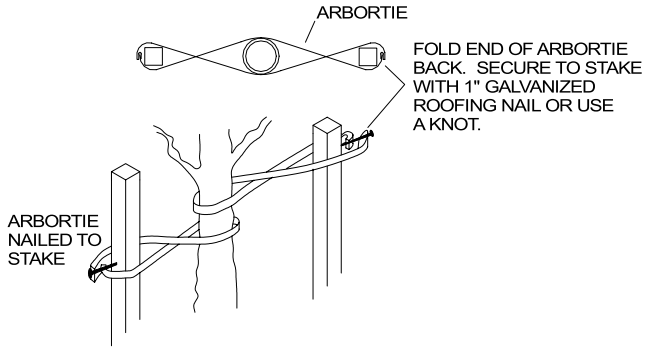
NOTES:

1) PLANT TREES SO THAT TOP OF ROOT FLARE IS EVEN WITH THE FINISH GRADE.

2) PLANT SHRUBS SO THAT TOP OF ROOT BALL IS EVEN WITH THE FINISH GRADE.

3) STAKING AS REQUIRED ONLY IN SITUATIONS WHERE TREES WILL BE SUBJECTED TO WINDY CONDITIONS AS DETERMINED BY THE PROJECT LANDSCAPE ARCHITECT.

4) EXAMINE TREES/SHRUBS AND REMOVE ALL NURSURY TAGS, ROPE, STRING AND SURVEYOR TAPE PRIOR TO PLANTING TO PREVENT GIRDLING.



Tree Caliper	Required Stakes & Ties
up to 2 inches	2 stakes with 2 ties
2 to 4 inches	3 stakes with 3 ties
over 4 inches	4 stakes with 4 ties

PLANTING DETAILS

Figure 9.1

APPENDIX D

Table of Contents

	Page
Section 1. Overview	
Overview	1
Definitions	3
Process diagram – algorithm	4
Section 2. Neighborhood Classifications	
Neighborhood Classification Definitions	5
Neighborhood Classification Matrix	9
List of streets assigned to each Neighborhood Classification	10
Neighborhood Classification Sections & Plans	15
Section 3. Guidelines and Recommendations	
Section 3A. Public/Private Coordination & Cooperation	
Public/Private Coordination & Cooperation	20
Sample agreement between the Town and the Landowner	21
Section 3B. Planting Guidelines	22
3B1. Overhead utility lines	23
3B2. Pruning for clearance	24
3B3. Roadside swales	25
3B4. Tree location inside greenbelt	26
3B5. Tree location at intersections	27
3B6. Offsets to driveway curb cuts	28
3B7. Offsets to underground utility services	29
3B8. Linear tree spacing	30
3B9. Tree planting detail	31
Section 3C. Recommended Street Trees	
Criteria for recommendation, genus and species diversity	32
Small trees	33
Medium trees	34
Large trees	35
Columnar trees	36
Trees for special situations	37
Section 4. Guidelines for street tree plantings in future neighborhoods	
Guidelines for street tree plantings in future neighborhoods	38
Section 5. Funding	40
Section 6. References	44
Section 7. Field Reconnaissance Appendix	
Street field reconnaissance data sheets	45

Section 1

Overview

Section 1. Overview

The Colchester Street Tree Master Plan is a planning document. The purpose of the Plan is to guide the Town in establishing an urban and rural streetscape that will enhance the quality of life in the community.

Relatively few of Colchester's residential neighborhoods were planted with street trees at the time of their creation. The Colchester Street Tree Master Plan proposes a strategy to retrofit these existing neighborhoods with street trees. The strategy for each street is tailored to fit the existing site conditions that are found on that particular street.

Section 2. Neighborhood Classifications

The Colchester Street Tree Master Plan includes roadways that serve urban style development such as Porters Point Road or Colonial Drive. The CSTMP does not include roadways that serve a lower density rural style of development such as East Road or Coon Hill Road. Private roads that do not have a public right-of-way are not included.

Field reconnaissance was used to evaluate each street in the CSTMP. Each street was assigned into one of five Neighborhood Classifications based upon an evaluation of the following criteria: width of road R.O.W., width of roadway, roadway surface, presence of existing street trees, width of greenbelt, curbs, roadside swales, drainage, existing sidewalk or bike path, future sidewalk or bike path, electric, telephone, CATV (cable television), street lights, water lines, natural gas lines, sanitary sewer, existing native vegetation, and the density of existing front yard trees.

The five Neighborhood Classifications and planting strategies are:

Neighborhood Classification 1. No planting
Neighborhood Classification 2. Inside road right-of-way traditional row planting
Neighborhood Classification 3. Inside road right-of-way gap planting
Neighborhood Classification 4. Outside road right-of-way row planting
Neighborhood Classification 5. Out side road right-of-way gap planting

Section 3A. Public / Private Coordination & Agreement

In some neighborhoods, street trees cannot be planted inside the road right-of-way due to existing conditions such as roadside swales or utility conflicts. The strategy on these streets may be to plant outside of the right-of-way on private property with the consent of the landowner. This section includes a draft agreement between the Town of Colchester and the private landowner that clearly defines the rights and responsibilities of both parties.

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Section 3B. Planting Guidelines
The Colchester Street Tree Master Plan establishes Planting Guidelines to address predictable conditions and probable conflicts that will occur during the future design and implementation phases. These guidelines recommend preferred solutions to items such as isolation distances from existing utilities, site distances to intersections, offsets from driveway curb cuts, and preferred locations in greenbelts.

Section 3C. Recommended Trees
This section includes lists of recommended street trees for the Town of Colchester. These lists have been screened to provide the species and cultivars with the best characteristics to fit the conditions in the five Colchester Neighborhood Classifications. The other objective of this list of trees is to encourage the planting of a diversity of species throughout the Town to reduce the risk of a catastrophic loss of street tree inventory from infestation or disease.

Section 4. Guidelines for street tree plantings in future neighborhoods
This section includes greenbelt dimensions, tree locations, tree spacing, and other guidelines for the design of future neighborhoods.

Section 5. Funding
Grants will be the primary source for funding future street tree plantings. This section includes a list of available grants and the agencies that administer them.

Section 6. References
This section is a list of reference materials that can provide additional information that may be helpful during the future implementation phases.

Section 7. Field Reconnaissance Appendix
This section documents the field reconnaissance for each street in the study. It will be a useful reference during the future design phase.

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Definitions

Greenbelt
The area available for planting trees and grass located between the edge of pavement or inside of curb and the right-of-way. The greenbelt may also include utilities like water lines, electric, telephone, cable, and natural gas.

Traditional Row Planting
A traditional row planting is a linear street tree planting usually of the same species. A traditional street tree planting typically runs the entire length of the street on both sides. For purposes of this plan, a row planting may occur either inside the road right-of way or outside on private property. The aesthetic strength of this strategy comes from rhythm, repetition of form, putting and reinforcing the geometry of the roadway.

Row Planting
On some streets, a traditional row planting may not fit with existing conditions such as randomly spaced existing tree canopies. However, a row planting may still be planted in the form of several short rows of three or more trees separated by sections of existing tree canopies. Different tree species may be used for each short row but the species should be selected so that the mature heights and crown shapes are similar. This strategy is less formal and rhythmic than the traditional row but it still results in a successful streetscape.

Gap Planting
Gap planting is a street tree planting of one or two trees. For purposes of this plan, a gap planting may occur either inside the road right-of-way or outside on private property. Gap plantings are located on streets with existing trees, utilities, or other existing features that preclude the opportunity to do a traditional row planting.

Genus, species, and cultivars
These three terms are used to identify and classify trees.

A genus is a group of species possessing fundamental traits in common but differing in other lesser characteristics. An example of a genus is Acer or Maple.

A species is a natural group of trees composed of similar individuals which can produce similar offspring usually including several minor variations. An example of a species is Acer saccharum or Sugar Maple.

A cultivar is a group of trees which is clearly distinguished by any characteristics and when reproduced retains its distinguishing characteristics. An example of a cultivar is Acer saccharum 'Green Mountain' or the Green Mountain Sugar Maple. As an example, the defining characteristic for the Green Mountain Sugar Maple is the ability to tolerate heat and dry restricted growing areas that is superior other trees in the species Sugar Maple

Columnar Trees
Columnar trees have shapes that are significantly taller than their width. Columnar trees are appropriate choices where space is restricted such as adjacent to overhead power lines.

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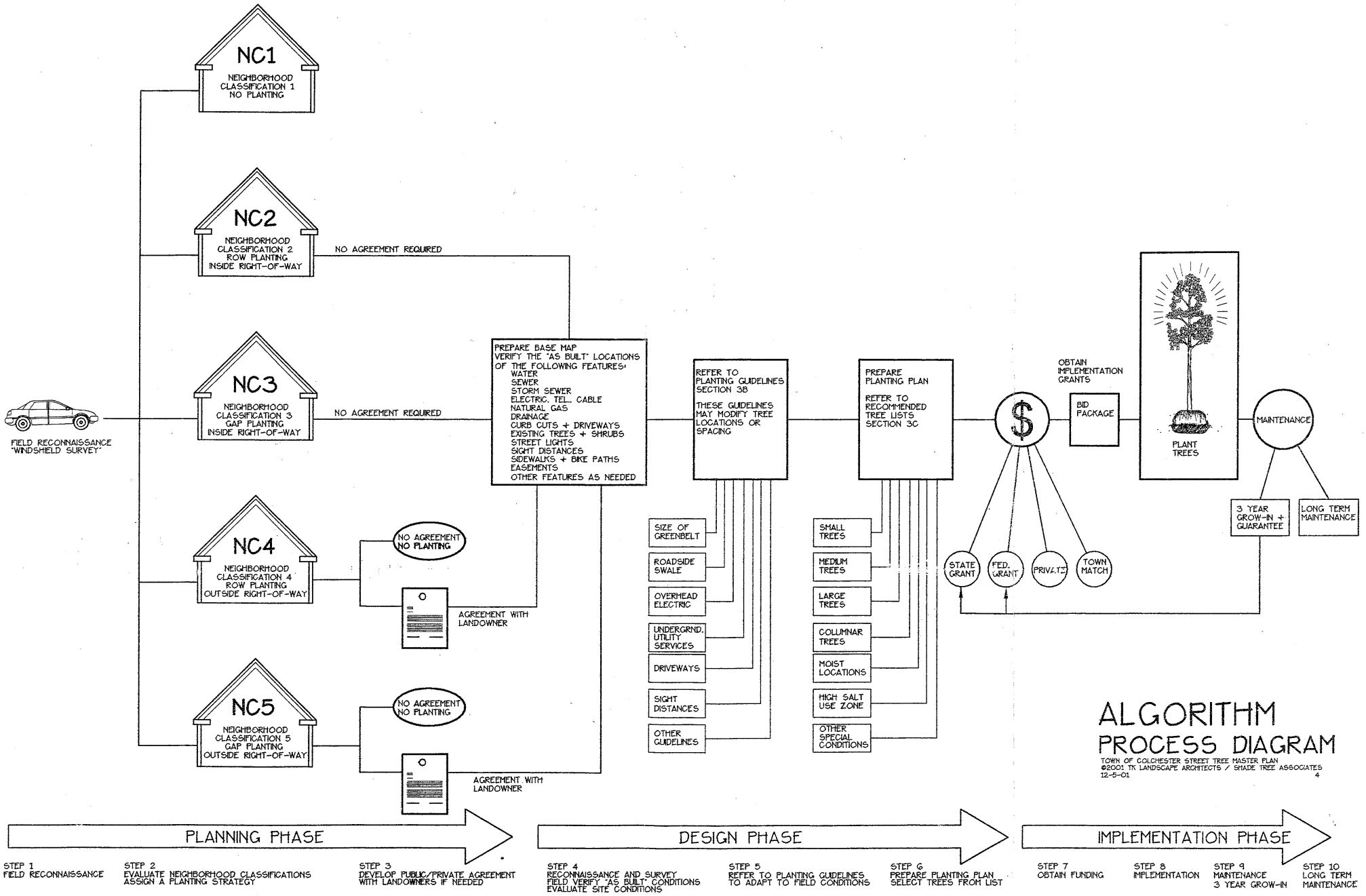
NC1
NEIGHBORHOOD CLASSIFICATION 1 NO PLANTING
NC2
NEIGHBORHOOD CLASSIFICATION 2 ROW PLANTING INSIDE RIGHT-OF-WAY
NO AGREEMENT REQUIRED
NC3
NEIGHBORHOOD CLASSIFICATION 3 GAP PLANTING INSIDE RIGHT-OF-WAY
NO AGREEMENT REQUIRED
NC4
NEIGHBORHOOD CLASSIFICATION 4 ROW PLANTING OUTSIDE RIGHT-OF-WAY
NO AGREEMENT NO PLANTING
AGREEMENT WITH LANDOWNER
NC5
NEIGHBORHOOD CLASSIFICATION 5 GAP PLANTING OUTSIDE RIGHT-OF-WAY
NO AGREEMENT NO PLANTING
AGREEMENT WITH LANDOWNER
FIELD RECONNAISSANCE "WINDSHIELD SURVEY"
PREPARE BASE MAP
VERIFY THE "AS BUILT" LOCATIONS OF THE FOLLOWING FEATURES:
WATER
SEWER
STORM SEWER
ELECTRIC, TEL, CABLE
NATURAL GAS
DRAINAGE
CURB CUTS + DRIVEWAYS
EXISTING TREES + SHRUBS
STREET LIGHTS
SIGHT DISTANCES
SIDEWALKS + BIKE PATHS
EASEMENTS
OTHER FEATURES AS NEEDED
REFER TO PLANTING GUIDELINES SECTION 3B
THESE GUIDELINES MAY MODIFY TREE LOCATIONS OR SPACING
SIZE OF GREENBELT
ROADSIDE SWALE
OVERHEAD ELECTRIC
UNDERGRND. UTILITY SERVICES
DRIVEWAYS
SIGHT DISTANCES
OTHER GUIDELINES
PREPARE PLANTING PLAN
REFER TO RECOMMENDED TREE LISTS SECTION 3C
SMALL TREES
MEDIUM TREES
LARGE TREES
COLUMNAR TREES
MOIST LOCATIONS
HIGH SALT USE ZONE
OTHER SPECIAL CONDITIONS
$
OBTAIN IMPLEMENTATION GRANTS
BID PACKAGE
STATE GRANT
FED. GRANT
PRIVATE
TOWN MATCH
PLANT TREES
MAINTENANCE
3 YEAR GROW-IN + GUARANTEE
LONG TERM MAINTENANCE
ALGORITHM
PROCESS DIAGRAM
TOWN OF COLCHESTER STREET TREE MASTER PLAN
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12-5-01
4
PLANNING PHASE
DESIGN PHASE
IMPLEMENTATION PHASE
STEP 1
FIELD RECONNAISSANCE
STEP 2
EVALUATE NEIGHBORHOOD CLASSIFICATIONS
ASSIGN A PLANTING STRATEGY
STEP 3
DEVELOP PUBLIC/PRIVATE AGREEMENT WITH LANDOWNERS IF NEEDED
STEP 4
RECONNAISSANCE AND SURVEY
FIELD VERIFY "AS BUILT" CONDITIONS
EVALUATE SITE CONDITIONS
STEP 5
REFER TO PLANTING GUIDELINES TO ADAPT TO FIELD CONDITIONS
STEP 6
PREPARE PLANTING PLAN
SELECT TREES FROM LIST
STEP 7
OBTAIN FUNDING
STEP 8
IMPLEMENTATION
STEP 9
MAINTENANCE
3 YEAR GROW-IN
STEP 10
LONG TERM MAINTENANCE

Section 2

Neighborhood Classifications

Every street in the study area was evaluated and placed into one of five neighborhood classifications based upon observations made during the field reconnaissance task. The following criteria were inventoried during the field reconnaissance: width of the road right-of-way, width of roadway, roadway surface, presence of existing street trees, width of greenbelt, curbs, roadside swales, drainage, existing sidewalk or bike path, future sidewalk or bike path, electric, telephone, CATV, street lights, water lines, natural gas lines, sanitary sewer, existing native vegetation, and the density of existing front yard trees. A sample field report form is attached.

Each of the five Neighborhood Classifications represents a different strategy for planting street trees that fits the existing conditions on that street.

NC1. Neighborhood Classification 1 - No Planting

These streets are recommended to receive no street tree planting for one or more of the following reasons. On some streets the canopy from a high density of existing front yard trees on abutting properties may extend over the available greenbelt with no significant gaps. These streets already have an attractive wooded streetscape created by these front yard trees. On other streets in this classification, there may already be an existing traditional street tree planting that is in good condition. Finally, some streets in this classification have "as built" locations of utilities or drainage swales that preclude the planting of street trees.

NC2. Neighborhood Classification 2 - Inside road right-of-way traditional row planting

These are streets that do not have existing street trees inside the road right-of-way. They may have low, medium, or high density of existing trees in the front yards of abutting properties. They typically have an existing sidewalk on one side of the street. The available greenbelt exceeds 4' in width. The road right-of-way is typically 60 feet wide. There are few conflicts with utilities or existing tree canopies inside the road right-of-way. These streets are recommended to receive a traditional linear street tree planting inside the road right-of-way.

NC3. Neighborhood Classification 3 - Inside road right-of-way gap planting

These are streets that have a high density of existing mature trees in the front yards of abutting properties. In some cases the canopies of these front yard trees extend over the greenbelt. On some streets, there are some existing trees inside the road right-of-way but these are random, non-linear, and of multiple species. In some places, there are random treeless gaps in an otherwise densely treed street. To fill in these gaps in the streetscape, NC3 streets are recommended to receive "gap planting" inside the road right-of-way wherever space permits. These gap plantings are excellent opportunities to plant the less common species to increase the overall diversity of species within the Town.

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NC4. Neighborhood Classification 4 - Outside road right-of-way row planting
These are streets that do not have existing street trees inside the road right-of-way and have a low to medium density of trees in the front yards of abutting properties. There are conflicts that prevent planting street trees inside the road right-of-way such as existing utilities, a narrow right-of-way width, a greenbelt less than 4 feet wide, or roadside drainage swales. Because the abutting front yards are relatively open, the recommended street tree planting for NC4 streets is a linear row of trees outside of the road right-of-way on the front yards of abutting properties. This requires the consent of these abutting landowners (Refer to Section 3A). The location should be as close to the road as possible and the species should be selected for the potential to grow a canopy over the roadway in the future.

NC5. Neighborhood Classification 5 - Outside road right-of-way gap planting
These streets have a high density of front yard street trees that also extend over the greenbelt in many locations. These privately owned trees establish a dense streetscape outside of the road right-of-way. The recommendation is to fill gaps in this existing streetscape with tree plantings outside of the road right-of-way. This requires the consent of these abutting landowners (Refer to Section 3A). These gap plantings are excellent opportunities to plant the less common species to increase the overall diversity of species within the Town.

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Notes on Neighborhood Classifications

A. The Neighborhood Classification for each street should be reevaluated in the future during the Planting Plan Design Phase. The field reconnaissance task in the scope of work for the Colchester Street Tree Master Plan was a visual evaluation with limited taped measurements. During the Design Phase, there will be more accurate information about the "as built" locations of existing features that may show that a street should be reclassified. For example, the location of certain features relative to the street right-of-way boundary was established visually in this Street Tree Master Plan. A surveyed Planting Plan may show that certain existing features that were thought to be inside the road right-of-way may actually be located outside of the R.O.W. on private property. The recommended protocol is to reclassify the street using the more accurate information and proceed using the appropriate planting strategy.

B. One particular complication was noted on several streets; some streets have different conditions on opposite sides of the street or from one end of the street to the other. For example, some streets have a sidewalk and an open greenbelt on one side of the street leading to a NC2 classification. The complication is that on the opposite side of the street, there may be an existing tree canopy that overhangs the greenbelt right up to the edge of pavement. These streets are classified as NC2 – Neighborhood Classification 2 – Inside Road Right-of-Way Traditional Row Planting. These streets will appear on the NC2 list even though one side of the street is classified as NC1 – No planting. The logic for this decision is that NC2 requires specific future action and these streets need to be listed in a Neighborhood Classification that will be included in the future Design and Implementation phases.

C. Some streets that were classified as Neighborhood Classification 1 – No Planting may actually have isolated locations for gap planting that were overlooked during the field reconnaissance. These streets should be reclassified as NC3 or NC5 gap plantings if more accurate information becomes available in the future.

D. Some streets that were classified as Neighborhood Classification 5 – Outside Road Right-of-Way Gap Planting already have a dense streetscape created by the existing front yard trees. These streets were objectively classified as NC5 as long as there were locations where it was technically possible to plant a tree with a high probability of success. However, there may be very little value added to an already heavily treed street by planting a few more trees. These streets may receive low priority when funding is considered or they may be reclassified as NC1 – No Planting.

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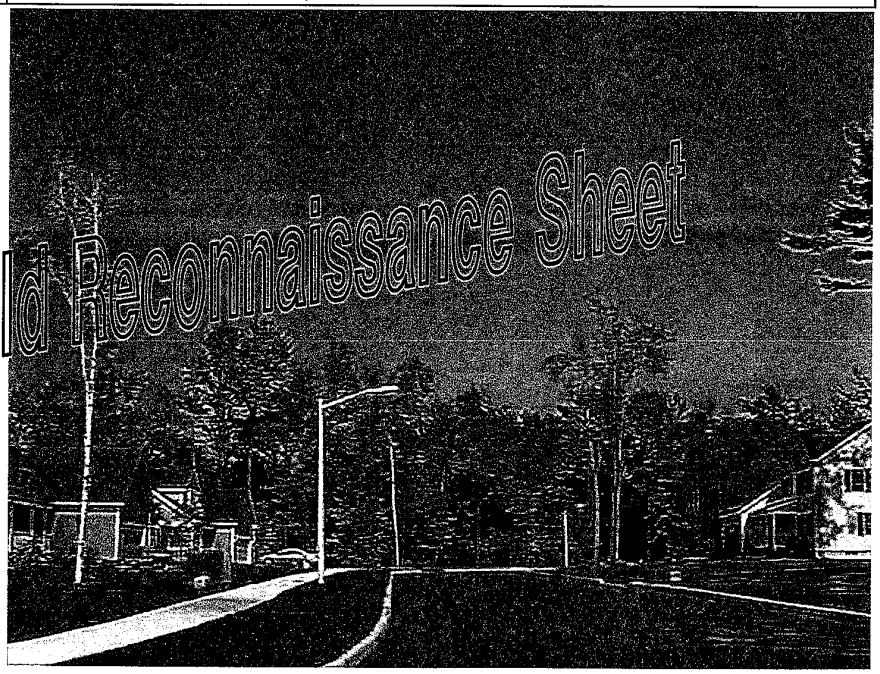
Colchester Street Tree Master Plan
Field reconnaissance

E911 Street Name	**Colonial Drive (extension section)**
Town Highway #	53
Neighborhood classification	**NC2 – Inside road right-of-way traditional row planting**
Width of right-of-way	60'
Width of roadway & surface	30' asphalt
Existing street trees	No
Width of greenbelt	9' / 15'
Curbs, swales, drainage	Concrete curb, catch basins, storm sewer
Existing sidewalk or bike path	One side, 5' concrete sidewalk
Future sidewalk or bike path	None planned
Electric, telephone, cable	Underground
Street lights	Yes, in greenbelt offset 6' ± from curb
Water	Yes
Natural gas	Yes
Sanitary sewer	On-site
Road salt high use zone	Yes on steep section
Existing native vegetation	White pine, oak, maple, birch, poplar
Notes	Low density existing front yard trees



Neighborhood Classification Matrix

	Neighborhood Classifications				
Existing tree inventory	NC1	NC2	NC3	NC4	NC5
Existing street trees inside road right-of-way	■				
Low to medium density front yard trees		■		■	
High density front yard trees		■	■		■
Front yard tree canopy extends over greenbelt	■				■

	Neighborhood Classifications				
Planting strategy	NC1	NC2	NC3	NC4	NC5
Traditional row planting inside right-of-way		■			
Gap planting inside right-of-way			■		
Row planting outside of right-of-way				■	
Gap planting outside of right-of-way					■
No planting	■				

One or more of the following criteria may modify each planting strategy. Refer to Sections 3A, 3B, and 3C for a sample agreement for permission to plant on private property, planting guidelines, and recommended tree species lists related to these modifiers:

Seasonal high water table
Salt zones
Width of greenbelt
"As built" locations of utilities:
- Underground electric, telephone, CATV
- Overhead electric, telephone, CATV
- Water lines
- Natural gas lines
- Sanitary sewer

Curbs
Roadside swales
Existing native vegetation in the neighborhood
Consent of adjacent landowners

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List of Streets assigned to each Neighborhood Classification

NC1. Neighborhood Classification 1 - No planting

Abigail Drive
Airport Road
Andrea Lane
Bayview Road
Birchwood Drive
Biscayne Heights
Bissette Drive
Canyon Estates Drive
Canyon Road
Chimney Hill Drive
Dunlop Way
Edgewood Drive
Holy Cross Road
Jason Drive
Joey Drive
Juniper Drive
Lakewood Court
Landing Avenue
Laura Lane
Lavigne Road
Leoray Court
Lois Lane
Mazza Court
Mountain View Road (upper)
Northland Court
Oak Circle (1 side)
Orion Drive
Pine Lane
Pretty Road
River Road
Rudgate Road
Shady Lane
South Oak Circle
Summit Ridge
Tanglewood Drive
Thayers Bay
Water Tower Circle
Watkins Road
Westview Road
Westward Drive
Windemere Way
Young Street

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List of Streets assigned to each Neighborhood Classification

NC2. Neighborhood Classification 2 - Inside road right-of–way row planting

Acorn Lane
Al Shir Road
Arbor Lane
Aurielle Drive
Barbara Terrace
Barnes Avenue
Blackberry Circle
Bluebird Circle (1 side)
Bonanza Park
Buckingham Drive
Burnham Lane
Casey Lane
Cedar Creek Road
Colonial Drive
Conquest Circle
Country Meadows
Creek Glen
Crossfield Drive
Deer Lane
Ethan Allen Avenue (north end)
Everbreeze Drive
Fastnet Circle (1 side)
Fern Court
Field Green Drive
Ford Lane (1 side)
Forman Drive
Fox Run
Giffen Court
Greenwood Drive
Grey Birch Drive
Hegeman Avenue (south end 1 side)
Hercules Drive
Hidden Oaks Drive
Hilltop Court
Holbrook Court
Hollow Creek
Horizon View
Hummingbird Drive
Indian Circle
Ira Allen Circle
Justin Morgan Drive
Kylies Way
Lawrence J. Drive
Liberty Lane
Longwood Circle
Mallard Drive
Maple Ridge Drive
Mercier Drive
Midnight Pass
Morellen Lane
Nice Way
Norway Drive (1 side)
Oak Circle (1 side)
Oak Ridge Drive (1 side)
Old Sawmill Road
Orchard Circle
Orchard Drive
Overlake Drive
Parkwood Drive
Peer Lane
Pine Meadow Drive
Ponderosa Drive
Renkin Drive
Reynolds Drive
Richfield Lane
Robin Road (1 side)
Ryan Place
Shetland Lane
South Bay Circle
Sunderland Woods
Thibault Drive
Thomas Drive
Timberlake Drive
Tower Ridge Circle
Turquoise Drive
Valleyfield Drive
Wall Street
Wheatley Court
Wintergreen Drive
Woodrose Lane

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List of Streets assigned to each Neighborhood Classification

NC3. Neighborhood Classification 3 - Inside road right-of-way gap planting

Belair Drive
Chestnut Lane
Church Road
Cobbleview Drive
Creek Farm Road
Dalton Drive
Gregg Lane
Heritage Lane
Leclair Drive
Lindale Road
Marble Island Road
Norway Drive (1 side)
Oak Ridge Drive (1 side)
Porters Point Road
Red Oak Drive
Robin Road (1 side)
Village Drive
Waybury Road

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List of Streets assigned to each Neighborhood Classification

NC4. Neighborhood Classification 4 - Outside road right-of-way row planting

Cedar Ridge Drive (at intersection)
Eagle Park Drive
Hillcrest Lane (at intersection)
Meadow Drive
Mountain View Road (lower)
North Harbor Road
Shore Acres Drive (partial)
Woodside Drive

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List of Streets assigned to each Neighborhood Classification

NC5. Neighborhood Classification 5 - Outside road right-of-way gap planting

Bean Road
Bellwood Avenue
Birch Drive
Don Mar Terrace
Jeffrey Drive
Julie Drive
New England Avenue
Princess Anne Drive
Shore Acres Drive (partial)
Sunset Drive
Williams Road

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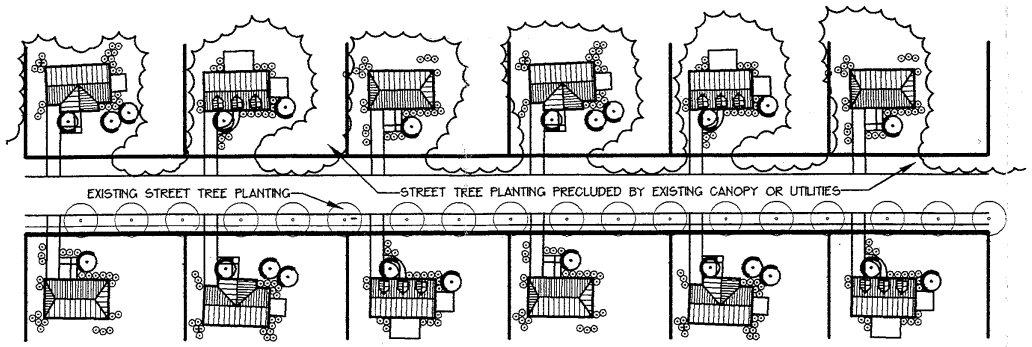

NEIGHBORHOOD CLASSIFICATION 1 PLAN

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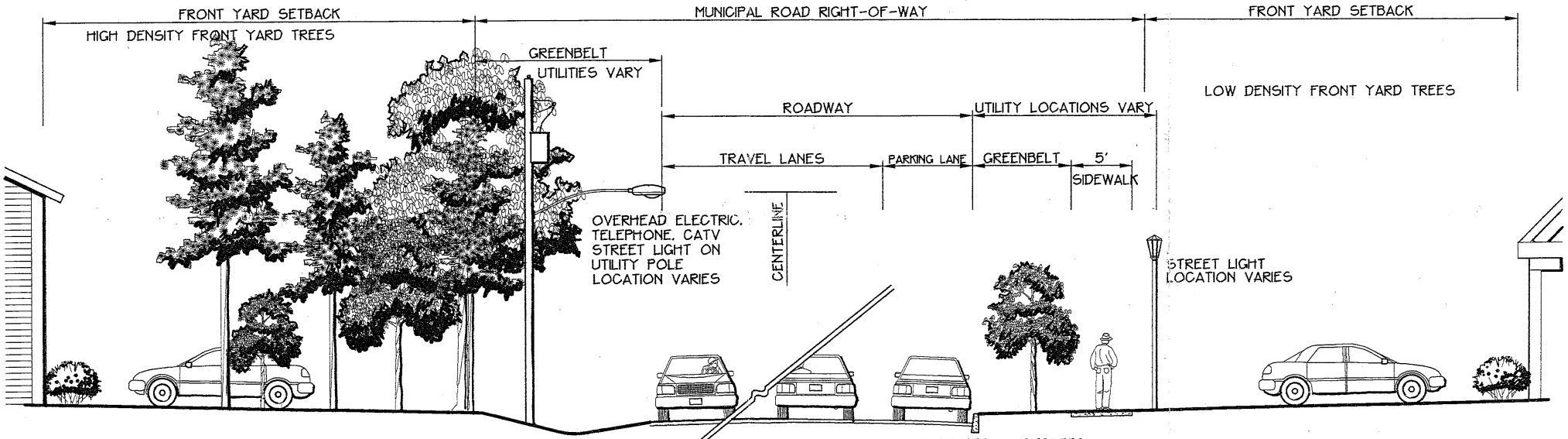

NEIGHBORHOOD CLASSIFICATION 1 SECTION

1"=8'0"

NC1

NEIGHBORHOOD CLASSIFICATION 1

NO PLANTING

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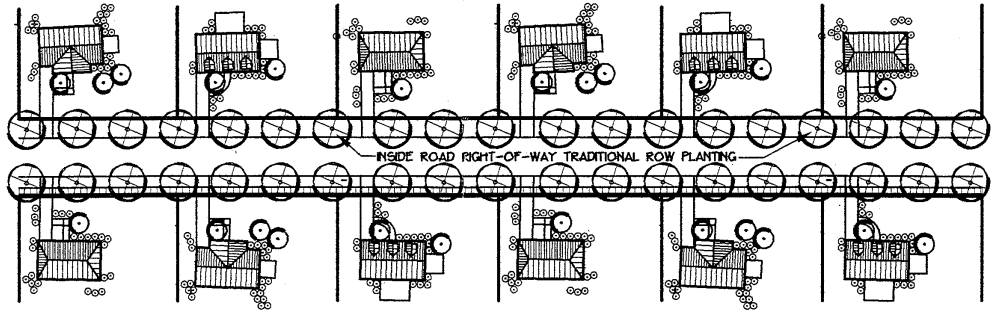

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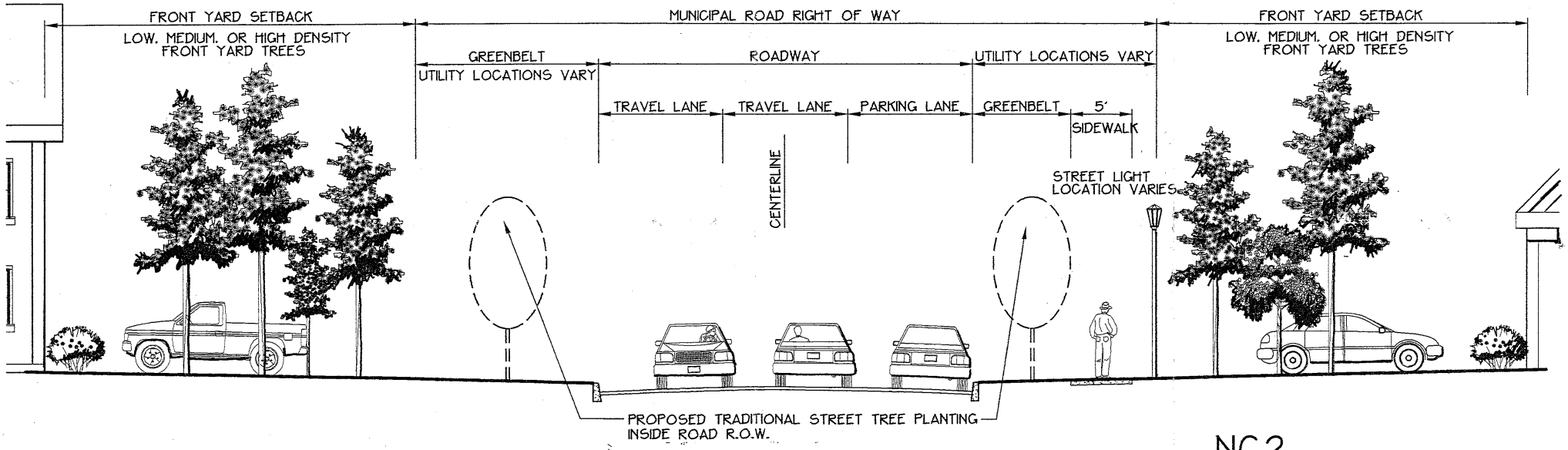

NEIGHBORHOOD CLASSIFICATION 2 SECTION
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NC2

NEIGHBORHOOD CLASSIFICATION 2
INSIDE ROAD RIGHT-OF-WAY
TRADITIONAL ROW PLANTING

TOWN OF COLCHESTER STREET TREE MASTER PLAN
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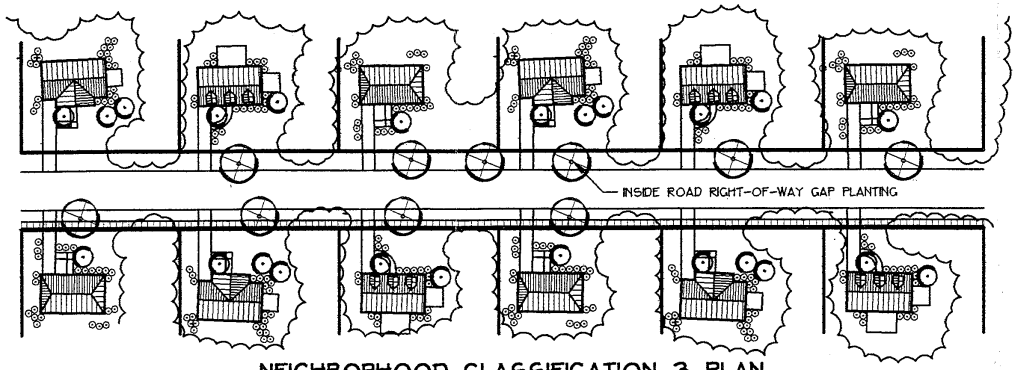

NEIGHBORHOOD CLASSIFICATION 3 PLAN
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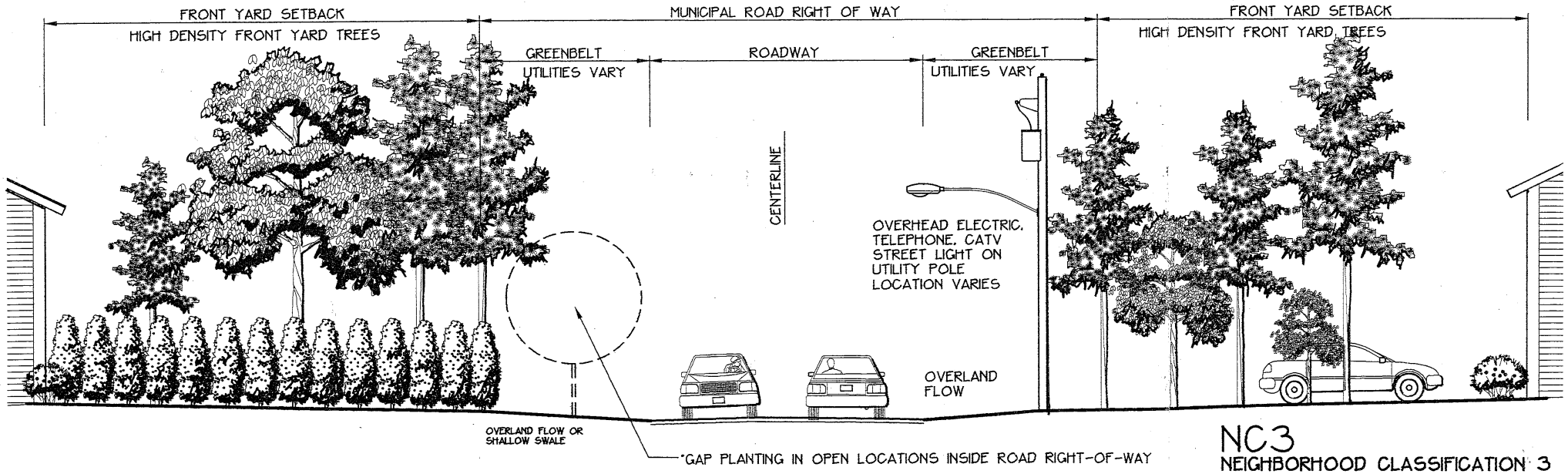

NEIGHBORHOOD CLASSIFICATION 3 SECTION
1"=8'0"

NC3

NEIGHBORHOOD CLASSIFICATION 3
INSIDE ROAD RIGHT-OF-WAY
GAP PLANTING

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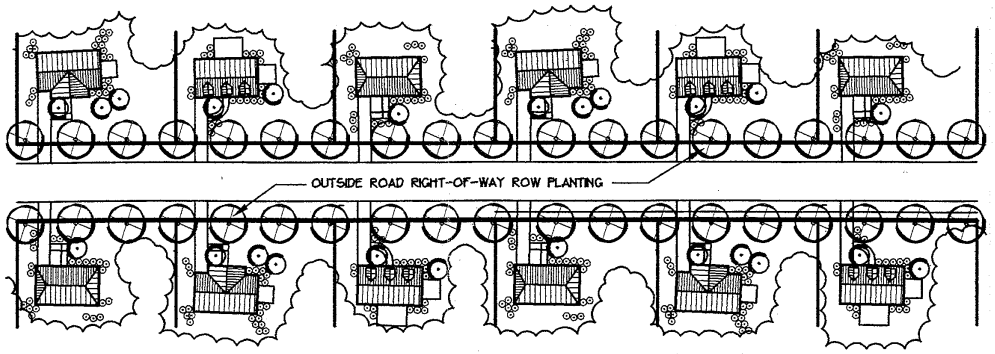

NEIGHBORHOOD CLASSIFICATION 4 PLAN
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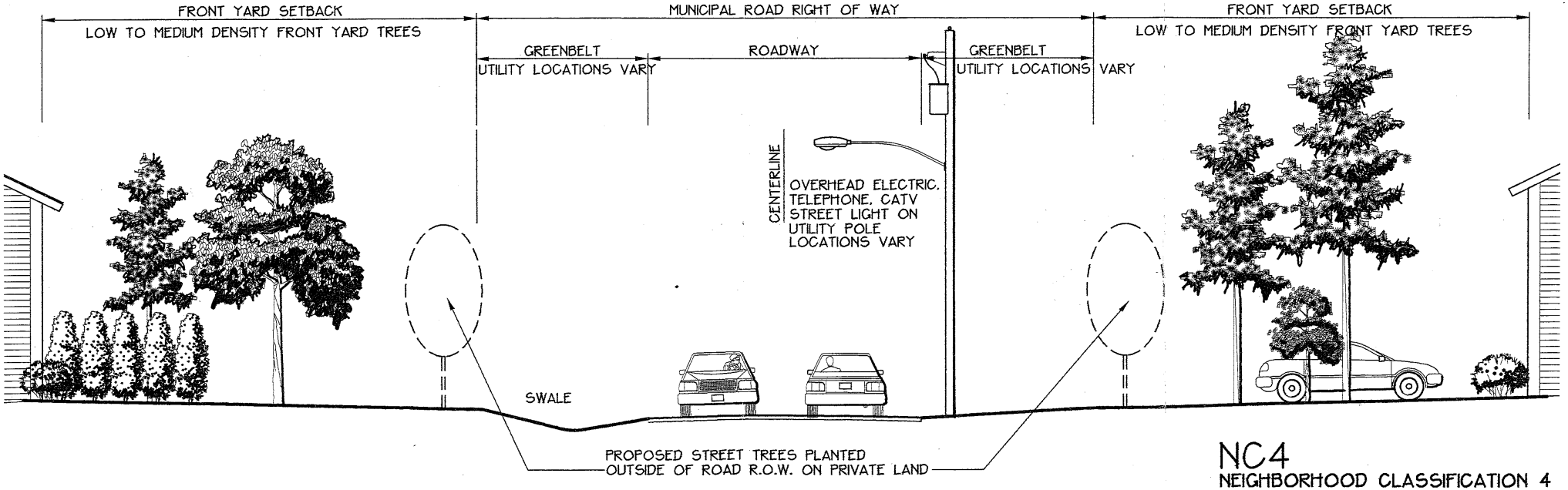

NEIGHBORHOOD CLASSIFICATION 4 SECTION
1"=8'0"

NC4
NEIGHBORHOOD CLASSIFICATION 4
OUTSIDE ROAD RIGHT-OF-WAY ROW PLANTING

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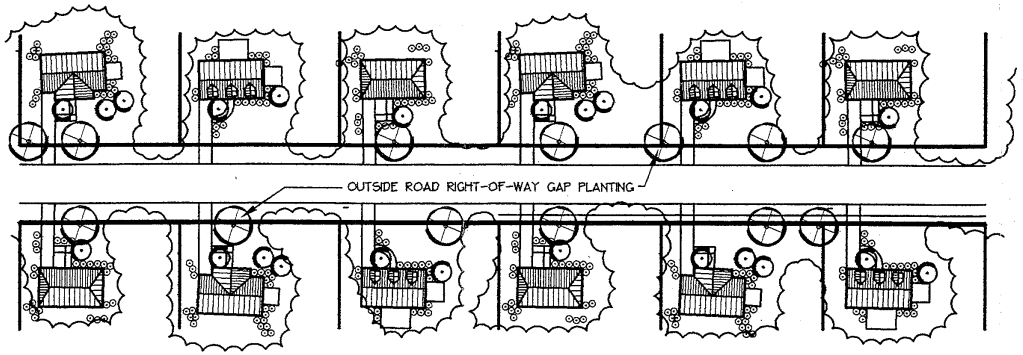

NEIGHBORHOOD CLASSIFICATION 5 PLAN
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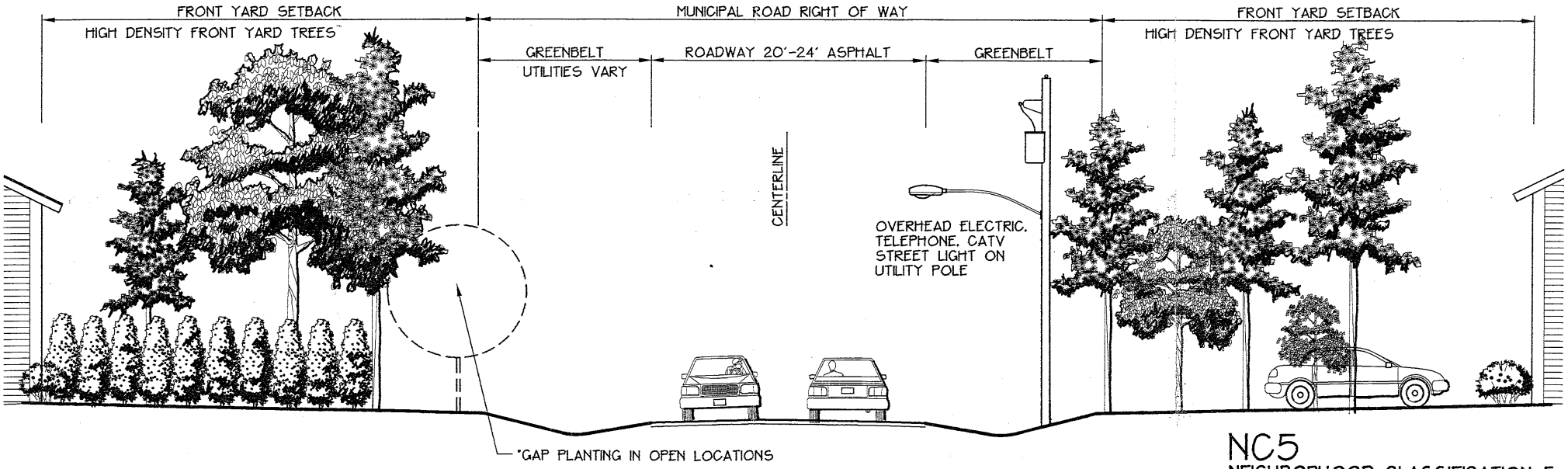

NEIGHBORHOOD CLASSIFICATION 5 SECTION
1"=8'0"

NC5

NEIGHBORHOOD CLASSIFICATION 5
OUTSIDE ROAD RIGHT-OF-WAY
GAP PLANTING

TOWN OF COLCHESTER STREET TREE MASTER PLAN
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Section 3A

Public / Private Coordination & Agreement

The implementation of this Master Plan will depend on coordination and cooperation between the Town of Colchester Department of Public Works and private landowners.

In Neighborhood Classifications NC2 and NC3 the street trees are located inside the road rights-of-way. The Town already has the authority to plant in these locations.

In Neighborhood Classifications NC4 and NC5 the proposed street trees are located outside of the road right-of-way on the front yard of abutting landowners. Obviously, this will require coordination and cooperation between all parties. The landowner will need to enter into a legal agreement with the Town to give permission for the tree planting. The species and locations shall be determined by the town subject to approval by the landowner. The Town will pay for the tree, and the planting of the tree. The tree will become the property of the landowner and the landowner will acknowledge that maintenance of the tree becomes their responsibility after the three year warranty period expires.

The Town should anticipate that some homeowners will not agree to have a tree planted on their property. Reasons for this may include a preference for an open lawn, obstruction of view, unwanted shade, leaf litter, or any number of unforeseeable reasons.

This strategy has been discussed with staff at the Urban & Community Forestry Program at the Vermont Department of Forest, Parks, & Recreation. Our understanding is that this strategy qualifies for funding through federal and state grant programs as long as the plan includes a minimum three year maintenance and guarantee for the tree plantings.

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Town of
Colchester
Seal

PERMISSION FOR TREE PLANTING

The undersigned owner hereby grants to the Town of Colchester and its agents the right and privilege to enter upon owner's property at _____ _____ for the purpose of planting a tree or trees on said property in connection with the Town of Colchester.

The undersigned owner agrees and acknowledges that any tree or trees planted by the Town of Colchester or its agents pursuant to this permission shall be the property of the owner and owner agrees to utilize his/her best efforts to maintain the tree or trees so planted.

The species and location of the tree or trees to be planted shall be determined by the Town of Colchester, subject to the approval of the undersigned owner.

Dated at Colchester, Vermont, this _____ day of _____, 200_____.

_____

Property Owner

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Section 3B

Planting Guidelines

The intent of these Planting Guidelines is to establish protocols that can be referred to in the future when specific Planting Plans are designed for each street. There are predictable issues or conflicts that come up repeatedly during the design of a Street Tree Planting Plan.

For example, where do we plant a street tree if there is an existing roadside swale? What is the closest a street tree can be planted to an intersection and still allow adequate sight distance for safety? How does the available width of the greenbelt affect the selection of tree cultivars? What is the preferred location of a tree within the available greenbelt? These guidelines are included to assist the designer in making decisions that will adapt to existing site conditions. Resolving planting issues and conflicts is in the best interest of public safety and the health of the trees.

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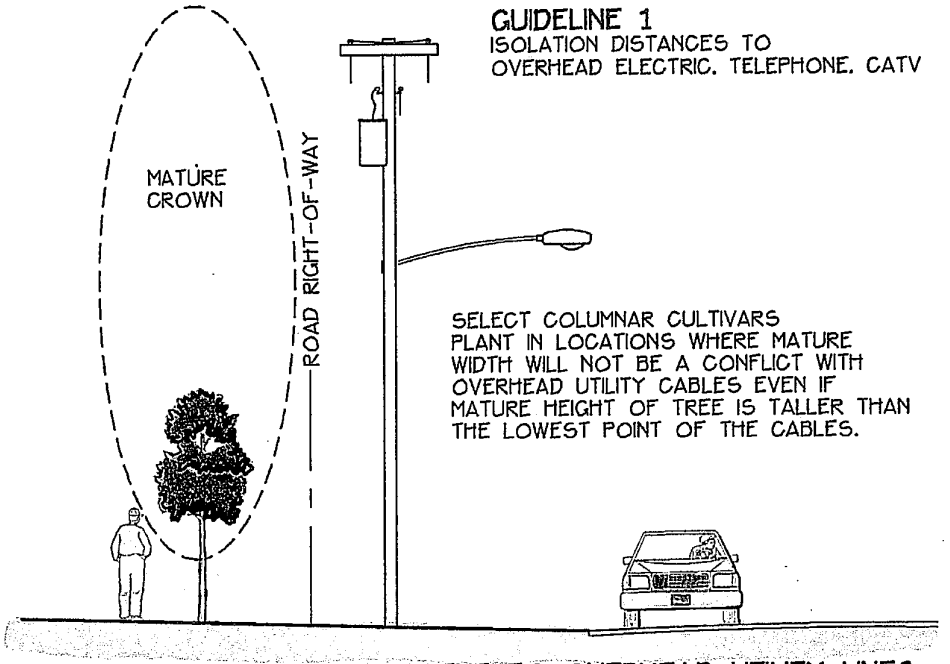
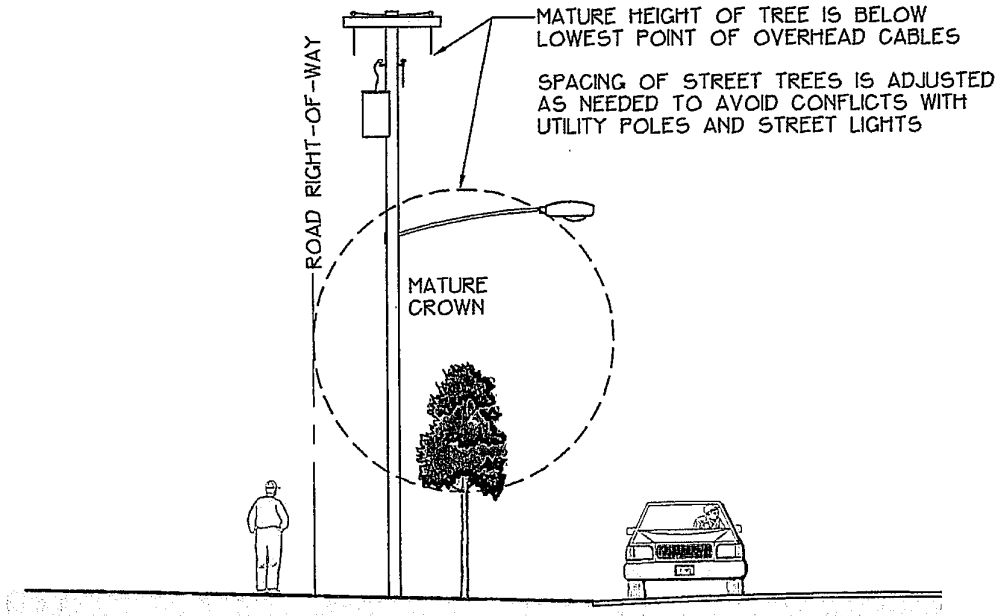
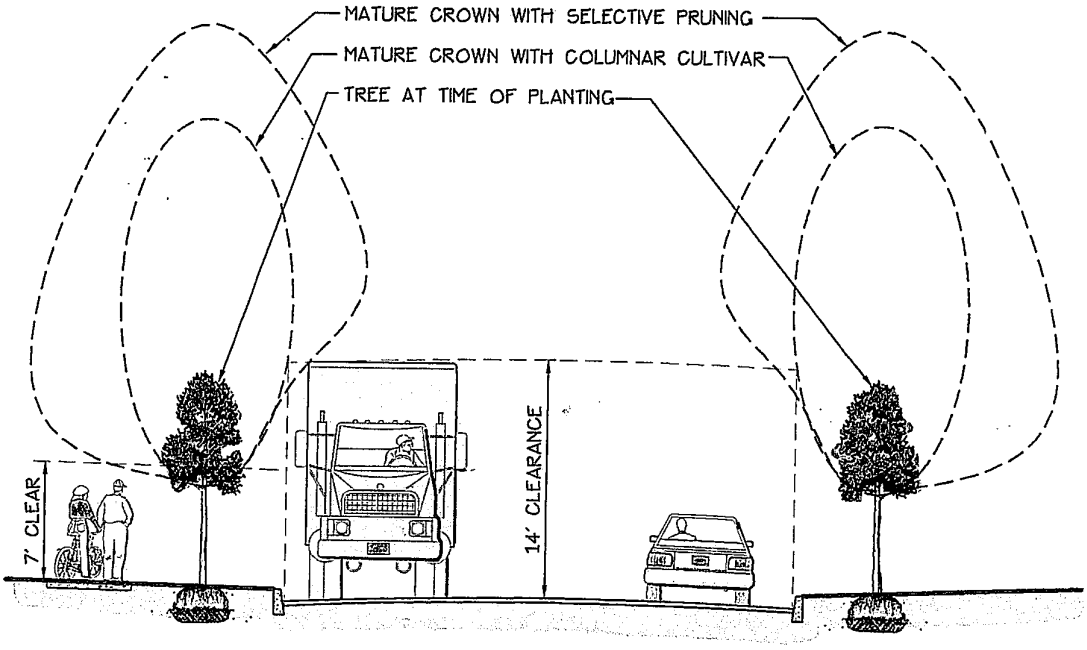


1A GUIDELINES FOR PLANTING ADJACENT TO OVERHEAD UTILITY LINES



1B GUIDELINES FOR PLANTING UNDER OVERHEAD UTILITY LINES

GUIDELINE 2
SPECIES SELECTION FOR
FUTURE BRANCH CLEARANCES



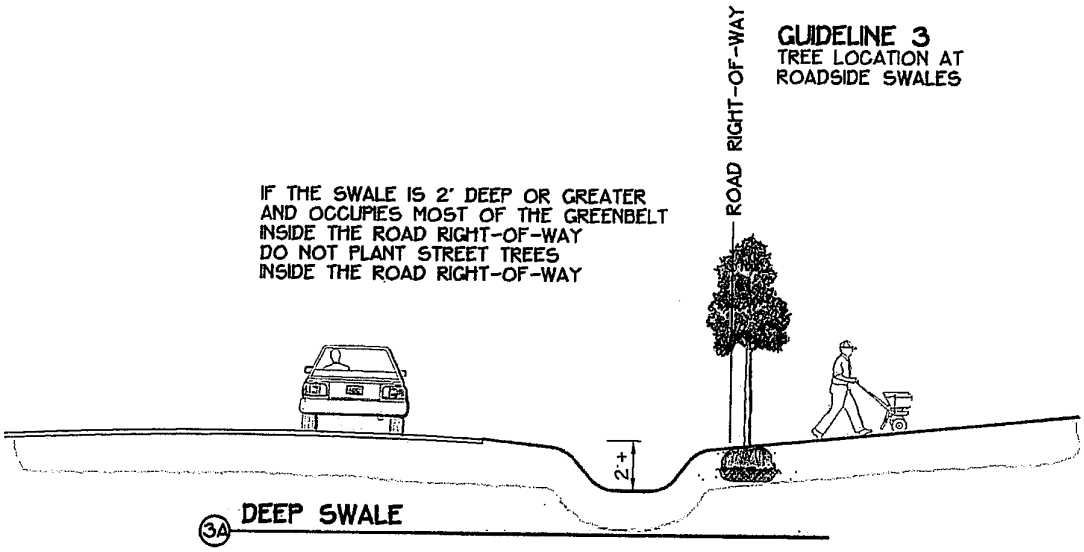
RECYCLING TRUCKS, MOVING VANS, SNOWPLOWS AND OTHER LARGE VEHICLES REQUIRE A 14' CLEARANCE TO THE LOWEST BRANCH OVERHANGING THE ROADWAY.

PEDESTRIANS AND BICYCLISTS REQUIRE A 7' CLEARANCE TO THE LOWEST BRANCH OVERHANGING A SIDEWALK OR BIKE PATH.

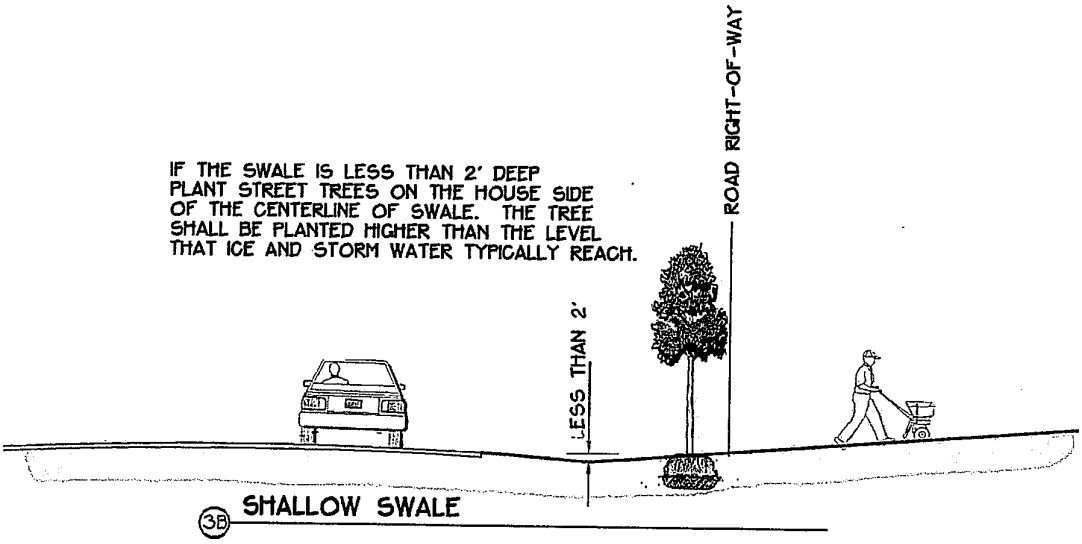
TO ALLOW FOR THESE CLEARANCES, STREET TREE SPECIES SHOULD BE SELECTED USING ONE OF THESE TWO STRATEGIES:
1. SELECT COLUMNAR CULTIVARS THAT WILL DEVELOP A CROWN THAT WILL NATURALLY PROVIDE THE REQUIRED CLEARANCE.
2. SELECT SPECIES THAT HAVE A BRANCHING STRUCTURE THAT WILL ALLOW FOR SELECTIVE PRUNING THAT WILL PROVIDE THE REQUIRED CLEARANCE AND STILL MAINTAIN AN ATTRACTIVE AND BALANCED APPEARANCE.

(2) PRUNING GUIDELINES FOR CLEARANCE

GUIDELINE 3
TREE LOCATION AT ROADSIDE SWALES



3A DEEP SWALE



3B SHALLOW SWALE

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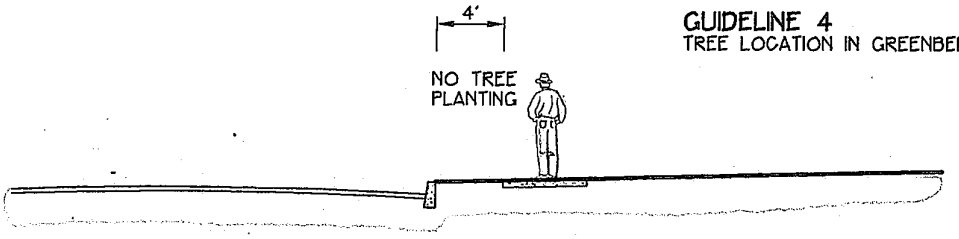
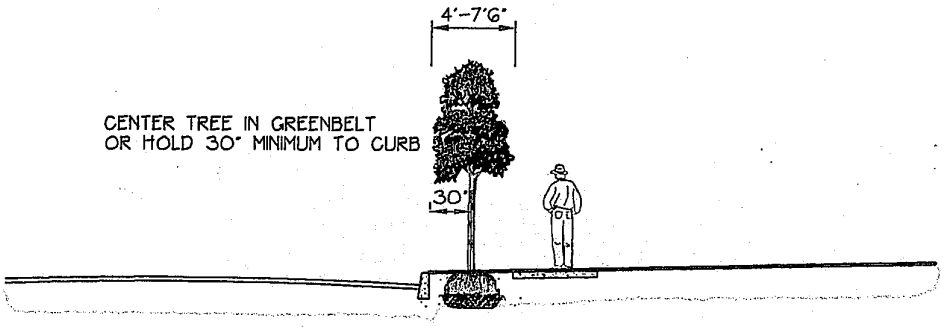
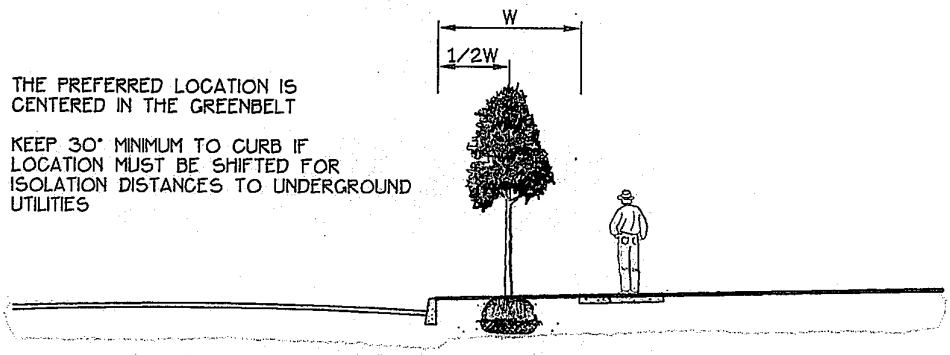
GUIDELINE 4
TREE LOCATION IN GREENBELT



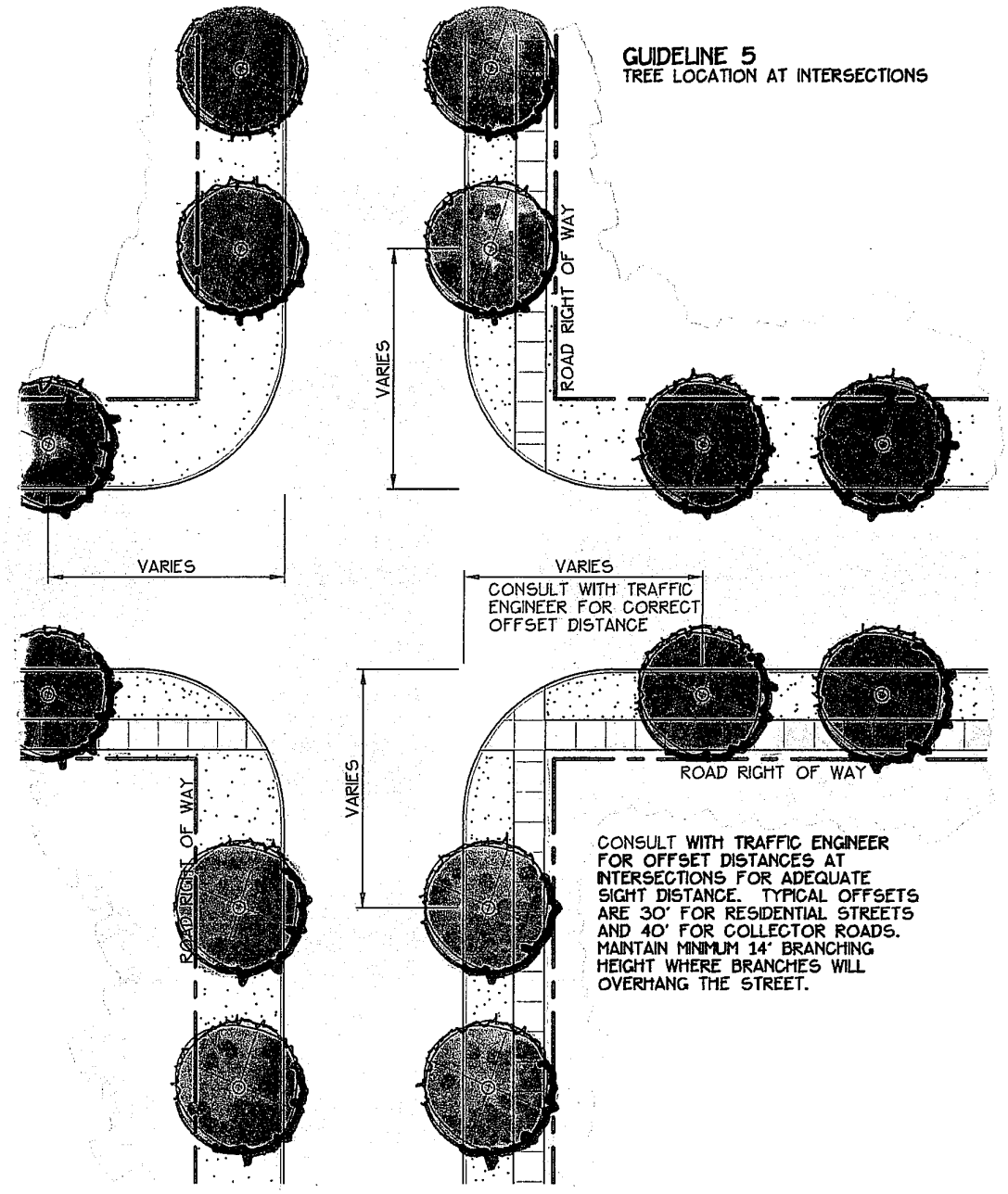
4A SMALL GREENBELT 4' OR LESS



4B MEDIUM GREENBELT 4'-7'6"



4C LARGE GREENBELT 7'6" OR GREATER



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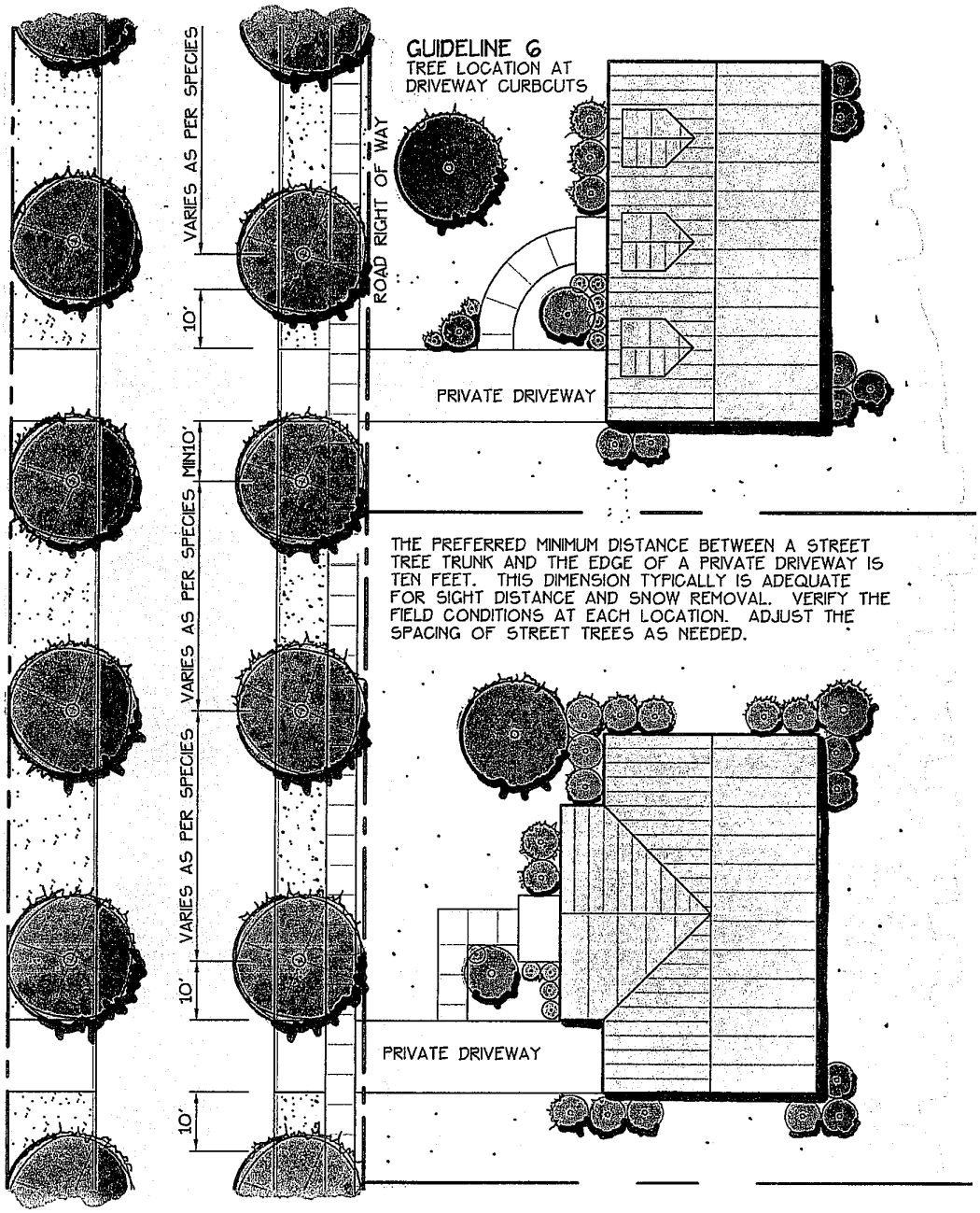
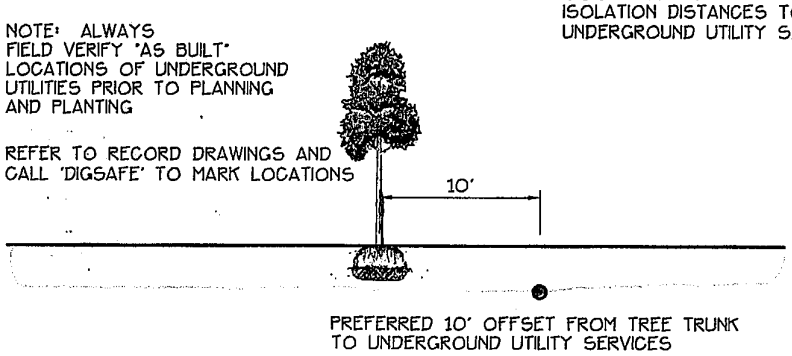
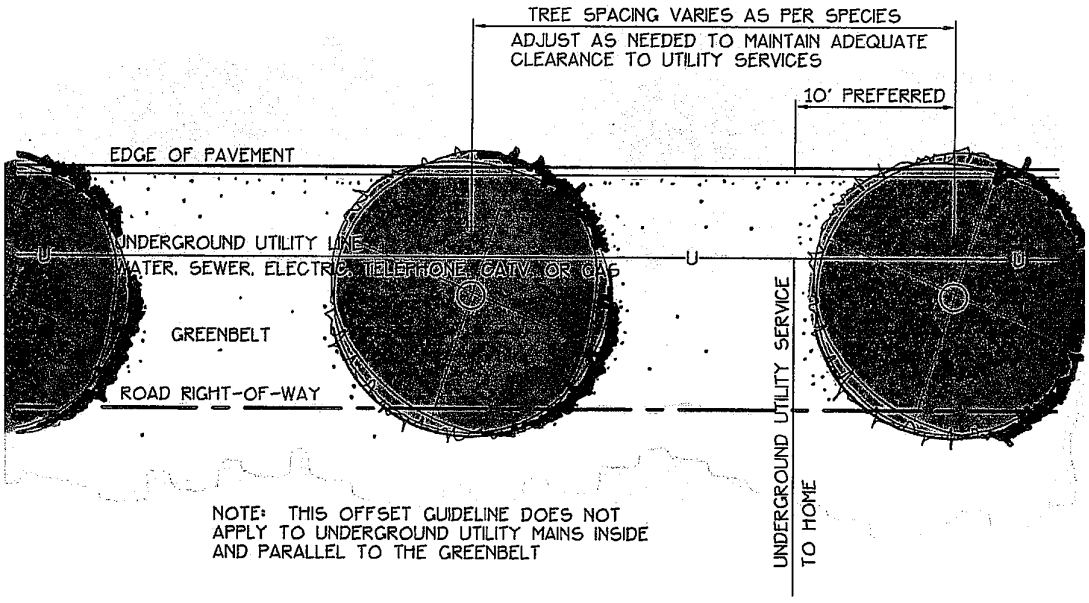

GUIDELINE 6
TREE LOCATION AT
DRIVEWAY CURBCUTS
VARIES AS PER SPECIES
10'
ROAD RIGHT OF WAY
PRIVATE DRIVEWAY
VARIES AS PER SPECIES MIN10'
THE PREFERRED MINIMUM DISTANCE BETWEEN A STREET TREE TRUNK AND THE EDGE OF A PRIVATE DRIVEWAY IS TEN FEET. THIS DIMENSION TYPICALLY IS ADEQUATE FOR SIGHT DISTANCE AND SNOW REMOVAL. VERIFY THE FIELD CONDITIONS AT EACH LOCATION. ADJUST THE SPACING OF STREET TREES AS NEEDED.
VARIES AS PER SPECIES
10'
PRIVATE DRIVEWAY
10'

GUIDELINE 7
ISOLATION DISTANCES TO UNDERGROUND UTILITY SERVICES



7A OFFSET TO UNDERGROUND UTILITY SERVICES - SECTION



7B OFFSET TO UNDERGROUND UTILITY SERVICES - PLAN

GUIDELINE 8
TREE SPACING

TREE SIZE REFER TO SECTION 3C	HEIGHT OF MATURE TREE	RANGE OF TREE SPACING
SMALL	LESS THAN 25'	20'-30'
MEDIUM	30'-60'	30'-40'
LARGE	GREATER THAN 60'	40'-60'
COLUMNAR	VARIES	25'-30'

1. THE TYPICAL LINEAR SPACING BETWEEN STREET TREES IN A ROW PLANTING IS DETERMINED AFTER EVALUATING THE "AS BUILT" LOCATIONS OF DRIVEWAYS AND UTILITY SERVICES, AND EXISTING TREE CANOPIES. ADJUST THE SPACING WITHIN THE RECOMMENDED RANGE OF TREE SPACING FOR THE BEST POSSIBLE FIT. ADJUST AS NEEDED TO FIT EXISTING CONDITIONS.

2. THE PREFERRED LOCATIONS FOR TREES ON OPPOSITE SIDES OF THE STREET IS A "MIRROR IMAGE". SOMETIMES THIS IS NOT POSSIBLE BECAUSE OF ROADWAY CURVES, OFFSETS TO DRIVEWAYS, OFFSETS TO UTILITIES, OR CANOPIES OF EXISTING FRONT YARD TREES. ADJUST THE SPACING AS NEEDED AND RETURN TO THE "MIRROR IMAGE" SPACING AS SOON AS POSSIBLE.

3. SPACING SHOULD RESULT IN A PLEASANT VISUAL RHYTHM FOR THE STREETSCAPE BASED UPON A PATTERN OF REPEATING INTERVALS.

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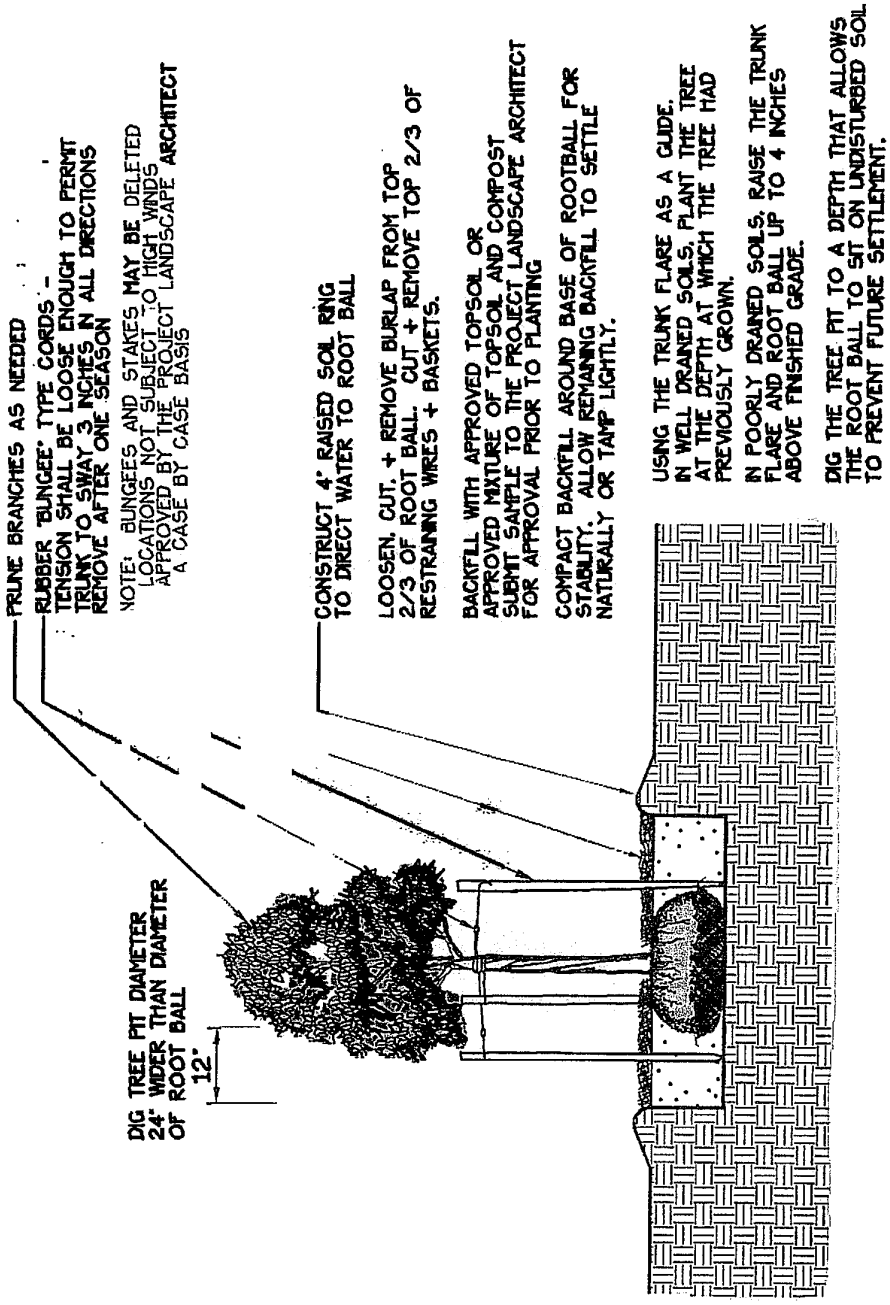
GUIDELINE 9
TREE PLANTING



TREE PLANTING

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Section 3C

Recommended Street Trees

Criteria for recommendations

The trees that are recommended for Colchester Street Trees, for the most part, meet the following requirements. However, not every tree meets every condition and judgment should be used when making the final selections to select the appropriate tree for each location:

- Hardy in USDA Zone 5 - Colchester
- Not currently prone to insect infestation
- Not currently prone to disease
- Not a litter problem
- Available from area nurseries or tree brokers
- Suitable for Colchester soil types
- Salt tolerant
- Tolerant to street side conditions including compaction, drought, & snow storage

Genus and species diversity

One of the objectives of the Master Plan is to increase the diversity of tree species throughout the Town. This will reduce the risk of infestation or disease damaging the majority of the Town's street tree inventory at one time. The goal for street tree diversity is to avoid having any one genus be greater than 10% or any one species be greater than 5% of the total inventory of street trees in Colchester.

Tree size & quality standards

The recommended minimum size for street trees is 2"-2½" caliper. Caliper measurements shall be taken on the trunk six inches above the natural ground line. Trees shall meet the standards set in the current edition of "American Standards for Nursery Stock", ANSI Z60, sponsored by the American Association of Nurserymen.

Small Trees

Small trees are less than 25' in height at maturity. Small trees are suitable for planting in narrow greenbelts (5'-7'6") or under overhead utility lines. Small ornamental trees may be desirable to homeowners for proposed planting outside of the road right-of-way in Neighborhood Classifications NC4 and NC5. The recommended linear spacing for small trees is 20'-30'.

Common Name	Botanic Name	Cultivars	Mature Crown Spread	Notes
Tatarian Maple	Acer tataricum		20'	
Serviceberry	Amelanchier x grandiflora	'Autumn Brilliance' ''Robin Hill' 'Cumulus' 'Autumn Pink'	15' 15' 15' 15'	Moist locations Native Shade tolerant
Crabapple	Malus spp.	'Adams' 'Adirondack' 'Donald Wyman' 'Harvest Gold' 'Indian Summer' 'Liset' 'Prariefire' 'Purple Prince' 'Red Jewel' 'Robinson' 'Sentinel' 'Sugar Tyme'	15' 10' 20' 15' 20' 15' 20' 17' 12' 25' 12' 15'	Salt tolerant
Amur chokecherry	Prunus maackii		30'	
Japanese Flowering Cherry	Prunus serrulata	'Kwansan'	30'	
Japanese Tree Lilac	Syringa reticulata	'Ivory Silk' 'Summer Snow'	15' 20'	Salt tolerant
American Hornbeam	Carpinus caroliniana		25'	Moist locations Salt sensitive
Thornless Cockspur Hawthorn	Cretaegus crus-galli inermis		25'	

Medium Trees

Medium trees range from 30' to 60' in height at maturity. They are suitable for planting in medium to large greenbelts that are not under overhead utilities. They will provide shade and scale for residential neighborhood streets. The recommended linear spacing for medium trees is 30'-40'.

Common Name	Botanic Name	Cultivars	Mature Crown Spread	Notes
Hedge Maple	Acer campestre		30'	Treeform
Freeman Maple	Acer x freemanii	'Celebration' 'Autumn Blaze'	20' 45'	
Red Maple	Acer rubrum	'Red Sunset'	45'	Salt sensitive Native
Ruby Red Horsechestnut	Aesculus x carnea		40'	
Heritage River Birch	Betula nigra	'Heritage'	35'	Moist locations
Thornless Honeylocust	Gleditsia triancanthos inermis	'Halka' 'Skyline'	45' 60'	Salt tolerant
Callery Pear	Pyrus calleryana	'Chanticleer' 'Cleveland Select' 'Redspire'	15' 30'	
American Hophornbeam	Ostrya virginiana		35'	Moist locations Salt sensitive

Large Trees

Large trees are greater than 60' in height at maturity. These trees require large greenbelts and setbacks to abutting buildings. These trees have the potential to overhang the roadway for a desirable streetscape appearance even if they are planted outside the road right-of-way. The recommended linear spacing for large trees is 40'-60'.

Common Name	Botanic Name	Cultivars	Mature Crown Spread	Notes
Red Maple	Acer rubrum		40'	Moist locations Salt sensitive
Sugar Maple	Acer saccharum	'Green Mountain' 'Legacy' 'Majesty'	50' 35' 45'	Salt sensitive Setback from road Native
European Horsechestnut	Aesculus hippocastanum	'Baumannii'	50'	
Ginkgo	Ginkgo biloba	'Autumn Gold' 'Lakeview'	35' 25'	Male only
Kentucky Coffee Tree	Gymnocladus dioicus		55'	
Bur Oak	Quercus macrocarpa		70'	
Red Oak	Quercus rubra		55'	Native Salt tolerant
Littleleaf Linden	Tilia cordata	'Glenleven' 'Green Spire'	45' 45'	
Silver Linden	Tilia tomentosa	'Green Mountain' 'Sterling Silver'	45' 45'	
Resistant American Elm	Ulmus americana	'Delaware #2' 'Valley Forge' 'Princeton'	50' 75'	Salt tolerant
Japanese Zelkova	Zelkova serrata	'Green Vase'	55'	

Columnar Trees

Columnar trees have less than a 25' crown diameter at maturity. Mature height will vary with the species. These trees are suitable for planting adjacent to overhead utility lines but not underneath them. They are also suitable for planting adjacent to existing tree canopies or other existing features. The recommended linear spacing for columnar trees is 25'-30'.

Common Name	Botanic Name	Cultivars	Mature Crown Spread	Notes
Red Maple	Acer rubrum	'Armstrong' 'Bowhall'	15' 25'	
Sugar Maple	Acer saccharum	'Endowment' 'Goldspire' 'Monumental'	20' 20'	Salt sensitive
Freeman Maple	Acer x freemanii	'Celebration' 'Scarlet Sentinel'	20' 25'	
European Hornbeam	Carpinus betulus	'Fastigata'	15'	
Ginkgo	Ginkgo biloba	'Fastigata' 'Princeton Sentry'	30' 25'	Male only
Crabapple	Malus spp.	'Centurion' 'Madonna' 'Pink Spire' 'Red Baron' 'Sentinel'	15' 10' 12' 10'	
Callery Pear	Pyrus calleryana	'Capitol' 'Chanticleer' 'Whitehouse'	 15' 15'	
English Oak	Quercus robur	'Fastigata'	15'	Salt tolerant
Japanese Tree Lilac	Syringa reticulata	'Ivory Silk'	15'	Salt tolerant
Littleleaf Linden	Tilia cordata	'Corinthian'	20'	

Trees for special situations
The list of recommended trees has been evaluated for use in special situations and locations. For additional information, refer to:

Recommended Trees for Vermont Communities
The Vermont Urban & Community Forestry Program
April 2001

Manual of Woody Landscape Plants
Michael A. Dirr
Fifth edition 1998

For use in a high road salt application zone
Hedge Maple
Ginkgo
Thornless Honeylocust
Harvest Gold Crabapple
Callery Pear
Northern Red Oak

For use underneath overhead utilities
Tatarian Maple
Serviceberry
Crabapple
Amur Chokecherry
Japanese Flowering Cherry
Callery Pear
Japanese Tree Lilac

For use in wet areas abutting roadside swales
Serviceberry
Red Maple
Ruby Red Horsechestnut
American Hornbeam

For use in dry sandy soils
Ginkgo
Honeylocust
Japanese Tree Lilac
Northern Red Oak
English Oak
Bur Oak
Callery Pear

Section 4

Guidelines for Street Tree Plantings in Future Neighborhoods

For purposes of this plan, future neighborhoods are grouped as either low to medium density or high density growth center neighborhoods.

Low to medium density neighborhoods

The recommended strategy for street tree plantings in future low to medium density neighborhoods is Neighborhood Classification 2 (inside road right-of-way traditional row planting). This strategy applies to single family detached residential, multifamily residential with public road rights-of-way, commercial, industrial, and mixed landuse. The following guidelines will apply:

Feature	Dimension
Width of greenbelt	Recommended 8'6" or wider Minimum 7'6" Wider is better
Preferred location in greenbelt	Centered
Minimum distance from curb or sidewalk if there is a conflict with a utility inside the greenbelt	3'
Preferred location for a street tree on the side of the street that is opposite of the side with the sidewalk	Mirror the offset location on the opposite side of the street
Tree type	Medium or large
Linear spacing	30' to 60' on center depending on species
Minimum offset distance to driveway	10'
Minimum offset distance to underground utility service	10'

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High density mixed use growth center neighborhoods

The recommended strategy for street tree plantings in future high density mixed use growth center neighborhoods needs to vary with the specific details of each project. At the time of writing this plan, some of these neighborhoods are expected to be developed using private roads with small building setbacks. Some designs are expected to use urban design details such as a generous sidewalk reaching from the curb to the building with no grassed greenbelt at all. Other neighborhoods may use public roads using current standards for road rights-of-way, building setbacks, and grassed greenbelts. Given this range of possible future neighborhood designs, the following guidelines for providing street trees should be considered:

Guideline 4.1 Tree pits and soil volume

If the neighborhood design includes a sidewalk reaching from the curb to the building without a grassed greenbelt, street trees may be planted in tree pits. These pits need to be designed to have adequate soil volume, soil texture, fertility, drainage, and water to support a healthy tree that will grow to maturity. Tree species need to be selected to match mature size and the amount of available soil volume.

Guideline 4.2 Tree grates and tree guards

Tree grates need to be specified and installed in a manner that will accept the weight of sidewalk snow plows. Tree grates need to be compliant with current ADA, pedestrian, and bicycle safety standards. In locations with adjacent on-street parking, tree guards should be fitted to the tree grates to protect the tree trunks from damage.

Guideline 4.3 Pruning for clearance

Special attention should be given to maintaining clearance to the lowest branches of 7' over the sidewalk and 14' over the roadway. To allow for these clearances, street tree species should be selected using one of these two strategies:

A. Select columnar cultivars that will develop a crown that will naturally provide the required clearance or

B. Select species that have a branching structure that will allow for selective pruning that will provide the required clearance and still maintain an attractive and balanced appearance.

Refer to Guideline 3.2.

Guideline 4.4 Clearance to buildings

Some neighborhoods use very small setbacks from the curb to the building. In these cases, the clearance guidelines described in 4.3 apply to buildings. In addition, trees should be located between window bays to provide access for fire fighting equipment.

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Section 5

Funding

Grants will be the primary funding source for implementing the recommendations in the Colchester Street Tree Master Plan. The Town strategy should be to obtain a combination of grants from multiple sources, year after year, to implement the recommendations in manageable phases.

The Town should evaluate the net revenue gain that a successful Grant Administrator could generate. If the evaluation is positive, the Town should consider hiring or contracting with a Grants Administrator to help acquire the necessary funding.

1. State Grants

Trees for Local Communities (TLC)
Agency of Natural Resources
Vermont Department of Forest, Parks, & Recreation
103 South Main Street, 10 South, Waterbury, Vermont 05671-0601
802-241-3673
Attention: Steve Sinclair, Vermont Urban & Community Forester

Vermont Agency of Transportation
Enhancement Activities Grant Program
Director of Planning, Agency of Transportation
133 State Street, Montpelier, Vermont 05633-7601
Attention: Sue White
ISTEA (Intermodal Surface Transportation Efficiency Act)
Area of interest: Landscape & scenic preservation

Vermont Community Development Program
Dept. of Housing & Community Affairs, National Life Building, Drawer 20, Montpelier, Vt
802-828-3211
Attention Carl Bohlen, Director of VCDP Program
Area of interest: Municipalities – housing, economic development, public facilities, and public services

2. Federal Grants

National Urban & Community Forestry Advisory Council (NUCFAC)
20628 Diane Drive
Sonora, California 95370
209-536-9201
Attention: Suzanne Del Viller

3. Landowner Funding

Individual landowners may make voluntary contributions to pay for tree plantings along their road frontage.

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4. Private Foundations

Altman-Stiller Foundation
25 Barrington Road, Dorchester, Massachusetts 02124-5001
Attention: Susan Altman Miller, Trustee

Baldwin Foundation Trust
974 Lawrenceville Road, Princeton, New Jersey 08540
Area of interest: Environment

Bell Atlantic Corporation
800 Hinesburg Road, P.O. Box 250, South Burlington, Vermont 05402-0250
Attention: Joan Jamieson, Associate Director of PR/Community Relations
802-863-0859
Civic and community arts and culture, using technology to enhance services

Cabot Family Charitable Trust
75 State Street, Boston, Massachusetts 02109
Attention: Ruth Sheer, Executive Director
Area of interest: Environmental issues in New England

Canaday Trust
c/o Bank Boston, PO Box 1861, Boston, Massachusetts 02105
Attention: Robert Frey
Area of interest: Natural resource conservation

Jessie B. Cox Charitable Trust
Donor Services Office, Hemenway & Barnes, 60 State Street, Boston, Ma 02109
Attention: Susan Fish
617-557-9775
Area of interest: Environment

Davis Conservation Foundation
4 Fundy Road, Falmouth, Maine 04105
Attention: Nancy Winslow, Executive Director
201-78115504
Area of interest: Advancement of our physical environment, volunteer activity

Gannett Foundation
Burlington Free Press, 191 College Street, PO Box 10, Burlington, Vermont 05402-0010
Attention: James Carey, President
802-660-1800
Area of interest: Arts and culture

William and Flora Hewlett Foundation
525 Middlefield road, Menlo Park, California 94025-3495
415-329-1070
Area of interest: Environment, community development

IBM
1000 River Street, Essex Junction, Vermont 05452-4299
Attention: Marie Houghton
802-769-9875
Area of interest: Combine technology, skills, and cash in effective partnerships to bring solutions to the systemic problems that impact society, business, and our quality of life.

IDX Foundation
c/o Vermont Community Foundation, PO Box 30, Middlebury, Vermont 05753
Attention: Judy Dunning
802-388-3355
Area of interest: Community development and environment

The Kelsey Trust
C/o Vermont Community Foundation, PO Box 30, Middlebury, Vermont 05753
Attention: Charlotte Stetson or Judy Dunning
802-388-3398
Area of interest: Protect the environment through action

Lintilhac Foundation
886 North Gate Road, Shelburne, Vermont 05482
Attention: Nancy Brink
802-985-3725
Area of interest: Environment

Merchants Bank Foundation
PO Box 1009, Burlington, Vermont 05402
Attention: Jennifer Varin
802-658-3400

Metanoia Fund Trust
Hemenway and Barnes, PO Box 6842, Boston, Massachusetts 02109
Area of interest: Natural resource conservation

Moriah Fund
1634 I Street, NW, Suite 1000, Washington, DC 20006
Attention: Jack Vanderryn
202-783-8488
Area of interest: Biodiversity, sustainable development

New England Grassroots Environment Fund
PO Box 1057, Montpelier, Vermont 05601-1057
Attention: Cheryl King Fischer
802-223-4622
Area of interest: Environment and sustainable community projects

Norcross Wildlife Foundation, Inc.
PO Box 269, Wales, Massachusetts 01081
Attention: Grants Administrator
Area of interest: Support for environmental and wildlife organizations, civic affairs

Orchard Foundation
PO Box 2587, South Portland, Maine 04107
Attention: Brigitte Kingsbury
207-799-0686
Area of interest: environment

Stettenheim Foundation
HC 64, Box 255, Lebanon, New Hampshire 03766-7607
Attention: Peter Stettenheim
Area of interest: Conservation and land protection

Surdna Foundation
330 Madison Avenue, 30th Floor, New York, New York 10017
Attention: Executive Director
212-557-0010
Area of interest: Environment, community revitalization

Vermont Community Foundation
Box 30, Middlebury, Vermont 05753
Attention: Judy Dunning
802-388-3355
Area of interest: environment, historic preservation, community development

Section 6

References

The following documents are either sources of information used in preparing the Colchester Street Tree Master Plan or are recommended references for use during future Design and Implementation phases.

Recommended Trees for Vermont Communities
The Vermont Urban & Community Forestry Program
April 2001

Manual of Woody Landscape Plants
Michael A. Dirr
Fifth edition 1998

Traffic Engineering Handbook
4th Edition
Institute of Transportation Engineers

Street Tree Fact sheets
School of Forest Resources
Pennsylvania State University
University Park, Pennsylvania 16802

Selecting Trees for Urban Landscape Ecosystems
State of New Hampshire
Division of Forests and Lands
State Foresters Office
Concord, New Hampshire

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Section 7

Field Reconnaissance

Every street within the study area was visited during September and October 2001. A digital photograph was taken for reference, the width of the greenbelt was measured, and a "windshield survey" was taken to note the presence of the following features:

Width of roadway
Roadway surface
Density of existing front yard trees
Curbs & catch basins
Roadside swales & culverts
Overhead electric, telephone, cable
Underground electric, telephone, cable boxes
Street lights
Water
Natural gas
Sanitary sewer
Existing street trees
Landuse
Typical building setback
Existing sidewalk or recreation path
Existing native vegetation
Traffic volume
On street parking
Salt zone
Miscellaneous observations

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Colchester Street Tree Master Plan
Field reconnaissance

E911 Street Name	
Town Highway #	
Neighborhood classification	
Width of right-of-way	
Width of roadway & surface	
Existing street trees	
Width of greenbelt	
Curbs, swales, drainage	
Existing sidewalk or bike path	
Future sidewalk or bike path	
Electric, telephone, cable	
Street lights	
Water	
Natural gas	
Sanitary sewer	
Road salt high use zone	
Existing native vegetation	
Notes	

APPENDIX E

PROJECT CERTIFICATION FORM

Prior to acceptance of any public improvements, the Design/Project Engineer must complete the following check list and submit all associated test reports and obtain all required sign offs. The Design/Project Engineer is directed to the Public Works Specifications and Standards for details on testing standards. methods, and number of tests required.

Project Name:_____

Required Items for Project Certification	Specification Section	To be completed by Design/Project Engineer: Submitted (√)	Conforming (√)	To be completed by Town Engineer: Accepted (√)
SECTION 1: GENERAL CONDITIONS				
Testing and Inspection (General)	1.12 A General (provide a record of personnel, dates and hours on the site for each task)			
Testing and Inspection (Roadway)	1.12 B Road Inspection Schedule			
Testing and Inspection (Utilities)	1.12 C Utility Systems			
Record Drawings	1.13 Submittal of Record Drawings			
Speed Study	1.14 Traffic & Engineering Study (Speed Study)			
Stop Sign Warrant Anlaysis	1.14 Traffic & Engineering Study (Speed Study)			
SECTION 2: EARTHWORK				
Excavation, Backfilling, and Compaction	2.2 D Compaction & Field Quality Control			
SECTION 3: ROADWAY				
Bituminous Concrete (Asphalt) Pavement	3.11 C Work			
SECTION 6: SANITARY SEWER				
Deflection Testing for Gravity Sewers	6.3 J Deflection Testing for Gravity Sewers			
Leakage Testing for Gravity Sewers	6.3 K Leakage Tests and Allowances for Gravity Sewers			
Manhole Leakage Testing	6.3 L Manhole Leakage Testing			
Leakage and Pressure Testing for Force Main	6.3 M Leakage and Pressure Testing for Force Main			
SECTION 7: WASTEWATER PUMPING STATIONS				
Spare Parts	7.3 N Spare Parts			
Field Testing	7.6 Field Testing (witnessed by Operations Manager)			
Operating Instructions	7.7 Operating Instructions			
Electrical System	7.9 Electrical System			

In addition to this Project Certification Check List, the Design/Project Engineer shall certify that all other required testing and inspection has been conducted, that the improvements inspected are in full conformance with the approved plans and specifications, and that the entire project is in reasonable conformance with the approved plans and specifications.

_____ Design/Project Engineer

_____ Date

REQUIRED TOWN SIGN OFFS

Traffic Study: Receipt	Town Engineer: _____	Date: _____
Approval	Town Engineer: _____	Date: _____
Select Board Traffic Ordinance Amendment	Admin. Coordinator: _____	Date: _____
Select Board Appeal Deadline	Admin. Coordinator: _____	Date: _____
Final Field Inspection (including traffic signs)	Town Engineer: _____	Date: _____
	Operations Manager: _____	Date: _____
	Building Inspector: _____	Date: _____
Wastewater Pumping Stations	Operations Manager: _____	Date: _____
Recommeded for Road Acceptance	Town Engineer: _____	Date: _____
Select Board Road Acceptance	Admin. Coordinator: _____	Date: _____
File in Roads binder	Admin. Coordinator: _____	Date: _____