

CHAPTER 5
TECHNICAL SPECIFICATIONS

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500 Street Specifications and Related Items

501.0 General

Streets and access ways constructed within the Town of Essex shall be designed by a Vermont-licensed, professional civil engineer and constructed as public roads meeting the requirements of this section and all applicable standard details found in Appendix A of this document.

Existing streets at the time of adoption of the Standard Specifications for Construction encompass a wide variety of conditions and standards. Street widths, surface materials, presence or absence of curbs and sidewalks, vary throughout the Town Highway system. The purpose of these street specifications is to standardize all future construction. A residential driveway is not considered to be a public road. A single residential driveway can serve a maximum of two single family dwelling units. Access ways to multifamily units shall not be considered public roads when one of the following is true:

1. The length of a non-looped access way is less than 300' or the length of a looped access way is less than 750'.
2. Less than 20 units are served.

The layout and design of non-public roads shall allow access by Town emergency vehicles.

502.0 Street Design Standards

502.1 Geometric Standards for Streets

The Town of Essex reserves the right to increase or decrease the sight distances provided in Table 1 of this section when local conditions dictate. Such conditions would include but not be limited to excessive speed above the posted limit, conflicting traffic movements within the minimum sight distance zone, and all other conditions that the Town takes exception to.

All new streets shall be designed in accordance with the following reference standards; the latest version of Manual of Uniform Traffic Control Devices,

AASHTO Policy on Geometric Design, Institute of Transportation Engineers, the Highway Capacity Manual, and all other pertinent reference materials.

GEOMETRIC STANDARDS FOR STREETS – TABLE 1	
ANGLE - Intersection	70 - 90 degrees
MAXIMUM GRADE – Street Intersection	3% within 100' of the centerline intersection
MINIMUM GRADE - All Streets	0.5%
MINIMUM CURVE RADIUS - STREET CORNER Minor/Dead End	25' (or equivalent offset tapered curve radius)
MINIMUM CURVE RADIUS - STREET CORNER Commercial/Industrial	30' (or equivalent offset tapered curve radius)
CHANGES IN GRADE	Vertical Curve Required to afford the minimum safe stopping sight distance
MINIMUM TANGENT - REVERSE CURVES	100'
MAXIMUM LENGTH - DEAD END STREETS	900' to the center of a cul-de-sac
CUL-DE-SAC (Required for Dead End Streets)	120' minimum right-of-way diameter 100' minimum outside diameter of traveled way.
MINIMUM CENTERLINE OFFSETS - STREETS	200'
MINIMUM WIDTH: BITUMINOUS CONCRETE WEARING SURFACE - URBAN STREET	30'

GEOMETRIC STANDARDS FOR STREETS – TABLE 1 (cont.)	
MINIMUM WIDTH: BITUMINOUS CONCRETE WEARING SURFACE - TYPE A RURAL ROAD (PAVED)	24'
MINIMUM ELEVATION	Above 100 year flood plain
SIDEWALKS/BIKEPATHS	As Required by Planning Commission 5' Min. Sidewalk/8' Min. Bitum. Path
MINIMUM WIDTH AT EDGE OF R.O.W.: RESIDENTIAL DRIVEWAYS	Single: 15' Double: 20'
MAXIMUM WIDTH AT EDGE OF R.O.W.: COMMERCIAL DRIVEWAYS	45'
BASED ON VERTICAL MINIMUM SIGHT DISTANCES: FOR DRIVEWAYS, ACCESS ROADS AND PUBLIC STREETS	Stopping sight distance for design speed shall be based on AASHTO design standards.
MINIMUM INTERSECTION SIGHT DISTANCES FOR NEW ACCESS ROADS AND DRIVES INTERSECTING PUBLIC HIGHWAYS.	Stopping sight distance for design speed shall be based on AASHTO design standards. If existing conditions along a new road/drive intersection prevent being able to meet the AASHTO intersection sight distance design standards, the town may consider using the stopping sight distances (for vehicles traveling along the existing public road) as being the minimum acceptable intersection sight distance for the new drive or road.

GEOMETRIC STANDARDS - TABLE 2				
	Major	Collector	Minor	Dead End
Minimum R.O.W. Width	66'	60'	60'	60'
Minimum Pavement Width Urban Street	32'	30'	30'	30'
Minimum Pavement Width Type A Rural Road (Paved)		24'	24'	24'
Maximum Grade	8%	8%	10%*	10%*
Minimum Curve Radius	750'	350'	200'	150'

* No grade greater than 8.0% may be continued for a distance of more than 300 feet.

503.0 Street Types

503.1 Urban Street

The characteristics of this roadway are a 30' paved width, a closed storm drain collection system, partial or full curbs and concrete sidewalks and/or bituminous paths. See Detail 100.02 for a typical Plan View of an Urban Street.

This type of road is generally the required and preferred road for new streets. Its use is required for collector, minor and dead end streets (in existing urban settings):

1. In zoning areas of the Town for residential development except the AR, R1, C1, C2 or O1 zones.
2. In planned unit residential developments.
3. In proposed developments where, in the opinion of the Planning Commission the present or future density of the development warrants the use of an urban street.

A modified form of the Urban Street may be required for major roadways in industrial developments and for portions of roadways where no curb cuts can or will be allowed. Because the requirements of a major or industrial road are often

unique, each major or industrial roadway will be reviewed on a case-by-case basis for width, type of drainage, curbing, sidewalks and similar features.

The Town Engineer shall be responsible for approval of the appropriate details of a modified street form for major or industrial Urban Streets. A Modified Urban Street will generally be 30' in paved width, gravel or paved shoulders and no curbs. The typical road cross section shall be per Detail 100.02, in Appendix A of this document.

503.2 Type A Rural Road (Paved)

The characteristics of this roadway are a 24' paved width, 4' gravel shoulders, each side, drainage ditches fed by overland flow, and paths or trails as required.

This type of road is intended for use in the rural areas of Town, where the density of development is low and will likely remain low for an extended period of time and for reconstruction/upgrade of existing rural roads. Its use is permitted

1. In the AR, R1, C1, C2, or O1 zones where in the opinion of the Planning Commission, the present or future density of the development will remain low for reconstruction of existing gravel roads.

The Town Engineer shall be responsible for approval to modify the characteristics of this roadway type for the reconstruction of existing gravel roads, on a case by case basis as the need arises. The typical road cross section shall be per Detail 100.03, in Appendix A of this document.

503.3 Type B Rural Road (Gravel)

The characteristics of this roadway include a 24' gravel traveling surface, 4' gravel shoulders each side, and deep drainage ditches.

This type of road is the standard to which existing gravel roads are to be reconstructed over time. Its use is limited to existing Class III gravel roads.

The Town Engineer shall be responsible for approval to modify the characteristics of this roadway type on a case by case basis as the need arises.

Cross section shall be per Detail 100.04, in Appendix A of this document.

504.0 Road Cuts (Utility Permit)

Excavation within the town right-of-way for underground utilities and other infrastructure requires written approval by the Town of Essex. An application shall be made with the Town and approved before any equipment is mobilized within the Town Right of Way. Two-way traffic should be restored before the end of each work day. All road cuts must be restored to original or better condition within 48 hours of the initial cut. The contractor shall be responsible for necessary repairs to the disturbed area due to settling or otherwise for a period of two years from the date of completion. Deposits will be refunded at the end of the warranty period provided that the area has been satisfactorily restored in the opinion of the Town Engineer.

All new infrastructure installed within an existing roadway, (r-o-w) shall be installed using Jack-N-Bore or Horizontal Direction Drilling. If any damage is done to the Town's infrastructure (road, curb, sidewalk or lawn), the contractor shall contact the Town immediately before any remedial action is taken. Should a jack or bore method not be possible, the applicant shall receive written permission from the Public Works Director / Town Engineer or designee prior to starting excavations within the Town's R-O-W.

No construction activities shall begin within the Town R-O-W after the Thanksgiving holiday or when the bituminous concrete distributors close for the season, whichever comes first. Winter work will only be allowed on a case-by-case emergency basis.

505.0 Curb Cuts

Driveway access onto public streets requires written approval by the Town of Essex. An application shall be made to the Town on the form provided for this purpose.

Driveway standards within these Specifications apply to the portion of the driveway located within the limit of the public right of way. Details 100.08 and 100.09 found in Appendix A of this document provide additional requirements regarding drive access to Town Roads. The following technical guidelines shall be applied to all proposed driveway curb cuts onto a Town road:

1. Minimum intersection sight distances as required in Section 502.01 of this document.
2. Maximum approach grade + or - 3%

3. Driveway apron to be constructed to same standard as adjacent street to right of way limit. For paved streets, aprons must be paved to sidewalk/path (or right of way limit in the absence of sidewalk/path).
4. Paved aprons shall have min. pavement thickness of 2½".
5. Drainage must be approved by the Town Engineer.

506.0 Excavation

506.1 Side Slopes

Road side slopes shall be constructed as shown on the appropriate details included in Appendix A.

506.2 Embankments

Embankments associated with road construction shall be constructed by the contractor with either approved surplus excavated material or with approved material obtained elsewhere. All material resulting from clearing and grubbing shall be satisfactorily disposed of in a manner approved by the project engineer and in compliance with state and local ordinances. Under no conditions will this material be buried below the seasonal high groundwater.

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 so that adverse movements of the slopes do not occur.

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 degrees Fahrenheit, 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 for use in embankments.

When an embankment is to be constructed across a swamp, muck, or areas of unstable soils, the unsuitable materials shall be excavated to reach soils of adequate bearing capacity and the embankment begun. Alternative methods, such as use of a road stabilization fabric in place of excavation and backfill, may be utilized only after approval of same by the Town and project engineer. Material being placed in embankments shall be placed in horizontal layers of uniform thickness across the full width of the embankment. Stumps, trees, rubbish, and other unsuitable material shall not be placed in embankments.

The layers shall begin at the deepest part of the fill. Material shall be placed in twelve inch (12+) lifts with a 95 percent maximum dry density by the AASHTO-T-99, Method A (Standard Proctor) test. Effective spreading equipment shall be used on each layer to obtain uniform thickness prior to compaction. Each layer shall be kept crowned to shed water to the outside edge of the embankment and continuous leveling and manipulating will be required to assure uniform density.

The entire area of each layer shall be uniformly compacted to at least the required minimum density by use of compaction equipment consisting of rollers, compactors, or a combination thereof. Earthmoving and other equipment not specifically manufactured for compaction purposes will not be considered as compaction equipment.

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 three 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 evidence shall be used for an engineering determination of lack of stability under this requirement, and further placement of material in the area affected shall be stopped or retarded to allow the material to stabilize.

When the 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. Water may also be added in excavation or borrow pits. The water shall be uniformly and thoroughly incorporated into the soil by disc, harrowing, blading, or by other approved methods. The manipulations may be omitted for sands and gravel.

When the moisture content of the material is in excess of three 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. Compaction of the layer

of wet material shall be deferred until the layer has dried to the required moisture content by evaporation.

Upon completion of filling and excavating, the subgrade shall be formed to the required grade and contour; and the entire surface again rolled as specified above. High spots shall be removed and low spots filled with acceptable material, and the process of leveling and rolling continued until no further depression results. Approval and certification by the project design engineer shall be necessary prior to placement of the gravel bottom course.

506.3 Road Stabilization Fabric

The Town of Essex requires the use of road stabilization fabric for additional road subbase stabilization on new public road construction within the Town as shown on Details 100.02 . 100.04 found in Appendix A of these Specifications.

Prior to placement of the road stabilization fabric, the road subgrade shall be smoothed to remove all objectionable material which could damage the fabric. Where more than one width of stabilization fabric must be installed, the edges shall be overlapped two feet (2') at the edges. The fabric may be anchored to the subgrade by use of excess subbase material and/or and joined by U-shaped wire pins, single-shaft steel pins with metal disc fasteners, or similar devices. Fasteners should be placed six feet (6') apart on the overlap.

At no time after fabric installation, shall construction vehicles be permitted to drive over exposed fabric. In the event that no other feasible alternative is available, the fabric shall be thoroughly inspected and approved, prior to the placement of any select materials.

506.4 Underdrain

This item shall consist of constructing underdrains using perforated pipe, stone, filter fabric, underdrain outlets, clean outs, and risers in accordance with these specifications and as shown on the accepted drawings or as ordered by the Town or project engineer. Further requirements regarding the design and installation of underdrains can be found in Section 511, Stormwater Control Facilities, and in Appendix A, Detail 200.07 if this document.

Where utilized in underdrains, storm outfalls, drainage swales, or streams, filter fabric should be overlapped in the direction of water flow. A four inch (4") bedding blanket of gravel shall be carefully placed over the filter fabric so as not to damage the fabric.

507.0 Road Materials

507.1 Design Standards

Standard road cross sections are depicted in the detail drawings found in Appendix A. Alternatives to standard sections may be approved by the Town Engineer if the Project Engineer can provide satisfactory evidence that the proposed modifications will provide equivalent structural and frost depth properties as calculated by the VTrans flexible pavement design method. Designs utilizing bituminous pavement depths less than the minimum requirements will not be considered. All designs shall provide a minimum of 36+ of non-frost susceptible material.

507.2 Paved Roads or Streets - Definitions

1. Subgrade - Existing native soil or rock upon which a road is to be constructed. Subgrade soils that are of poor quality as determined by the Design Engineer and/or the Town Engineer, may be excavated and replaced with sand borrow (VTrans 703.03A) or granular borrow (VAOT 703.04A)
2. Subbase - Portion of a flexible pavement structure between the subgrade and base course. Subbase may consist of crushed gravel, dense graded crushed stone, or a combination of these materials and sand.
3. Fine Graded Base Course - Portion of a flexible pavement structure between the subbase and pavement. The base course shall be top course aggregate for paved roads (plant mix). A two inch (2") thick layer of fine gravel may be used for the top layer of base course aggregate prior to paving to accommodate fine grading prior to paving. At no time shall the fine graded base course be left open to vehicular traffic or exposed to the elements for longer than 24 hours.
4. Shoulders - Shoulders shall be constructed with 704.12A, Aggregate for Surface Course and Shoulders.
5. Wearing Course Bituminous Pavement . The top 1 ½" layer of Type III bituminous pavement on a paved road as shown on Details 100.02 and 100.03 in Appendix A of these Specifications.
6. Base Course Bituminous Pavement . The bottom 2 ½" Type II bituminous pavement on a paved road as shown on Details 100.02 and 100.03 in Appendix A of these specifications.

507.3 Gravel Roads - Definitions

1. Subgrade - Existing native soil or rock upon which a road is to be constructed. Subgrade soils that are of poor quality must be excavated and replaced with sand borrow (VTrans 703.03A) or granular borrow (VTrans 703.04A)
2. Subbase - Portion of the gravel road between the subgrade and the gravel wearing course. Subbase may consist of bank run gravel, crushed gravel for subbase, dense graded crushed stone, plant mix aggregate, or a combination thereof plus sand for subbase.
3. Wearing Course - Top course must be 704.12A, Aggregate for Surface Course and Shoulders
4. Shoulders - Shoulders shall be constructed with the same Materials as the road base

507.4 Testing Requirements

Prior to submittal of final drawings, soil borings and/or test pits shall be made to depth of six feet (6') below final road grade surface on the basis of at least one representative test every 300 linear feet of road. 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 section.
2. Standard Proctor Tests may be required for verification of compaction.
3. Plasticity index and liquid limit for each representative soil in the cross section.

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

The sampling and testing of all materials to be used in the construction of the project is the responsibility of the project engineer. Sufficient lead time must be established for acquiring the approvals of materials prior to placement. Below are Sieve requirements for all road materials required for construction of new roads.

507.5 Sand Subbase

Sand shall consist of material free from silt, loam, clay, or organic matter. It shall conform to the VTrans Standards for Sand Borrow, VTrans 703.03A. It shall be obtained from approved sources.

Sand Subbase shall be placed in uniform lifts not exceeding 12", and shall be uniformly compacted in a manner as outlined in Section 507.04 of these specifications.

507.6 Crushed Gravel for Subbase

Crushed Gravel consists of material free from silt, loam, clay, or organic matter. It shall conform to the VTrans Standard 704.05A. It shall be obtained from approved sources.

Crushed Gravel for Subbase, (Fine), shall be placed on a prepared subgrade in uniform lifts not exceeding 12+in thickness. Each lift shall be thoroughly compacted in a manner as outlined under in Section 507.4 of these specifications. The (Coarse) material shall be used when unsuitable material has been removed from subgrade or in areas with unstable subgrade.

507.7 Crushed Gravel Filler for Subbase

Crushed gravel filler for subbase shall consist of material free from silt, loam, clay, or organic matter. It shall conform to the VTrans Standards for Filler, VTrans 704.06B. It shall be obtained from approved sources.

Filler shall be placed between the subbase material and the base course of bituminous concrete pavement in one uniform lift not exceeding 2" in total thickness, and shall be uniformly compacted in a manner as outlined in Section 507.4 of these specifications. The intent of this fine gravel is to provide a uniform paving surface for base coarse pavement

507.8 Dense Graded Crushed Stone for Subbase

Dense Graded Crushed Stone consists of material free from silt, loam, clay, or organic matter. It shall conform to the VTrans Standards for Dense graded Crushed Stone for Subbase, VTrans 704.06A. It shall be obtained from approved sources. Dense Graded Crushed Stone shall be used to fill unstable areas beneath subgrade, and to replace unsuitable material that has been removed from subgrade or in areas with unstable fill. The material shall be

placed in uniform lifts not exceeding 18+in thickness. Each lift shall be thoroughly compacted a manner as outlined in Section 507.4 of these specifications.

507.9 Wearing Course Aggregate for Gravel Roads

Top Course Gravel shall consist of material free from silt, loam, clay, or organic matter. It shall conform to the VTrans Standards for Aggregate For Surface Course and Shoulders, VTrans 704.12A. It shall be obtained from approved sources.

This material shall also be utilized to provide a uniform driving surface on existing gravel. The Town of Essex Public Works Department shall perform all grading operations on all Class III Gravel Roads within the Town of Essex.

507.10 Bituminous Concrete Pavement

This type of pavement shall be composed of mineral aggregate, mineral filler if required, and bituminous material, plant-mixed and laid hot. This pavement shall be constructed in two or more courses on the prepared or existing base in accordance with these specifications and in conformity with the lines, grades, thickness, and typical cross-sections shown on the drawings. The minimum depth of pavement is a total thickness of 4+for all roads.

The course aggregate shall consist of clean, hard-crushed rock or screen-crushed gravel free from dirt or foreign matter. It shall be reasonably free from soft and elongated pieces. The fine mineral aggregate shall consist of sand or a mixture of sand and stone screenings of which at least 50 percent by weight shall be sand. The sand shall consist of clean, hard, durable grains free from injurious amounts of vegetable matter or other harmful substances.

The asphalt cement shall conform to all the requirements as set forth in section 702 and 704 of the VTrans Standard Specifications for Construction. The materials shall be combined and graded to meet the composition found in Section 406 of the VTrans Standard Specifications for Construction:

The Town will require 2 1/2+type II for the base coat and 1 1/2+type III for the final surface coat. The materials shall be combined and graded to meet the following criteria based on the Marshall Test, 50 blows per side.

Property:	Criteria:
Air Voids, types II, III, IV	3-5%
Voids in Mineral Aggregate	

Type II	14% minimum
Type III	15% minimum
Type IV	16 % minimum
Stability	1200 lbs. min.
Flow	.08+.18+

The percentage of air voids of the mixture shall be calculated by the following formula:

$$VA=100 [(Gmm-Gmb)/Gmm]$$

Where VA = % air voids in the compacted mixture, Gmm= maximum specific gravity of uncompacted mixture (AASHTO T-209), and Gmb= bulk specific gravity of compacted mixture (AASHTO T-166, Method A)).

Equipment for spreading and finishing the mixture shall be a mechanical spreading and finishing machine provided with an activated screed and heated, if required. The machine shall be capable of spreading the mixture without segregation and shall be approved by the design/project engineer before being used.

Application of bituminous concrete pavement shall meet all the requirements of the VTrans Standard Specifications for Construction, Section 406, including, but not limited to, the following:

Weather limitations: Bituminous material shall not be applied between November 1 and May 1, unless prior approval is obtained from the Town Engineer. 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 degrees Fahrenheit for courses 1 ¼+or greater in compacted thickness or below 50 degrees Fahrenheit for courses less than 1 ¼+in compacted thickness. When it is the public interest for servicing traffic, the Engineer may adjust the air temperature requirements or extend the dates of the paving season.

Conditioning: When new bituminous concrete is to be placed over existing bituminous concrete or cement concrete surfaces, they shall be cleaned and sprayed with Emulsified Asphalt RS-1 before placing of the new bituminous concrete. The emulsified asphalt treatment will also be required when the bituminous or cement concrete surface to be paved has been placed in the same construction season (May through November of the same year), unless deleted by the Town Engineer. The emulsion shall be applied under pressure at the rate of 0.01 to 0.03 gallons per square yard. This application shall be made

just prior to the placement of the bituminous concrete mixture but shall progress sufficiently ahead of the paving so that the surface to be paved will be tacky. The entire surface to be paved shall be covered with a uniform film thickness of emulsified asphalt at the application rate described above. All longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon Portland cement concrete surface. All excess bituminous material shall be removed from joints and cracks prior to placing the bituminous concrete mixture.

Any large cracks in a bituminous surface shall be thoroughly cleaned and filled with a bituminous material or mixture approved by the project engineer. Contact surfaces such as curbing, gutters, and manholes shall be painted with a thin, uniform coat of Emulsified Asphalt RS-1 immediately before the bituminous concrete mixture is placed against them.

If there are deficiencies that require corrective action, in the base course constructed as part of the Contract, a bituminous concrete mix which meets the approval of the project engineer shall be used to bring the base course to the designed grade and contour at the expense of the contractor.

Where bituminous concrete is used to resurface existing pavements and the existing pavement contains irregularities, depressions or waves, such deficiencies shall be eliminated by the use of bituminous material for leveling to bring the existing base to uniform section and grade before placing of the required courses of bituminous concrete.

Placing and Finishing: The bituminous mixture, at the time of discharge from the haul vehicles, shall be within ten degrees Fahrenheit of the midpoint of the compaction temperature for the approved mix design. All exposed surfaces which are not to be treated shall be protected from damage during all phases of the paving operations. Manhole and catch basin tops shall be flush with the surface on base coarse paving which will not be overlaid until the following year. The bituminous mixture shall be placed and finished with the specified equipment and struck off in a uniform layer to the full width required and of such depth that each course, when compacted, shall have the required thickness and shall conform to the grade and elevation. Specified bituminous pavers shall be used to distribute the mixture over the entire width or over such partial width as may be practical. The direction of paving of parking areas or other paved areas without a crown shall be parallel to the direction of drainage.

Compaction: immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the

proper condition and when the rolling does not cause cracking or shoving under displacement.

The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot or lightly oiled hand tampers, smoothing irons, or with mechanical tampers.

Unless otherwise directed, the longitudinal joint shall be rolled first and then rolling shall begin at the side of the pavement and proceed towards the center or high side with lapped rollings parallel to the centerline. The speed of the roller shall be slow and uniform to avoid displacement of the mixture and the roller should be kept in as continuous operation as practical. Rolling shall continue until all roller marks and ridges have been eliminated.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of bitumen shall be removed and replaced. These replacements shall be at the developer/contractor's expense.

The contractor shall replace the pavement with like material where cores are removed during hot mix operations. These replacements shall be at the contractor's expense.

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

Butt joints shall be formed by cutting the pavement in a vertical plane at right angles to the centerline, at a location approved by the project engineer, where the pavement has a true surface as determined by the use of a straight edge. The butt joint shall be thoroughly coated with Emulsified Asphalt, Type RS-1, just prior to depositing the paving mixture.

Unless otherwise noted by the project engineer or on the plans, transverse paving joints in wearing courses shall be butt type.

Where directed by the project engineer, tapered joints shall be formed by ramping down the last 18 to 24 inches of the course being laid to match the

lower surface. Care shall be taken in raking out and discarding the coarser aggregate at the low end of the taper, and in rolling the taper. The taper shall be thoroughly coated with Emulsified Asphalt, type RS-1, just prior to resuming paving. As the paver places new mixture on the taper, an evenly graduated deposit of mixture will complement the previously made taper. Shovels may be used to add additional mixture if necessary. The joint shall be smoothed with a rake, coarse material discarded, and properly rolled.

Longitudinal joints that have become cold shall be coated with Emulsified Asphalt, type RS-1, before the adjacent mat is placed. If directed by the project engineer, they shall be cut back to a clean vertical edge prior to painting with the emulsion.

Unless otherwise directed by the design/project engineer, longitudinal joints shall be offset at least 6 inches from any joint in the lower courses of pavement. Transverse joints shall not be constructed nearer than 1 foot from the transverse joints constructed in lower courses.

Testing: Testing for temperature of the mix will be performed by the contractor and provided to the Town Engineer at the time of paving. Bituminous mixtures, at time of discharge from the haul vehicle, shall be at a temperature of not less than 225 degrees F or more than 325 degrees Fahrenheit, unless otherwise approved by the Town. In addition the Town Engineer may require a certification from the supplier of the mix being furnished.

The surface will be tested by the project engineer using a 16 foot straight-edge 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 will be provided by the contractor. On parking area surfaces or other paved areas that have no crown, the surface will be tested parallel to the drainage slope of the area.

508.0 Street Related Items

508.1 Street Lighting

Streets and roadways shall be illuminated by standard street lights, approved by the Town, a maximum of three hundred feet (300') apart and at street intersections or as approved. Street lights shall be installed on the sidewalk side of the street.

All street lighting installed in the Town of Essex shall adhere to the requirements

and guidelines of the current version of the Outdoor Lighting Manual for Vermont Municipalities. This manual is a publication of the Chittenden County Regional Planning Commission.

508.2 Traffic Control Devices

Traffic control devices shall be installed to the standards contained in the latest version of the Manual of Uniform Traffic Control Devices (MUTCD).

508.3 Street Name Signs

Street name signs, posts and foundation materials shall be as shown on Sign Detail 600.02 in Appendix A of this document. The sign post shall be located in the green strip between the sidewalk and curb at a point which will not interfere with pedestrian or vehicular travel, at a minimum distance 3' from the curb.

All public roads shall be labeled with white lettering on a green background. All private roads shall be labeled with white lettering on a blue background. The text size and shape shall conform to the latest version of the Manual of Uniform Traffic Control Devices (MUTCD).

508.4 Guard Rails

This item shall consist of the construction of twelve (12) gauge standard steel beam and post guard rail, conforming to the design indicated on the accepted drawings, Section 621 and 728 of the current version of the VTrans Standard Specifications for Construction, and Sheets G-1 and G-1d of the VTrans Standard Details for Construction.

Guard rails shall be erected when the height of fill at the shoulder point is more than ten feet (10') with a slope steeper than 1 on 3 or as directed by the Town Engineer.

508.5 Street Sideline Monuments

Street property sideline monuments shall be installed at street intersections and at points of curve and/or tangency or other critical points in the street lines as will enable a land surveyor to correctly stake out lots in the subdivision.

Reinforced concrete monuments shall be 4" x 4" x 36" pre-cast concrete. The top shall have a marked center, which shall be the point of reference and a mark identifying the license number of the registered land surveyor under whose

direction the monument was set. In ledge, a minimum 4" deep hole shall be drilled or chiseled and a 6" long concrete monument shall be grouted in the hole.

The monuments shall be set vertically and to a depth so that the top of the monument will project one-half inch ($\frac{1}{2}$ ") above the surrounding ground surface. The monuments shall be set in place after other street improvements are completed. The monument's location shall be established by a surveyor licensed to practice in the State of Vermont.

509.0 Curbing, Sidewalks, Drive Aprons and Paths

509.1 General Requirements

All concrete used in the construction of roadway curbs shall meet or exceed the requirements of Class B Concrete, (3,500 psi), as described in Section 501 of the current version of the VTrans Standard Specifications for Construction. No concrete shall be poured on a frozen or thawing subgrade, or when the temperature is 38 degrees Fahrenheit and falling. The Contractor shall record the temperature daily as outlined in Proposed Recommended Practice for Cold Weather Concreting, ASI 306.

In hot weather, temperature of freshly placed concrete shall not be allowed to exceed 85 degrees Fahrenheit, conforming to ACI 305.

Just prior to placing the concrete, the subgrade shall be moistened. The concrete, mixed to the proper consistency, shall be placed in the forms and thoroughly tamped in place so that 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 should be taken to not affect the alignment or grade of the curbing.

When the initial curing period is over (approximately 28 days after placement), exposed surfaces shall receive two additional coats of Anti-spalling compound. Anti-spalling compound shall only be applied when the air temperature is above 50 degrees Fahrenheit. The Town may require tests to verify comprehensive strength.

509.2 Portland Cement Concrete Curbing

Portland cement concrete curb shall be constructed on a prepared subgrade in accordance with the current version of the VTrans Standard Specifications for Construction, and the requirements provided in Detail 100.07, in Appendix A of this document.

Each residential lot shall be allowed one curb cut, which shall be constructed as outlined in the details in Appendix A of this manual. Approved development plans which indicate curb cut locations may be used in lieu of individual permits. Refer to Detail 100.08 in Appendix A for further construction requirements.

When preparing the subgrade, all boulders, organic material, soft clay, spongy material, and other unsuitable material shall be removed and replaced with approved material. The concrete curbing shall be built to the required line and grade on a base of crushed gravel a minimum of six inches (6") in depth, which shall be fully compacted.

One-half ($\frac{1}{2}$ ") expansion joints shall be placed at intervals of twenty (20) feet. At intervals not greater than ten (10) feet nor less than five (5) feet, the concrete curbs shall be scored for a depth equal to one-fourth the total depth of the concrete.

Forms shall be metal or approved planed and matched lumber and of such construction that a smooth surface will be produced. Slip forms may be used in lieu of forms providing required joints are provided and all other requirements of this section are met, and these specifications are adhered to.

509.3 Portland Cement Concrete Sidewalk

Portland cement concrete sidewalks shall be constructed on a prepared subgrade in accordance with the requirements of Detail 100.05 in Appendix A of this document.

At a minimum, sidewalks constructed within the Town of Essex shall be made of one course of Portland cement concrete not less than five (5") thick and with a width of not less than five feet (5'). Where the sidewalk crosses a driveway, the depth of concrete shall be a minimum of six inches (6") for residential driveways and eight inches

(8") for commercial and industrial driveways for the full width of the driveway.

Sidewalks shall have ADA compliant ramps (including Detectable Warning

Surfaces) where they intersect with streets to provide for handicapped access. Further requirements are provided with Detail 100.06 in Appendix A of these Specifications.

When preparing the subgrade, all boulders, organic material, soft clay, spongy material, and other unsuitable material shall be removed and replaced with approved material. The subgrade shall be properly shaped, rolled, and uniformly compacted to conform with the accepted cross-sections and grades. A minimum depth of six inches (6") of compacted crushed gravel shall be placed on the subgrade to the accepted grades. Under curb cuts and driveways, a total of 12" of compacted crushed gravel is required as a base for the cement concrete sidewalk. Under commercial or industrial drives 18" of base material is required. Refer to Details 100.05 and 100.08 for further sidewalk construction requirements at drive crossings.

The forms for the concrete shall be constructed of wood or metal, straight, free from warps or kinks, and of sufficient strength. Forms shall be staked securely enough to resist the pressure of the concrete without springing. The Contractor shall apply an approved anti-bonding agent to all form surfaces before concrete is poured. When ready for the concrete, forms shall not vary from the approved lines and grades and shall be kept so until the concrete has set.

509.4 Drive Aprons

509.4.1 Bituminous Concrete Drive Apron

Bituminous concrete driveway aprons shall not be less than two and one half inches (2 1/2") thick, and be constructed on a prepared subgrade in accordance with these specifications and as shown on the accepted drawings. (See Detail 100.08.)

509.4.2 Portland Cement Concrete Drive Apron

This item shall consist of a Portland cement concrete driveway apron not less than six inches (6") thick to be constructed on a prepared subgrade in accordance with these specifications, the current version of the VTrans Standard Specifications for Construction, and Detail 100.08 in Appendix A of this document.

Portland Cement Concrete drive aprons shall be constructed using the same requirements as Section 509.3, Portland Cement Concrete Sidewalks, of this document. The Contractor shall utilize the additional requirements below for

installation of Portland Cement Concrete Drive Aprons.

1. One-half inch ($\frac{1}{2}$ ") transverse expansion joints shall be placed where the driveway apron and driveway joins the sidewalk and curb or pavement.
2. Curbs shall be constructed so as to protrude one and one-half inches ($1\frac{1}{2}$ ") above the roadway surface at the entrance to the driveway. This curb shall be constructed with a smooth and gradual depression transition which shall not exceed nine inches (9") in length.

510.0 Recreation Paths

Recreation paths shall be constructed as depicted on Detail 100.12 in Appendix A of this document and as shown on VTrans Standard A-78.

511 Stormwater Control Facilities

It is not intended by the Town of Essex that this ~~%Section+~~ be a complete set of specifications. It is to be used as a basic standard for any person planning to work in the Town storm sewer system. All materials listed shall be acceptable to the Town Public Works Department and any materials not listed will require acceptance by the Town Public Works Department before installation. Failure to receive acceptance of materials prior to their incorporation into the system shall leave the person having the work done liable to replace those substandard materials with acceptable materials at his/her cost.

The applicant(s) proposing extensions or alterations to the existing storm sewer system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state and federal). Applicants shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, and permits and shall have obtained all acceptances and paid all applicable fees.

511.1 General

Drainage facilities shall be designed on the basis of a 25 year, twenty-four hour storm event. Drainage facilities not impacting Town highways, utilities, or other infrastructure may be designed on the basis of a 10 year, twenty-four hour storm event if approved by the Town of Essex. Projects that adversely impact existing storm drainage facilities will be expected to upgrade these facilities.

On steep slopes, an effective method of anchoring storm drain pipes to prevent movement and/or slippage will be required. Storm drainage systems must be designed by a professional engineer, licensed in the State of Vermont.

511.2 Open Drainage

The drainage systems for paved or unpaved rural roads shall be constructed using overland flow, gravel shoulders, grassed slopes, deep drainage ditches and cross culverts as necessary to provide proper erosion control.

511.3 Closed Drainage

The drainage systems for urban Type I roads shall be constructed with catch basins, underground piping, outlet structures, energy dissipation devices and proper erosion control. Urban roads, classified as major roads, may be constructed with open drainage, on a case-by-case basis, as approved by the Town.

511.4 Materials

511.4.1 Pipe

Storm drainage pipes shall be HDPE conforming to AASHTO M252, AASHTO M294 or ASTM F2306 minimum cell classification 435400C for 18+through 60+diameters. All storm drainage pipes shall have a minimum diameter of 18+.

Underdrain pipes shall be PVC SDR 35 perforated pipe with ½+diameter holes at 5+on center. The underdrain pipes shall have a minimum diameter of 6+and all fittings shall be manufactured PVC SDR 35 gravity sewer fittings.

Roadway and driveway culverts shall be HDPE pipe conforming to AASHTO M252, AASHTO M294 or ASTM F2306 minimum cell classification 435400C for 18+through 60+diameters.

All roadway and driveway culverts shall have a minimum diameter of 18+ and be sized to meet the up gradient drainage watershed for a 25 year storm.

511.4.2 Pre-cast Concrete Structures

Catch basins shall be precast reinforced concrete structures with a monolithic base. The catch basins shall be a minimum of 36+ diameter or 24+ square, but for structures with more than two (2) pipe penetrations (not including underdrain pipe penetrations), the catch basin diameter shall be a minimum of 48+. Catch basins located within the travelled way shall be designed and constructed to withstand (H-20) loading.

Catch basins shall be sized such that:

- At any elevation, a minimum of 60% of the circumference shall be concrete.
- The minimum distance, as measured along the circumference, between two (2) openings shall be a minimum of 6+.
- The structures shall meet the minimum requirements of Table 4.1.

**Table 4.1
 Catch Basin Minimum Requirements**

Catch Basin Diameter	Largest Pipe Diameter Allowed	Sidewall Thickness	Concrete Cover Thickness
36+(24+x 24+)	18+	6+	8+
48+	30+	6+	10+
60+	36+	6+	12+
72+	48+	7+	18+

All catch basins shall be constructed such that they have a 24+ sump.

Manholes shall be round precast reinforced concrete structures with a monolithic base. All drainage manholes shall have a minimum 48+ diameter. All storm manholes located within the travelled way shall be designed and constructed to withstand (H-20) loading.

Flexible manhole sleeves manufactured by Lock Joint or accepted equal shall be provided at all mainline inlet and outlet pipe penetrations greater than or equal to 4+ diameter.

511.4.3 Frames and Grates

Catch basin frames and grates shall be 24+x 24+ square and be manufactured in the United States. A three (3) flange frame and grate shall

be installed adjacent to curbs. Where the grade of the road exceeds 5%, high capacity grates may be required

Manhole covers and frames shall be 30+ diameter and be manufactured in the United States. The cover shall have the word "Storm" cast into it.

511.5 Methods of Installation

511.5.1 Storm Drain Pipe

Storm drains and culverts shall be constructed in accordance with Detail 200.04 and the VTrans Standard Specifications for Construction, Section 601, and on a trench bottom, prepared and bedded as shown on the drawings. Each pipe shall be checked just prior to laying to ensure that it is clear of all dirt and debris and shall be laid true to line and grade as indicated on the contract drawings. All joints shall be tight and inverts shall be continuous.

Storm drains and culverts with water flow velocities greater than 12 feet per second shall require special design which must be approved by the Town Engineer.

All material for backfilling shall be free of roots, stumps, and frost. Backfill for all pipe lines shall be either native material or select backfill placed in six inch (6") lifts with each lift being compacted to not less than 95 percent of maximum dry density as determined by the AASHTO-99, Method A, Standard Proctor. Pipe bedding shall be as shown on Detail 200.04 in Appendix A of these Specifications.

A continuous sheathed solid conductor copper tracer wire shall be installed over all storm pipes. See Details 200.01 through 200.04 in Appendix A of these specifications.

511.5.2 Drainage Swales

Roadside drainage ditches shall be constructed to a minimum depth of 6+ below the road subbase.

As shown on Detail 200.06 in Appendix A of this document, ditches with centerline grade more than 5% shall have stone fill or riprap placed in the bottom to stabilize them.

Stone used to stabilize ditches shall be of sufficient size for the purpose intended, but will be a minimum size of VTrans Type I Stone Fill.

Stone fill and riprap shall be as defined by VTrans. Standard Specifications for stone fill 706.04 and riprap 706.03. Stone fill and riprap shall be placed according to VTrans Standard Specification 613.

511.5.3 Road Underdrain and Slope Drains

This item shall consist of constructing underdrains using pipe, stone, filter fabric, underdrain outlets, clean outs, and risers in accordance with these specifications and as shown on the accepted drawings or as ordered by the Town or project engineer. Further requirements regarding the design and installation of underdrains can be found in Appendix A, Detail 200.07 of this document.

Trenches for underdrain shall be excavated to the dimensions and grades shown on the approved plans or as ordered by the project engineer and/or the Town. Filter fabric, Mirafi 140N or approved equal, shall be placed in the trench. 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 or as directed by the project engineer and/or the Town.

PVC SDR 35 perforated underdrain, shall be placed in the center of the trench and firmly embedded in the material. The underdrain shall be placed with perforations down, and backfilled with $\frac{3}{4}$ +washed crushed stone, and wrapped on filter fabric as shown in Detail 200.07 in Appendix A.

Underdrain installation shall begin at the outlet (low) end and proceed toward the upper end. Upgrade ends of all underdrain pipe installations shall be connected to a storm drain structure or closed with suitable plugs to prevent entry of soil material.

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. Trench backfill shall be limited to the use of hand shovels, backhoes, front-end loaders, or other similar types of equipment.

Underdrain pipes shall run continuously from structure to structure to minimize the need for cleanouts. The underdrain pipes shall enter and exit the structures whenever possible, and be located a minimum 18+ above the carrier pipe's invert.

511.5.4 Drainage Outlets

As shown on detail 200.05 of these Specifications, at each stormwater pipe outlet, a combination of stone fill within the drainage way and rip rap above the sides shall be provided for sufficient distance from the outlet to prevent scouring and erosion of the drainage way.

Stone fill shall conform to the VTtrans Standard Specifications, Section 706.04.

Erosion control fabric may also be required as a base for the stone fill, when in the opinion of the Town Engineer, the erodibility of the soil warrants its inclusion.

In addition, energy dissipation devices may be required to slow the velocity of the outflow at the stormwater outlet. Devices include but are not limited to the following:

1. gabions
2. vertical drops in stormwater manholes
3. concrete or bituminous splash plates
4. permanent check dams, in addition to temporary erosion control devices
5. concrete or stone barriers.

Storm water detention basins will be allowed providing the detention basins are constructed of sufficiently porous materials to enable the basins to drain within 24 hours of a storm event and further providing that the detention basin is less than 3' deep during the peak period of the design storm. The design storm to be used for sizing a detention basin shall be a minimum two-year, twenty-four hour storm event. Side slopes on detention basins shall be 1:3 or less.

511.6 Testing and Permit Requirements

511.6.1 Final Inspection

All storm drain lines shall be checked for line and grade and shall be visually inspected by the design/project engineer prior to acceptance by the Town. The design/project engineer shall certify that the storm sewer system was built in accordance with the approved plans.

511.6.2 Cleaning and Flushing

All storm drain lines, catch basins, catch basin sumps and other appurtenant features shall be thoroughly cleaned of all debris and foreign material prior to acceptance by the Town.

512 Sanitary Sewer Specifications

512.1 General

It is not intended by the Town of Essex that this ~~Section~~ be a complete set of specifications. It is to be used as a basic standard for any person planning to work in the Town sanitary sewer collection system. All materials listed shall be acceptable to the Town Public Works Department and any materials not listed will require acceptance by the Town Public Works Department before installation. Failure to receive acceptance of materials prior to their incorporation into the system shall leave the person having the work done liable to replace those substandard materials with acceptable materials at his/her cost.

The applicant(s) proposing extensions or alterations to the existing sewer system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state and federal). Applicants shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, and permits and shall have obtained all acceptances and paid all applicable fees prior to commencement of work. This item shall consist of the excavation and backfilling required for the complete construction of gravity sanitary sewers, force mains, and all appurtenant construction related thereto, including chimneys, service connections, thrust blocks, and other items necessary for a complete sanitary sewer system as indicated on the drawings. The work shall also include testing and placing the system into satisfactory operation.

All sewer plans submitted for review shall be prepared by a licensed professional civil engineer registered in the State of Vermont. All submittals shall contain the plan and profile, invert elevations at the manhole (in and out elevation with a minimum 0.1' drop at each manhole), pipe slope and type of pipe to be used. Details of construction shall be provided for those ancillary items not covered in this document.

All sewer mains shall be a minimum 8" in diameter, without exception.

No sewer shall receive live sewerage until such time as the Town has given final approval to the sewer installation, including satisfactory completion of all

required tests. Service connections shall not be made until all receiving sewer mains have been completed and approved.

The horizontal and vertical separation for sewer and waterlines shall be designed and installed in accordance with the latest edition of the Vermont Environmental Protection Rules and as depicted in Detail 400.04 of these specifications

Unless the plans require a particular type of pipe material, the contractor shall have the option of utilizing, with Town approval, any one of the gravity sewer pipe materials listed in this section providing the pipe utilized meets or exceeds the strength and other class requirements shown on the Contract Drawings.

512.2 Gravity Sewer

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

512.3 Forcemain

Force mains shall be either class 52 ductile iron with push on joints, or PVC when installed in an open trench, or HDPE when installed by Directional Boring.

512.4 Materials

512.4.1 Iron Pipe Size HDPE

High Density Polyethylene (HDPE) material shall meet the following as the minimum in place standards. Materials shall be appropriate for the stresses generated by the selected equipment and field conditions. Ensure that the appropriate material is used to retain compliance once it is installed.

Non-pressure installations

ASTM D 2447

ASTM D 3350

ASTM F714

Pressure installations

ASTM D 2447

ASTM D 3350

ASTM F714

ASTM 2513

512.4.2 Polyvinyl Chloride Pipe

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 PVC pipe shall meet ASTM Specifications for SDR35 pipe. All pipe and fittings shall be clearly marked as follows:

1. Manufacturer's Name and Trademark
2. Nominal Pipe Size
3. Material Designation 12454C PVC
4. Legend "Type PSM SDR35 PVC Sewer Pipe"
5. 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 13 or 14 foot lengths. All connections will require the use of manufactured fittings. Field fabricated, saddle type connections will not be considered acceptable.

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 mitre box. The cut end shall be beveled to the same as the factory bevel and all interior burrs shall be removed. A homing mark shall be placed on the pipe before assembling. 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%).

The manhole water stop gasket and stainless steel clamp assembly must be approved by the design/project engineer prior to the installation of any pipe.

The Contractor will submit certification to the project engineer that the materials of construction have been sampled, tested, inspected, and 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 degrees Fahrenheit or goes above 100 degrees Fahrenheit without prior approval. 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.

512.4.3 Ductile Iron Sewer Pipe

Ductile iron pipe shall be the thickness class designated on the plans. 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 Inch Through 48 Inch of 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 Section 11-2 through 11-5 and 11-7 through 11-8 of ANSI A21.11. Mechanical joining, ductile iron pipe, shall be the thickness class designated on the plans and shall be installed where specified on the plans.

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.

Where indicated on the plans and for the purpose of resisting corrosion, an 8 mil. thick polyethylene wrap shall be provided for the pipe. All material and installation shall be done in accordance with the latest version of AWWA Standard C105.

512.4.4 Pipe Bedding

For PVC Gravity Sewer, the bedding material shall consist of crushed stone or crushed gravel, uniformly graded from 3/4" to 1/4" extending from

the trench bottom, 6" below the pipe invert to the crown of the pipe. For ductile iron gravity sewers and force mains, the bedding material shall consist of sand or gravel from the trench bottom, 6" below the pipe invert to the centerline of the pipe. Gravel shall mean a material reasonably free from silt, loam, clay or organic material containing no more than 8% by weight passing the #200 sieve, uniformly graded and the largest stone shall not exceed 1" in any dimension.

For pipe materials different from those listed, the Town Engineer shall make a determination as to the equivalent level of bedding construction, based on information submitted prior to construction by the contractor.

When an unstable trench bottom is encountered and in the opinion of the Town Engineer, it cannot support the pipe adequately, an additional depth should be excavated and refilled to the pipe invert with approved material.

All pipe trenches shall be dry during the laying of pipe.

512.4.5 Directional Bore

Directional Boring, also commonly called Horizontal Directional Drilling shall only be for the installation of force mains. No gravity sewer mains may be installed with this method. The materials, installation methods and testing shall meet or exceed those specified in Section 520, Potable Water Specifications, of these Specifications.

512.4.6 Pre-cast Concrete Structures

Manholes shall be placed at all changes in slope, size, alignment of pipe, at the ends of each line, and not exceeding three hundred feet (300').

Reinforced concrete manholes and drop manholes shall be constructed to the dimensions and at the locations shown on the contract drawings. All precast reinforced concrete manhole sections shall conform to the latest version of the ASTM Specifications C 478. The footing may be either cast-in-place with 3000 PSI concrete or precast and shall conform to the dimensions indicated on the plans.

Shelves and inverts shall be constructed with red-hardened brick as shown on Details 300.01 and 300.02 in Appendix A of these Specifications. Inverts for sewer manholes shall be as shown on the plans and details. Inverts shall have the exact shape of the sewer to which they are connected, shall be gradual and even. All construction of sewer manholes

must be carried out to ensure watertight work. Any leaks in manholes shall be caulked on the exterior wall of the structure and completely repaired to the satisfaction of the design/project engineer or the entire structure shall be removed and rebuilt.

All manholes are to be provided with copolymer polypropylene plastic rungs with steel reinforcement eight inches (8") on center. The rungs will have a minimum pull out strength of 2500 lbs.

Precast risers and bases for manholes shall conform to ASTM Specification C361. The pipe openings in the precast manhole riser shall have a flexible gasket. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form). Mortar purging will not be allowed on the interior seams of manhole walls, but may be used on the outside of joints.

To protect manholes from groundwater intrusion, the manholes will be sealed on the exterior with a two-coat coal-tar epoxy coating system. The two coating thickness shall achieve a minimum dry film thickness of 15 mils.

512.4.7 Frames and Covers

All manholes shall be provided with tough gray, cast iron manhole frames and covers of the size and type as indicated on the detailed drawings. The minimum diameter shall be 30", with a minimum weight of 400 pounds is the preferred type. All castings shall be manufactured in the United States.

Castings shall be true pattern and free from flaws. Bearing surfaces of manhole frames and covers against each other shall be machined to give continuous contact throughout their entire circumference. All iron castings shall be thoroughly cleaned and then coated with hot tar before being delivered. Manhole covers shall be marked "sewer". Water-proof type manhole covers shall be provided when noted on the plans or as required by the project engineer. All manholes shall be non-venting.

512.4.8 Brick Masonry Inverts

Brick masonry shall be used for filling of manhole inverts and for similar uses.

As noted on Detail 300.02 in Appendix A of these Specifications, the brick for ordinary brickwork shall be common red 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 Grade MS.

The brick for ordinary brickwork shall be laid in Portland cement mortar reinforced with fiber-glass fibers (block bond) composed of one part Portland cement and two parts of sand, measured by volume, to which not more than 10 pounds of lime shall be added for each bag of cement. Water for mortar shall be clean and only an amount sufficient to produce a workable mortar shall be used. Mortar shall be used within one hour from the time the cement was added to the mix. Pre-mixed, bagged mortar will not be allowed.

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

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.

512.4.9 Service Connections

As noted on detail 300.06 of these specifications, sewer service connections within the town right-of-way for one house shall be constructed of six inch (6") pipe to the property line, unless otherwise noted on the plans, of the type material specified under this section. The pipe shall be laid and its joints made as required for sewer construction in this specification. Larger service connections may be required for commercial or industrial applications.

As noted on detail 300.06 of these specifications, open ends of pipes shall be properly sealed with a watertight cap or plug to prevent damage and intrusion of foreign matter where hookup to the building sewer is not coincident with sewer main construction. Additionally, a stable, temporary marker approved by the project engineer shall be provided from the sewer service invert up to six inches (6") above the finished grade and 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 by the town. The excavation, bedding material, installation, and backfill for service connections shall be same as for sewer mains.

512.4.10 Sewer Cleanouts

As noted on detail 300.07 of these specifications, cleanouts for gravity sewers and force mains shall be provided at locations indicated on the plans or as directed by the project engineer. Cleanout frames and covers shall be of tough gray cast iron. Castings shall be true to patterns 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.

Cleanouts shall be installed where the distance from the building to the main sewer is greater than one hundred (100) feet or where bends greater than or equal to the sum of forty-five (45) degrees are used in the building sewer. Cleanouts shall be made by installing a "Y" and one-eighth (1/8) bends of the same diameter as the building sewer. The cleanouts shall ordinarily be installed at the point of connection between the building sewer and the outside part of the house plumbing system, at curves on the building sewer and on the straight part of the house sewer to the main sewer. The cleanout shall be brought up from the building sewer to four (4) inches below ground level and be properly capped. The locations of all cleanouts shall be recorded and copies of those records shall be turned over to the Town.

512.4.11 Thrust Blocks and Anchors

As noted on detail 400.03 of these specifications, concrete thrust blocks and 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 design/project engineer. Concrete for thrust blocks and anchors shall be 3000 psi concrete. Exposed steel rods and clamps as required shall be rustproofed or painted.

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

shown on the contract drawings or as required by the project engineer. There shall be neat contact with fittings.

512.5 Methods of Installation

512.5.1 Excavation

Before any construction takes place with the Town's right-of-way, or within 15' of the edge of that right-of-way, all construction warning signs and safety measures shall be installed and approved. The signs and safety measures shall meet or exceed the requirements of the latest edition of the Manual on Uniform Traffic Control Devices.

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. Wherever boulders or ledge rock are encountered in excavations for pipelines or structures, such boulders or ledge rock shall be removed to a depth of six inches below grade and space occupied by them shall be refilled to grade with the specified bedding material. Trenches shall be opened at such times and to such extent only as may be permitted by the project engineer or the Town. All driveways, crosswalks, sod, shrubs, trees and any other surface material affected by the work shall be carefully taken up and kept separate from other excavated material. If suitable, excavated material shall be used for embankments, backfill and fill. Side slopes of excavations shall be as required by VOSHA.

Wherever material at or below grade line of pipe or structure plus depth of bedding material is unsuitable for foundations, it shall either be excavated to such additional depths as directed by the project engineer and then refilled with well compacted crushed stone or the project engineer may direct that a filter fabric be utilized. It shall be installed and the excavation then brought to grade line of pipe with well-compacted bedding.

512.5.2 Sewer Pipe Installation

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 developer/contractor shall fill any gully to make a suitable bedding for the sewer pipe. The fill shall be compacted to a 95% dry density by the

AASHTO-T-99, Method A (Standard Protector) test, upon which six inches (6") of bedding material shall be placed.

Any pipe which is not laid to grade and alignment shall be re-laid to the satisfaction of the project engineer. The allowable horizontal and/or vertical deflection shall as per the manufacturers specifications. The bedding material shall be placed and compacted on each side of the pipe to a height as required for the type of pipe and for the full width of the excavated trench and as shown on the accepted plans.

All piping shall be laid in the dry. It is the responsibility of the contractor to dewater the site prior to and during pipe installation. The interior of the pipe shall be emptied of any debris and cleaned prior to installation. All gravity sewer mains shall have a Mandrel pulled between each successive manhole.

A continuous sheathed solid conductor copper tracer wire shall be installed over all sanitary sewer pipes. See Details 300.01, 300.03-300.05 and 300.09 in Appendix A of these specifications.

512.5.3 HDD – Horizontal Directional Drilling

HDD is a multi-stage process consisting of site preparation and restoration, drilling a pilot bore along a predetermined path and then pulling the product back through the drilled space. When necessary, enlargement of the pilot bore hole may be necessary to accommodate a product larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the product is being pulled back through the pilot bore hole.

Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation, unless approved by the Engineer.

Within 48 hours of completing installation of the boring product, the contractor shall clean the work site of all excess slurry or spoils and ensure that the work site is restored to pre-construction conditions or as identified on the plans. The contractor shall be responsible for repairing any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid (frac-out), or the directional drilling operation, at no cost to the Town.

The contractor shall have a representative who is thoroughly knowledgeable of the equipment and boring methods present at the job site

during the entire installation and available to address immediate concerns and emergency operations. Installation shall not begin until the Engineer is present at the job site and agrees that proper preparations have been made.

Use either a continuous green sheathed solid conductor copper wire line (minimum #12 AWG for external placement or minimum #14 AWG for internal placement in the conduit/casing). Tracking conductors must extend 2 feet beyond bore termini. See standard details for further direction on protecting and terminating the tracer wire.

512.5.4 Precast Concrete Manhole Installation

Manhole covers and frames shall be set to final grade immediately prior to paving of the final top course. When top course pavements are not paved prior to the onset of winter, all manhole frames and covers shall be flush or below top of the paved base course. Just prior to paving the top course, the manhole frames will be cut out and reset to final grade prior to paving or a manhole extension used.

As shown on detail 300.01 of these specifications, manholes frames shall be set to grade with precast concrete riser rings. All manhole lift holes shall be grouted inside and out with expandable grout.

512.5.5 Backfill

All material for backfilling shall be free of roots, stumps, and frost. Backfill for all pipe lines shall be either native material or select backfill placed in six inch (6") lifts with each lift being compacted to not less than 95 percent of maximum dry density as determined by the AASHTO-99, Method A, Standard Proctor. Pipe bedding shall be as shown on Detail 200.04 in Appendix A of these Specifications. No stones in excess of one and one-half inch (1 1/2") diameter shall be placed within two feet (2') of the outside of the pipe. Particular precautions shall be taken in placement and compaction of the backfill material in order not to damage and/or break the pipe. The backfill shall be brought up evenly on both sides of the pipe for its full length.

Walking or working on the completed pipeline, except as may be necessary in tamping or backfilling, shall not be permitted until the trench has been backfilled to a height of at least two feet (2') on the top of the pipes. During

construction, all openings to the pipelines shall be protected from the entering of earth or other materials.

512.5.6 Frost Protection

As noted on details 300.04 and 400.09 of these Specifications, sewers with less than five and one-half feet (5.5') of cover over the crown or where indicated on the plans shall be protected against freezing by installing two inch (2") thick Styrofoam SM insulating sheets with a width of three feet (3') 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 during backfill and during compaction over the styrofoam. SM sheets shall meet the compressive strength requirements of ASTM D1621-73. The styrofoam shall be as manufactured by Dow Chemical Company, Midland, Michigan or equal.

512.6 Final certification

512.6.1 Testing of Sewer Infrastructure

512.6.2 Gravity Sewers

Low Pressure Air Test

The low pressure air test shall conform to the requirements and procedures set forth as follows:

1. Test is to be conducted between two (2) consecutive manholes, as directed by the Project Engineer.
2. The test section of the sewer line is plugged at each end. One of the plugs must be tapped and equipped for the air inlet connection for filling the pipeline from the air compressor.
3. All service laterals, stubs, and fittings into the sewer test section should be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slipping and blowouts.
4. When a constant pressure of 4.0 psig is reached, throttle air supply to maintain the internal pressure above 3.5 psig for at least five (5) minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections.

5. If leakage is detected at any cap or plug, release the pressure in the line and tighten all leaky caps and plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug a new five (5) minute interval must be allowed after the pipe line has been refilled.
6. After the stabilization period, adjust the air pressure to 3.5 psig and shut off or disconnect the air supply. At 3.5 psig commence timing with a stop watch until the line pressure drops to 2.5 psig. The time required for a pressure loss of 1.0 psig is used to determine the test results.
7. If the time, in minutes and seconds, for the air pressure to drop from 3.5 to 2.5 psig is greater than that shown in the table for the designated pipe size, the section undergoing the test shall have passed and shall be presumed to be free of leaks. The test may be discontinued at that time.
8. If the time, in minutes and seconds, for 1.0 psig drop is less than that shown in the table below for the designated pipe size, the section of pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

Low Pressure Air Test – Time Table

The minimum test times for various pipe sizes are as follows;

Nominal Pipe Size in inches	T (time) min/100ft	Nominal pipe size in inches	T (time) min/100ft
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

9. An air pressure correction is required when the prevailing ground water is above the sewer line being tested. Under this condition, the air test

pressure must be increased .433 psi for each foot the ground water level is above the invert of the pipe.

10. If the section does not pass the leakage tests, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his/her own expense and without extensions for completion of work. Additional tests and repairs shall be made until the section passes the specified test.

11. No more than 1,000 feet of sewer shall be constructed initially without testing. After the initial test, the frequency of testing shall be as determined by the Project Engineer.

Deflection Test

This test is applicable in sections in which plastic pipe (PVC) has been installed. Requirements and procedures as recommended by the manufacturer and as detailed below shall be followed for the specific pipe material used. Deflection testing of PVC pipe (flexible) shall conform to the requirements and procedures set forth by the manufacturer but as directed by the Project Engineer. Testing shall take place on all lines designated by the engineer only after the final backfill has been in place at least thirty (30) days. The test shall be conducted using a rigid ball or mandrel having a diameter 92.5% of the pipe. This go-no go+deflection testing equipment shall be pulled through the pipe without the use of mechanical pulling devices.

All sewer lines shall be lamped by a licensed Professional Engineer as witnessed by the Public Works Department. The maximum limits of vertical deflection for PVC pipe (flexible) shall be 7.5%. In any area where the deflections exceed 7.5% (i.e. the mandrel will not successfully pass and the lamping test fails), the trench shall be re-excavated, and the pipe zone backfill and embedment shall be removed and replaced in accordance with the original specifications. If, in the opinion of the Project Engineer and/or the Public Works Department, the pipe has been damaged, the pipe shall be removed and replaced with new pipe and installed in full accordance with the specifications.

512.6.3 HDD – Horizontal Directional Drilling

Testing requirements shall meet or exceed those specified in Section 520, Potable Water Specifications, of this document.

512.6.4 Sanitary Sewer Manhole

After each manhole has been set in place (**but before backfilling**), all inlet and outlet pipes connected, joints and openings sealed and otherwise ready to be backfilled, the Contractor shall perform a vacuum test of each manhole in the presence of the licensed Project Engineer as follows:

1. Set the testing equipment on the top section of the manhole and inflate the compression band to affect a seal between the structure and the vacuum base.
2. Connect the vacuum pump to the outlet port, open the valve, and draw a vacuum of 10+Hg. (Mercury).
3. Close the valve and monitor the vacuum gauge.
4. The manhole shall pass this test if the vacuum holds at 10+Hg. or drops no lower than 9+Hg. within the following times shown on Table 2.2.

**Table 2.2
Manhole Vacuum Test**

Manhole Depth	Time
0q. 10q	2 min 00 sec
10q. 15q	2 min 30 sec
15q. 20q	3 min 00 sec

5. If the vacuum drop exceeds 1+Hg. during the specified time periods, the manhole shall be resealed and steps 1 through 4 above shall be repeated until the vacuum holds for the specified time.
6. After the manhole passes the vacuum test, it shall be backfilled carefully so that no leaks are created. If the manhole is disturbed in any way during backfill, it shall again be vacuum tested according to steps 1 through 4 above.
7. The Contractor shall provide the Design/Project Engineer with a written log of each manhole leakage test result.
8. The Contractor may perform a water leakage test on sewer manholes instead of a vacuum test in accordance with the State of Vermont Environmental Protection Rules.

512.6.5 Sanitary Sewer Forcemain

After a force main has been completed, the pipe shall be subjected to hydrostatic and leakage tests in accordance with AWWA C600 (latest

edition). Refer to the Vermont Environmental Protection Rules for the testing requirements for force mains.

$$L = \frac{(N)(D) \times P}{7400}$$

Where

L = leakage allowed per hour;

N = number of pipe joints in the length of pipe tested;

D = nominal diameter of the pipe, in inches; and

P = average test pressure during the leakage test in psi.

512.7 Cleaning and Flushing

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

513 Municipal Wastewater Pump Stations

The information provided under this section is representative of what the Town of Essex Public Works Department requires for sanitary sewer pumping stations and shall be used as guidance throughout any design of infrastructure that will be turned over to the Town of Essex for ownership and future operation and maintenance. The Public Works Department reserves the right to provide input and comment on all pump station projects throughout the design process. All concerns and issues raised by Public Works staff during design must be addressed to the satisfaction of the Public Works Department prior to transfer of infrastructure ownership.

513.1 General

Wherever feasible, gravity sewers shall be utilized rather than wastewater pumping stations. Sewer pipeline depths up to 20' shall be considered feasible, unless the design engineer can substantiate the cost-effectiveness of pumping over a 20-year life, including capital and operations/maintenance costs.

The Town has standardized its sewage system on the basis of Smith & Loveless prefabricated pumping stations. This is due to the large number of existing wastewater pumping stations within the Town of Essex, the similarity of design requirements, the standard of construction and the limited number of personnel to manage the sewer system. Other manufacturers of pump stations will not be approved for installation for pump stations to be turned over to the Town. The

design of all pumping stations will be reviewed by the Town Engineer prior to ordering.

The Town of Essex currently has two types of sanitary sewer pump stations within the system, a wet well / dry well configuration or a wet well only, (dog house), configuration. For stations serving in excess of 50 living units or the equivalent flow of 10,000 GPD, the Town will require the use of a factory-built wet-well/dry-well design. Stations serving 50 living units or less, the Town will consider the use of factory-built, surface or recessed wet-well mounted units.

Submersible pumps will only be allowed, on a case-by-case basis, for those situations involving failed onsite leaching systems where no other viable alternative exists, for mound systems or for those special situations such as when service to a single isolated lot requires a substantial increase in design depth of the sewer.

513.2 Prefabricated Pump Station System

The pump station shall be either an above-ground, fiberglass hood-covered station or a recessed station by Smith & Loveless as dictated by the criteria above in Section 519.1. A minimum dual pump station shall be furnished, including all clearing and grubbing, excavation and backfill, dewatering, exterior piping, electrical work, site work, alarms, remote telemetry function, onsite emergency back-up power, four-hour storage capability and other work required for a complete installation.

Each pump station shall be designed to contain, in combination with the gravity lines to the first point of overflow, a minimum of four hours storage capacity built into the station. The storage may either be in the wet well above the operating level or in a separate chamber, as for wet well/dry well stations.

Each pump station shall meet or exceed the following requirements;

The pressure rating of sewage pumps and discharge piping components shall be at least equal to sewage pump discharge pressure, but not less than 125 psig. The pressure rating of other piping components shall be at least equal to system operating pressure.

The foundation for the pump station shall be a pre-cast or cast-in-place reinforced concrete wet well with minimum 4000 psi concrete, externally coated with two coatings of coal tar epoxy. The wet well chamber shall be designed to minimize deposition of solids.

An auxiliary discharge connection manhole with a valved access port into the discharge force main shall be provided to enable the Town to bypass the pump station with a portable pump. Detail 300.09, Auxiliary Discharge Manhole, in Appendix A of this document, provides further detail on the discharge connection requirements.

513.3 Product Data and Shop Drawings

The Town of Essex Public Works Department shall receive copies of all product data and shop drawings submitted for approval by the engineer of record for a particular project. Public Works reserves the right to provide comment and direction on all future equipment to be installed throughout the pump station design.

Product data submitted for review shall include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories. Shop Drawings submitted for review and approval shall include fabrication and installation details for each packaged pumping station, detailed equipment assemblies indicating dimensions, weights, loads, required clearances, product option drawings indicating size, profiles, and dimensional requirements of packaged pumping stations and based on the specific system supplied, method of field assembly, components, and location and size of each field connection, wiring diagrams for power, signals, and controls.

- “ Product Certificates for sewage pumps, signed by product manufacturer.
- “ Field quality-control test reports.
- “ Maintenance Data including in maintenance manuals.
- “ Warranties: Special warranties specified in this Section.

Product data regarding electrical components, devices, and accessories listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to the Town, and marked for intended use.

- “ HI compliance with HI 1.1-1.5 for sewage pumps.
- “ NEMA compliance with NEMA MG 1 for electric motors.
- “ UL compliance with UL 778 for sewage pumps.

As part of the product submittal process, a Quality Assurance package shall be

submitted including but not limited to the following;

~ Installer Qualifications,

~ Manufacturer Qualifications,

~ Testing Agency Qualifications (Testing agency as defined by OSHA in 29 CFR 1910.7)

513.4 Typical Pump Station Operation

~ When the wastewater level rises in the wet well sufficiently to trigger the level transducer "on", the vacuum pump connected to the lead pump will activate and prime the lead pump.

~ When the wastewater level in the lead pump reaches the level sensing probe, the vacuum pump shuts off and the lead pump will immediately start. The pump will remain primed from cycle to cycle.

~ If the inflow to the wet well is greater than the capacity of the lead pump, the wet well level will continue to rise until the high level "on" transducer level setting is reached. This will activate the standby vacuum system and operate the standby pump. When priming is complete, the standby vacuum pump will shut off and the standby pump will immediately start.

~ The standby pump also will remain primed from cycle to cycle. The wastewater is drawn up through the suction pipe to the centrifugal pump, pumped out through the discharge pipe, check valve and gate valve into the force main.

~ The pumps decrease the wet well level until the pump low level "off" on the level transducer setting is reached and shuts off both pumps.

~ The pumps remain primed and the vacuum pump will not come on unless the liquid level has fallen below the level sensing probe, and the low level "on" setting is reached by the level transducer.

513.5 Pump Station Requirements

All prepackaged pumping stations shall be provided by Smith & Loveless, Inc., as a factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with suspended sewage pumps and dry equipment chamber for pump motors, controls, and accessories.

All equipment and workmanship shall be guaranteed to be free from mechanical and electrical defects for a period of one year from the date 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.

At the completion of the project, all work areas shall be left in a clean and orderly condition and all debris, including materials not used shall be removed from the site.

Each pump station shall contain the following items as a minimum. The Town of Essex may change any of the following or add additional requirements on a case-by-case basis.

- The pumps shall be designed such that one pump will handle the peak level design flow at the lowest rpm and highest efficiency.
- The pump/motor shaft shall be one piece stainless steel.
- The pump impellers shall be of the enclosed type made of close grained cast iron and shall be balanced. All impellers less than full diameter shall be trimmed, to prevent the buildup of foreign particles.
- The pump shaft seal shall be sealed against leakage by a double mechanical seal.
- The controls for the station shall be NEMA 1 type with all coded wiring.
- A trouble shooting block diagram shall be provided for fast diagnosis of problems.
- Dual vacuum pumps shall be provided as well as a duplex priming system.
- Spring loaded, external arm, non-slamming check valves are required.
- The pumps shall be protected by a hinged fiberglass hood, for access, service and maintenance. The fiberglass cover shall contain ventilation louvers, opening handle and hasp for a padlock.
- The unit shall be equipped with special hood insulation, the largest heater available, and high capacity, low noise level, squirrel-cage ventilation blowers.
- Level controls in the wet well, submersible level transducer with back up low level shutoff, high level activation and high level alarm shall be of the mercury

- float type.

513.6 Pumps and Process Piping

All factory fabricated piping between unit components shall be galvanized steel pipe and cast-iron fittings or ductile-iron pipe and fittings.

Sewage pump piping shall include gate valve on each pump inlet and gate and check valves on each discharge pipe. Sump pump piping including ball or gate and check valves on discharge pipe. Vacuum piping shall include ball and check valves on inlet pipe to each vacuum pump.

All valves shall be manufactured of ferrous alloy.

Fittings shall be used for changes in direction and branch connections. Flanged and union joints may be used instead of joints as specified. Dielectric fittings are required for connections between ferrous- and copper-alloy piping. Unless otherwise indicated, make the following piping connections:

Sewage Pumps: Two dry-well-type, non-clog sewage pumps with controls and piping. Include ASTM A 48, Class 25, non-clog, cast-iron impeller capable of passing solids of 3-inch minimum diameter; mechanical or stuffing-box seals; and pedestal-mounted motor.

An inline gate valve shall be installed on the forcemain outside of the pump station, to allow the forcemain to be stopped from back-draining, and to allow the pump station piping to be isolated.

513.7 Electrical System

All material and equipment necessary for a complete and workable electrical system shall be furnished and installed including but not limited to: conduit and fittings, wire and cable, service panel, grounding, alarm system, connections to pump station, power company connection fees, telephone service fees, and any additional costs directly related to the installation of the pump station.

Packaged pump stations 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 are not the responsibility of the pump station manufacturer.

Unless specifically noted otherwise on the design drawings, all materials and

equipment furnished and installed shall be new and 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. The latest edition of the National Electric Code, all local ordinances and all regulations prescribed by Green Mountain Power Company shall be used as standards covering all electrical work.

Work performed shall comply with the latest edition of the National Electric Code Underwriters Laboratories regulations and all Municipal, State and Federal codes.

513.8 System Controls

System controls shall be manufactured by Smith and Loveless, Inc. or approved equal by the Town of Essex Public Works Department.

The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein. The level control system shall be capable of operating as a submersible transducer type system. The level control system shall utilize alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle.

1. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the lead pump start level. When the liquid is lowered to the lead pump stop level, the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the lag pump start level so that both pumps are operating. These levels shall be adjustable as described below.
 - a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
 - b. The electronic pressure switch shall be capable of operating on a supply voltage of 12 VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be

0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile.

- c. The electronic pressure switch shall consist of the following integral components; pressure sensor, display, electronic comparators and output relays.
 - i. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
 - ii. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19+high alpha-numeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
 - iii. Level adjustments shall be electronic comparator set-points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
 - iv. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The ON state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA

size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

- d. The electronic pressure switch shall be equipped with an output board which shall include LED status indicators and a connector with cable for connection to the main unit.
- e. The electronic pressure switch shall be equipped with pump start delay(s) preset at a fixed delay time of five (5) seconds.
- f. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
- g. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
- h. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.
- i. The electronic pressure switch shall have internal capability of providing automatic alternation, manual selection of pump sequence operation, and alternation in the event of 1-199 hours excessive run time.
- j. The electronic pressure switch shall be equipped with a security access code to prevent accidental set up changes and provide liquid level set point lock out.
- k. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5VDC, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10-24VDC supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
- l. The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12 or 24VDC EPS power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
- m. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well level exists. The alarm

signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

- n. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a low liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for low wet well level has been corrected and the circuit had been manually reset. A low liquid level condition shall disable both pump motors. When the wet well rises above the low level point, both pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
 - o. EPS Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lightning.
2. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
3. Submersible Level Transducer
- a. A Siemens Water Technologies Control Systems Bulletin A1000 Model 157GSCE Submersible Level Transducer or equal, shall sense the liquid level of the wet well. The transducer shall be a 3 wire type to operate from a supply voltage of 10.5 to 24 VDC and produce a 1-5 VDC instrumentation signal in direct proportion to the measures level excursion over a factory calibrated range of zero to (10) feet of water.
 - b. 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 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 job plans.
 - c. 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 ĩ bonded to a synthetic rubber back/seal.

- d. A hydraulic fill liquid behind the diaphragm shall transmit the sensed pressure to a solid state variable capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against the diaphragm that flexes minutely so as to vary the proximity between an internal ceramic diaphragm and a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser trimmed, temperature compensated, high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory calibrated range.
 - e. The transducer element shall incorporate high over pressure protection and be designed to withstand intermittent overpressures five times the fill scale range being sensed. Metallic diaphragms shall not be acceptable in that they are subject to damage or distortion. Sensing principles employing LVDTs, resistance or pneumatic elements shall not be acceptable.
 - f. The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy duty urethane jacketed hose/cable assembly and a slack PVC bellows mounted in the control panel. The sealed breather system shall compensate for variations in barometric pressure and expansion and contraction of air due to temperature changes and altitude as well as prevent fouling from moisture and other corrosive elements.
 - g. The transducer assembly shall be installed where directed by the Engineer and connected with other system elements and placed in successful operation.
 - h. The control panel shall include a UL 913 Listed intrinsic safety barrier that has been UL tested with the specific submersible transducer furnished for this application to render the transducer suitable for use in Class 1, Division 1 or 2, Groups A, B, C and D; Class II, Division 1 or 2, Groups E, F and G; and Class III, hazardous location (which includes a sewage wet well).
 - i. The transducer will be furnished with a transient voltage surge suppression to protect related equipment from an induced voltage spike from lightning.
4. Cable Suspension Mounting Kit.

Each sensor shall be suspension mounted using a 2' long 1 inch NPT type 316 SS pipe with coupling, bolt, cable clamps and hardware along with the required length of ¼ inch diameter 7 x 19 SS cable.

5. Redundant High Alarm Pump Override Control

- a. An independent high level alarm and redundant control capability with features hereinafter listed shall be provided in addition to the specified primary control system. It shall be powered by a 120 VAC circuit breaker (other than the one powered the primary system) and use one or more direct acting level responsive float switches as described.
- b. The independent alarm/control panel equipment shall be designed to UL508 Industrial Control Panel standards and shall incorporate a 120 VAC input transformer with transient protection, a fused primary and a DC power supply with limited 12 VDC to supply the level sensing float circuit (s). The control shall be used here with a single high level float switch arranged in the wet well at a higher elevation than the normal operating range of the primary control and alarm. The float switch shall be mounted in the wet pit in accordance with manufacturer's instructions or as shown on the plans. The front face of the Controller shall incorporate a High Level Alarm LED, a Control Turn On LED, a Control Hold LED, Control Contacts LED and a time adjustment with a 0 to 5 minute range.
- c. Upon the occurrence of a high level condition sensed by the high alarm float, the High Level Alarm red LED shall light, a form C SPDT alarm output contact circuit shall transfer to operate the specified alarm devices and two (2) form A, normally open, redundant control (50 amp/208 VAC) circuits shall close to provide redundant pump operation. These control circuits shall be wired in parallel with the primary control system two wire control circuits to provide a redundant capability. As the level recedes from the high level float, the alarm contact shall return to its normal state; however, the redundant control contacts are to continue to operate during the time period setting of the off delay timer. After that time interval (which is to commence following the lowering of the high level float) the control relay contacts are to re-open.
- d. The Control Turn On and Control Hold LED's and circuitry allow two additional floats to be used with the CB1T to provide differential level automatic control in addition to the High Level Alarm capability. When the differential level pump control is in use, the High Level Alarm circuitry is not generally connected to activate the control circuits in the redundant mode here described.

- e. The redundant control/alarm capability shall be completely integrated in the specified control panel and system as described and in accordance with all applicable codes and job requirements. This redundant control shall be provided in the overall pump control panel, not as a separate panel.

6. Float Switches

- a. Two direct acting float switches shall be supplied for use with the redundant high alarm/pump override control.
- b. The contractor shall furnish, install, and wire the float switches as shown on the drawings. Each float shall have a molded polyethylene body, internal redundant polyurethane foam flotation, potted switch and cable connections and fine stranded AWG #18 cable with a heavy duty synthetic rubber jacket in lengths as required to run unspliced to the control panel. The floats shall operate at an intrinsically safe voltage and used with a pump/alarm controller providing differential pump operation, float indicating LEDs and test switches and alarm circuitry as required.
- c. The float switches shall be individually suspended in the wet well with weight kits. The float switch cables shall be suspended from a cable rack mounted to the top slab of the wet well.
- d. When the low float is activated, the controller will turn off the pump(s) and signal an alarm. The alarm will remain on until manually reset.
- e. When either back-up float is tripped, the pump controls will remain with the back-up float controls, until manually reset for switch pressure control.

7. Float Switch Intrinsic Barrier

The float level sensor shall interface to the control circuitry via an intrinsically safe module. The module shall provide an intrinsically safe interface for up to six sensors located in a hazardous area rated Class 1, Group A, B, C and D, and Class 2 Groups E, F, and G. The module shall contain an LED indicator for each of up to six sensor inputs, providing visible indication of sensor actuation as well as an LED to indicate barrier power On+status. The intrinsic safety barrier shall be UL listed.

8. Selector Switches

- a. A heavy-duty tight three-position, Hand-Off Automatic selector switch shall be flush-mounted on the operator's door of the control panel for the operation of each magnetic motor starter. The selector switch shall operate the starter when it is in either the Hand position or the Automatic position, and the automatic control system is calling for the operation of the equipment in the manner as herein described.
- b. A heavy-duty oil tight green Pump Running pilot light shall be flush-mounted on the operator's door of the control panel. This pilot light shall be operated from a respective starter auxiliary contact. The pilot light shall have a replaceable bulb.

9. Alarm Light (External)

The station manufacturer will supply one 115 VAC alarm light fixture with vapor-tight shatter resistant red globe, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the Contractor.

10. Spare parts

The following minimum spare parts shall be furnished with the pump station:

- One (1) pump mechanical seal.
- One (1) cover plate O-Ring.
- One (1) rotating assembly O-Ring.
- One (1) set of impeller clearance adjustment spacers.

11. Contradictory Specifications

If any of the preceding control system specifications are different than those provided by Smith and Loveless, Inc., those differences shall be brought to the attention of the Town prior to the work.

513.9 Alarm System

An alarm system for the pump station shall be provided, consisting of a communicator (transmitter) tied to a dedicated telephone company line and through it to the central station of the Town's current alarm monitoring provider. A flashing red light shall also be provided at the pump station as part of the alarm system.

The communicator shall be digital with a minimum of 7 channels, a built-in power supply, gel-type battery and battery charger. The communicator shall have a 20 gauge anodized aluminum enclosure.

When activated, the communicator shall seize the telephone line, then dial the central station receiver telephone number programmed into its memory. After receiving an acknowledgement from the receiver the communicator shall transmit the station account number and the proper alarm code and shall repeat this information until receiving a shut-down signal from the central station receiver.

The communicator shall be capable of being activated by any of up to seven different sensing channels. Circuit inputs may be either a normally open or a normally closed configuration by switch selection. A 5 to 15 V DC position signal may also be used to activate the alarm. Simultaneous activation of a second or third input channel shall be reported in regular numerical sequence. Restore (return to normal) reporting shall be switch selected for any or all channels. When a restoration occurs on a selected channel, the communicator shall report an all clear code.

The communicator shall contain a self-test feature to generate accurate status reports, to the central station receiver, automatically at 24 hour intervals.

The alarm signals requiring transmission are:

- ~ Security / Hatch Alarm
- ~ Power Failure
- ~ Pump Over-Run (if applicable)
- ~ High Water/Wet Well
- ~ Low Water/Wet Well
- ~ Flooded Dry Well (if applicable)
- ~ Loss of Phase (if applicable)
- ~ System Test/Reset Signal (daily/weekly)

The Town will provide a coding list for these alarm conditions and review each design on a case by case basis. Additional alarm signals may be required as directed by the Town.

513.10 Emergency Generator

To supplement the existing emergency storage onsite, a diesel fuel emergency generator shall be provided with an automatic transfer switch to provide a continuous source of power to the sewer pump station. See the generator specifications below.

The contractor shall provide and/or install the required modifications and improvements listed on this page as required by the town prior to the municipality accepting ownership and operation of the pump station.

The contractor shall provide a complete submittal package on all new elements of the pump station and generator. The submittal package and O&M manual shall include a complete electrical schematic.

The emergency generator shall be a diesel fuel outdoor generator capable of supplying the proper power phase and voltage for emergency power to the sewer pump station. The generator shall be capable of operating the pump station control panel, pumps, and all equipment necessary to fully operate the pump station. The Generator must be able to run both pumps, with sequential pump start-up.

The generator weatherproof enclosure shall include the following components: structural steel base with linear vibration insulators, unit mounted radiator, and unit mounted automatic start/stop control panel, 12 V DC.

513.11 Services of the Manufacturer

After installation has been completed but before operation, the manufacturer's representative shall inspect, lubricate, operate, test, adjust the equipment 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 stating the results of his inspection, operation, tests and any suggestions for proper operation and maintenance of the facilities. The service representative shall also certify that the equipment conforms to the requirements of the contract and is ready for permanent operation. He/she shall also certify that the installation meets the manufacturer's warranty requirements.

513.12 Warranty

The manufacturer shall supply a warranty agreeing to repair or replace components of packaged pumping stations that fail in materials or workmanship

for a period of three (3) years from the date of Substantial Completion.

513.13 Factory Test

All pumping equipment shall be given an operational test 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 lines shall be coupled to a reservoir and the pumps shall recirculate water for at least one hour under simulated service conditions. The automatic control shall be adjusted to start and stop the pumps at approximately the levels required by the job conditions.

513.14 Field Start Up

The manufacturer's representative shall be present during field acceptance testing. Upon completion of the installation, each 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, for the pumps and control equipment and other equipment as necessary and at no expense to the Town.

513.15 Operation and Maintenance Manual

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 pump chambers.

In addition to the maintenance and operating chart, the manufacturer shall further provide five copies of a complete and detailed operating and maintenance manual. This manual shall cover, in addition to general operating procedures, the operation, maintenance and servicing procedures of the major individual components provided with the pump station. These manuals shall be shipped with the pump station. All instructions and parts lists shall be prepared for the specific equipment furnished and shall not refer to similar equipment.

514 Potable Water Specifications

514.1 General

It is not intended by the Town of Essex that this section be a complete set of specifications. It is to be used as a basic standard for any person planning to work on the Town water distribution system. All materials listed shall be acceptable to the Town Public Works Department and any materials not listed will require acceptance by the Town Public Works Department before installation. Failure to receive acceptance of materials prior to their incorporation into the system shall leave the person having the work done liable to replace those substandard materials with acceptable materials at his/her cost.

The applicant(s) proposing extensions or alterations to the existing water system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state and federal). Applicants shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, and permits and shall have obtained all acceptances and paid all applicable fees.

Water mains and their related appurtenances shall be eligible for acceptance as part of the Town water system when the following criteria have been complied with:

- The installation and materials have been accepted by the Public Works Director and the Utilities Director.
- The installation has passed the necessary hydrostatic pressure and leakage tests in accordance with the latest revisions of AWWA C-600.
- The installation has been disinfected in accordance with the latest revision of AWWA C-651 and has been certified by the Vermont Department of Health or other Town-accepted testing facility to be free of bacteriological contamination.
- The installation must be within an existing Town highway Right-of-Way or within a proposed highway Right-of-Way that is deeded to the town.
- The Public Works Department has been furnished two (2) sets of Record Drawings. All Record Drawings shall be 24"x 36" in size and drawn to a 1"= 50' or less scale. All Record Drawings shall be provided to the Town on disk in AutoCAD format.
- After a minimum of three (3) years from the date that the new installation was

placed in service, it may be deeded to the Town of Essex and become a part of its distribution system and by such acceptance the Town of Essex shall be responsible for the maintenance of it. However, it should be clearly understood that prior to acceptance into the distribution system, full responsibility for the maintenance and repair of the new main and its related appurtenances shall rest with the Owner.

514.2 Materials

514.2.1 Pipe

All water mains shall be a minimum of 8" diameter. The minimum acceptable types of pipe which may be used for water mains under normal conditions of installation, depth and subsurface materials are Ductile Iron, Class 52, double cement lined meeting current ANSI Specification A21.51, PVC pressure pipe with maximum dimension ratio (DR) of 18 meeting AWWA C900 and C905 or High Density Polyethylene Pipe meeting the specifications in this section. Ductile Iron pipe shall be required under all paved surfaces and further the Town may require the use of ductile iron on a case by case basis depending upon subsurface condition, depth of burial, location, purpose of water line, etc. Where Ductile Iron Pipe is used, there shall be a minimum of two (2) bronze wedges installed in the bell of each joint.

Unless the plans require a particular type of pipe material, the developer/contractor shall have the option of utilizing, with Town approval, any of the water main materials, providing the pipe utilized meets or exceeds the strength and other requirements shown on the contract drawings. When a pipe material is specifically noted on the contract drawings, such as 18 inch ductile iron class 52, the developer/contractor shall not have the option of utilizing any other pipe material.

C-900 Polyvinylchloride Pipe

Pipe shall conform to AWWA Specification C900, Class 150 with SDR ratio of 18. Any portion of a water system subject to normal and routine operating pressures above 100 psi shall be required to use Class 200 PVC pipe. All pipe joints shall be the push on type with rubber rings except for joints at fittings and valves which shall be mechanical joints unless otherwise noted on the plans.

All pipe and fittings shall be clearly marked as follows:
Manufacturers name and trademark

Nominal pipe size
 Material description and class

PVC pipe shall not be installed when the temperature drops below 32 degrees Fahrenheit or goes above 100 degrees Fahrenheit without Town approval. 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 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.

Ductile Iron Pipe

Pipe shall conform to current AWWA/ANSI . C151/A21.51 Standards. Push-on joint pipe shall be thickness Class 52.

Push-on joint accessories shall conform to applicable requirements of AWWA/ANSI . C111/A21.11.

Pipe shall be cement mortar lined on the inside in accordance with AWWA/ANSI . C104/A21.4 Standard except that the cement lining thickness shall not be less than 3/16% A plus tolerance of 1/8+ will be permitted.

Pipe shall be given an exterior bituminous coating of coal tar or asphalt base in accordance with Specification ANSI A21.51.

All ductile iron pipe shall be polyethylene encased in accordance with ANSI A21.5.

High Density Polyethylene Pipe

Material Standards for HDD Installation

Material Type	Pressure
Polyethylene (PE)	ASTM 2513 ASTM D 2447
High Density Polyethylene (HDPE)	ASTM D 2447 ASTM D 3350 ASTM F714 ASTM 2513
Polyvinyl-Chloride (PVC)	N/A
Steel	AWWA C200 API 2B ⁽¹⁾

(1) Dimensional tolerances only

514.2.2 Fittings

Ductile iron fittings shall conform to ANSI / AWWA C153 / A21.53, Class 350 working pressure.

Bolts and nuts shall conform to AWWA/ANSI . C111/A21.11 and shall be Type 18-8 stainless steel.

Anchor tees shall be a standard mechanical joint tee except that the branch is plain end with an integral retaining ring and split gland. Tee will be Class 350 ductile iron, cement lined, conforming to AWWA Standards C110 (latest version), C111 (latest version), and C104 (latest version).

Pipeline couplings shall conform to AWWA Standards C110 (latest version) and ANSI A21.10 (latest version) and shall be installed in accordance with the manufacturer's recommendation and at locations directed by the Project Engineer.

All nuts and bolts used with pipeline couplings shall be Type 18-8 stainless steel.

514.2.3 Valves

Gate valves shall be manufactured to meet all requirements of AWWA C515 (latest version). Valves shall have non-rising stems, open counterclockwise, and shall be provided with a 2+square operating nut with arrow cast in metal to indicate direction of opening. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure.

Valve boxes shall be cast-iron three (3) piece slide type; 5 ¼+shaft; 6qtrench depth.

Cast-iron cover shall be marked %WATER+and shall indicate direction of opening

Air release valves shall have stainless steel or bronze trim. A brass gate valve shall be provided in the connecting piping ahead of the valve. Valves shall be manufactured by APCO or accepted equal. Orifice shall be 3/16+and valve,

isolating valve, and connection piping shall be 1+unless otherwise specified.

514.2.4 Fire Hydrants

As noted in detail 400.02 of these Specifications, Fire hydrants shall be Kennedy Guardian K-81D, with the following specifications:

Main Valve Opening: 5-¼+or equal

Nozzle Arrangement: Two 2-½+hose nozzles with National Standard thread.
One 5+Stortz connection

Inlet Connection: 6+mechanical joint

Operating Nut: Standard 1 1/2+Pentagon

Color: Enameled hydrant red

Depth of Bury: Hydrant shall be installed to the manufacturer's instructions with nozzles about 18+above finish grade

Drain Plugs: Shall be plugged

Hydrant assemblies shall consist of an anchor tee off the main, a 6+ mechanical joint valve conforming to these specifications and the appropriate length of 6+ductile iron cement lined Class 52 pipe, anchor coupling, and hydrant. The use of restrained mechanical joint fittings and rods or concrete thrust blocks are both acceptable methods of restraint for hydrants.

514.3 Connections to Existing Infrastructure

Connections to existing A.C. mains shall be in conformance with Detail 400.07 of these Specifications.

As noted on Detail 400.06 of the Specifications, tapping valves shall conform to AWWA C-509 Standard for Gate Valves, 3+through 48+for water and other liquids, except as modified herein. Valve body and bonnet shall be fusion banded epoxy coated per AWWA C-550. Valves shall open counterclockwise and shall have a minimum working pressure of 150 psi. End connections shall be mechanical joint by tapping for bolting of the valve to the branch outlet.

Tapping sleeves shall be of the split sleeve design constructed with two solid half-sleeves bolted together. Sleeves for Ductile Iron connections shall be constructed of either cast iron or stainless steel and shall have a working pressure of 150 psi. with mechanical joint ends and side gasket seals. Sleeves for PVC connections may be constructed of stainless steel.

All exterior nuts and bolts used with the tapping sleeve and valve shall be Type 18-8 stainless steel.

Buried tapping valves shall be provided with a 2+square wrench nut and shall be installed with a valve box as required in these specifications for buried valves.

514.4 Pipe Bedding

Laying pipe and fittings shall be in accordance with the requirements of AWWA *Standard Specifications for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances*, C600 and as provided herein.

Pipe shall be laid according to lines and grade shown on the drawings but in no case shall deviate from a straight line by more than the deflection recommended by the manufacturer for specific diameters and joint types. See Detail 400.01 of these Specifications for additional notes and requirements.

514.5 Service Connections

As shown on Detail 400.05 of these Specifications, taps on ductile iron watermains shall be direct tapped. Taps on other mains shall require a bronze saddle and straps or a ductile iron nylon coated saddle with stainless steel single strap. All service brass shall be in accordance with AWWA Specification C-800.

All plumbing pipes, fixtures and fittings used to convey or dispense water for human consumption shall comply with the State of Vermont Act 193 requirements for maximum lead content.

Service lines $\frac{3}{4}$ +to 1 1/2+shall be Type K copper tubing. All services greater than 1 1/2+may use PVC, HDPE or CTS.

Curb stops shall be manufactured by Mueller or approved equal.

Without exception, curb boxes and stops shall not be constructed beneath drives or sidewalks.

Curb boxes shall be Erie type with stainless steel pins and a stainless steel operating rod connected to the curb stop and the box consisting of an arch pattern base and an adjustable upper section. Curb boxes shall be Mueller H-10350 or accepted equal. All curb stops shall be installed within the Town Right-of-Way.

514.6 Thrust Blocks and Anchors

For pressure piping, concrete thrust blocks shall be installed at all fittings and bends. Joints must be protected by polyethylene prior to placing concrete. Concrete shall be placed against undisturbed material and shall not cover joints, bolts, or nuts, or interfere with the removal of any joint. Excess concrete shall not be discarded in the trench.

515 Methods of Installation

515.1 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.

Wherever boulders or ledge rock are encountered in excavations for pipelines or structures, such boulders or ledge rock shall be removed to a depth of six inches below grade and space occupied by them shall be refilled to grade with the specified bedding material. Trenches shall be opened at such times and to such extent only as may be permitted by the design/project engineer. All driveways, crosswalks, sod, shrubs, trees and any other shrubs, trees and any other surface material affected by the work shall be carefully taken up and kept separate from other excavated material. If suitable, excavated material shall be used for embankments, backfill and fill. Side slopes of excavations shall be as required by VOSHA.

Wherever material at or below the grade line of the pipe or structure plus depth of bedding material is unsuitable for foundations, it shall either be excavated to such additional depths as directed by the design/project engineer and then refilled with well compacted crushed stone or the design/project engineer may direct that a filter fabric be utilized. It shall be installed and the excavation then brought to grade line of pipe with well-compacted bedding.

515.2 Watermain Pipe Installation

Pipes, fittings and accessories shall be carefully handled to avoid damage. Prior to the acceptance of the water line and within the guarantee period, any defective pipe or accessory found to be defective shall be replaced at no expense to the Town. All pipes showing visible cracks shall be rejected and replaced with new pipe.

Any pipe which is not laid to proper depth and alignment shall be re-laid to the satisfaction of the Town Engineer. The bedding heights as required for the type of pipe and for the full width of the excavated trench and as shown on the accepted plans. All piping shall be laid in the dry. The site shall be dewatered prior to and during pipe installation.

All pipes and fittings shall be cleared of all foreign matter and debris prior to installation and shall be kept clean until the time of acceptance by the Town. At all times, when the 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. The pipe shall be installed in trenches and at the line and grade shown on the Contract Drawings. Any deflection joints shall be within the limits specified by the manufacturer. All piping and appurtenances connected to the equipment shall be supported so that no strain will be imposed on the equipment.

Concrete thrust blocks as shown on Detail 400.03 in Appendix A of these specifications shall be installed on all plugs, tees and bends deflecting 11 ¼ degrees or more. Care shall be taken to ensure that concrete will not come in contact with flanges, joints or bolts. The required area of thrust blocks are indicated on the plans or shall be as approved by the Project Engineer.

Conductivity bonds or wedges shall be installed at every pipe joint.

All trenching safety standards shall be in conformance with all applicable State and Federal guidelines.

After the various pipelines have been installed, the trenches and other areas to be filled shall be backfilled to subgrade with, wherever possible, material excavated from the trench. No backfilling will be allowed until any concrete masonry has set sufficiently, as determined by the Project Engineer.

All material for backfilling shall be free of roots, stumps and frost. Materials used for backfilling trenches shall be free of stones weighing over 30 pounds.

No stones measuring over three inches in the longest dimension shall be placed within one foot (1q) of the pipeline being backfilled. Backfill for all pipe lines shall be either native material or select backfill placed in six inch (6") lifts with each lift being compacted to not less than 95 percent of maximum dry density as determined by the AASHTO-99, Method A, Standard Proctor.

Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe or structure. The backfill shall be brought up evenly.

Surplus excavated materials not used for backfill shall be disposed of in a manner satisfactory to the design/project engineer. All surplus material shall be removed promptly and disposed of so as not to be objectionable to abutters or to the general public.

A continuous sheathed solid conductor copper tracer wire shall be installed over all water pipes. See Details 400.01 and 400.02 in Appendix A of these specifications.

515.2.1 HDD – Horizontal Directional Drilling

Accomplish alignment of the bore by proper orientation of the drill bit head as it is being pushed into the ground by a hydraulic jack. Determine orientation and tracking of the drill bit by an above ground radio detection device which picks up a radio signal generated from a transmitter located within the drill bit head. Then electronically translate the radio signal into depth and alignment. In order to minimize friction and prevent collapse of the bore hole, introduce a soil stabilizing agent (drilling fluid) into the annular bore space from the trailing end of the drill bit. The rotation of the bit in the soil wetted by the drilling fluid creates a slurry. The slurry acts to stabilize the surrounding soil and prevent collapse of the bore hole as well as provides lubrication.

Select or design drilling fluids for the site specific soil and ground water conditions. Confine free flowing (escaping) slurry or drilling fluids at the ground surface during pull back or drilling. Accomplish this by creating sump areas or vacuum operations to prevent damage or hazardous conditions in surrounding areas. Remove all residual slurry from the surface and restore the site to preconstruction conditions.

Use either a continuous green sheathed solid conductor copper wire line (minimum #12 AWG for external placement or minimum #14 AWG for internal placement in the conduit/casing). Tracking conductors must extend 2 feet beyond bore termini.

Drilling Fluids shall not include any chemicals or polymer surfactants which are environmentally un-safe and/or harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds or fire hydrants. Any water source used other than potable water may require a pH test.

Equipment Requirements:

Ensure that appropriate equipment is provided to facilitate the installation as follows:

Match equipment to the size of pipe being installed. Ensure that the drill rod can meet the bend radius required for the proposed installation.

Drilling Operations:

The contractor shall adequately remove all soil cuttings and stabilize the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming and pipe installation. Contain excess drilling fluids at entry and exit points until they are recycled or removed from the site or vacuumed during drilling operations. Ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, or federal regulatory agencies. Remove any excess material upon completion of the bore.

Documentation Requirements.

Boring Path Report: Furnish a Bore Path Report to the Engineer within seven days of the completion of each bore path. Include the following in the report:

- (a) Location of project and financial project number including the Permit Number when assigned
- (b) Name of person collecting data, including title, position and company name.

Record Drawings: Provide the Engineer a complete set of Record Drawings showing all bores (successful and failed) within 30 calendar days of completing the work. Ensure that the plans are dimensionally correct copies of the Contract plans and include roadway plan and profile, cross-section, boring location and subsurface conditions as directed by the Engineer. The plans

must show appropriate elevations and be referenced to the project bench mark.

515.3 Water Service Connection

No house service connection shall be made until the water main has been installed, disinfected, tested and turned over to the town for potable water use. All water service initiation fees must also be paid prior to any house service connection being made. A house service connection shall be considered when there is complete and serviceable link between the house plumbing and the water main.

The contractor shall be responsible for making all necessary taps onto the watermains, installing an approved corporation stop for each service, installing the service pipe to the curbstop and from the curbstop to the building plumbing, installing the curbstop and valve box and for obtaining a spacer bar (on loan from the town). As noted on Detail 400.10 of these Specifications, there shall be a ball valve installed on both the inlet section leading to and the outlet section leading from the house water meter as well as a check valve (backflow preventer) downstream of the meter.

Upon installation of a meter by the Town, the spacer bar shall be returned to the Town or the contractor shall be billed for the replacement of the spacer bar.

515.4 Backfill

Backfill shall consist of approved material placed in twelve inch (12") layers with each layer being thoroughly compacted to not less than 95 percent of the maximum dry density as determined by the AASHTO-T-99 Standard Proctor by means approved by the design/project engineer. No stones in excess of one inch (1") diameter shall be placed within two feet (2') of the outside of the pipe. Particular precautions shall be taken in placement and compaction of the backfill material in order not to damage and/or break the pipe. The backfill shall be brought up evenly on both sides of the pipe for its full length.

Walking or working on the completed pipeline, except as may be necessary in tamping or backfilling, shall not be permitted until the trench has been backfilled to a height of at least two feet (2') on the top of the pipes. During construction, all openings to the pipelines shall be protected from the entering of earth or other materials.

515.5 Water and Sewer Separation

As shown on Detail 400.04 of these Specifications, whenever sewers cross under water mains, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. This vertical separation shall be maintained for that portion of the water main located within ten feet (10') horizontally of any sewer it crosses. When it is impossible to obtain horizontal and vertical separation, both the water main and sewer shall be constructed with watertight joints and shall be pressure tested to assure water tightness before backfilling. No water main shall pass through or come in contact with any part of a sewer manhole.

There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks which are supplied or may be supplied with water that is, or may be, contaminated. In instances where the use of different types of pipes require joining, the developer/contractor shall furnish and install all necessary adapters.

515.6 Frost Protection

In no case shall there be less than six feet (6') of cover over new waterlines installed in the Town of Essex. Waterlines with less than six feet (6') of cover over the crown must be approved by the Town Public Works Director. As shown on Detail 400.09 of these Specifications, protection against freezing shall be provided by installation of two inch (2") thick Styrofoam SM insulating sheets with a width of 3 feet or twice the pipe diameter, whichever is greater. **In no case shall there be less than five feet (5') of cover.**

The sheets shall be placed six inches (6") above the crown of the main after compaction of the 6 inch (6") lift immediately above the crown. Care shall be exercised by the developer/contractor during backfill and compaction over the Styrofoam sheets to prevent damage to the sheets.

515.7 Use of Water by Contractors

During the construction of the project, the contractor will often use the municipal water system for flushing of lines, cleaning services, washing trees, germinating grass, etc. No water shall be taken from hydrants nor other parts of the system without the prior approval of the Town Engineer.

The contractor shall schedule with the Town to provide a licensed water operator to help pressurize, fill and flush new watermains. Only Town water

operators will be allowed to operate infrastructure owned by the Town. When water is needed on site, the contractor shall coordinate with the Town and pay for water used by way of a hydrant meter.

516 Final Certification

516.1 Pressure Test

The pipeline, including hydrant laterals, shall be tested in accordance with AWWA Standard C600-93 (latest version) at the Contractor's expense.

Minimum test pressure shall be 200 psi, and will be monitored at the highest elevation in the lengths of pipeline being tested. The AWWA Standard for maximum allowable leakage is as follows:

$$L = \frac{0.0001 \sqrt{P}}{0.0001, 0.0001}$$

where:

L = Leakage Allowed, gph.

S = Section of Pipe Length, ft.

D = Diameter Pipe, inches.

P = Average test pressure, psi.

516.2 Flushing and Disinfection

Disinfection and testing of the pipeline shall be directed by the Design/Project Engineer at the Contractor's expense and in the presence of the Town. AWWA Standard C651 (latest version) shall be used as a basis for the disinfection process outlined as follows:

1. Complete flushing of the pipeline to wash out all dirt, debris, etc. which may have accumulated in the pipeline during construction.
2. Following flushing, the Contractor will add chlorine to the entire pipeline volume of water and let the mixture set for at least 24 hours. The initial chlorine concentration shall be 25 mg/l or greater.
3. After the 24-hour duration, the water in the pipeline shall be tested for residual free chlorine and must contain a minimum of 50 mg/l chlorine. If less than 50 mg/l is found, then the disinfection procedure shall be repeated until at least 50 mg/l chlorine residual is indicated by test.

4. 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.
5. Chlorinated water flushed from the pipeline shall be dechlorinated prior to being discharged to any surface water.

516.3 Bacteriological Test

1. After this final flushing and before the pipeline is placed in service, two (2) consecutive sets of bacteriological samples shall be collected by the Design/Project Engineer in the presence of the Public Works Department. The two (2) samples shall be taken 24 hours apart from each other and delivered by the Design/Project Engineer to the Vermont Health Department, or other Town-accepted testing facility for analysis. At least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the new water main and at least one set from each branch. All costs associated with sampling and testing shall be paid for by the Owner.
2. If the initial disinfection fails to produce samples which pass the Vermont Water Supply Division requirements for potable drinking water, then the process shall be repeated at the Contractor's expense until satisfactory results are obtained.
3. Upon satisfactory test results by the Vermont Health Department and with the Public Works Department acceptance, the pipeline may be placed in service.

516.4 HDD Pressure Testing

When there is any indication that the installed product has sustained damage and may leak, stop all work, notify the Engineer and investigate damage. The Engineer may require a pressure test and reserves the right to be present during the test. Perform pressure test within 24 hours unless otherwise approved by the Engineer. Furnish a copy of test results to the Engineer for review and approval. The Engineer is allowed up to 72 hours to approve or determine if the product installation is not in compliance with the specifications. The Engineer may require non-compliant installations to be filled with excavatable flowable fill.

516.4.1 Testing Methods

Testing may consist of one of the following methods and must always meet or exceed the Department's testing requirements:

- (a) Follow the product manufacturer's pressure testing recommendations.
- (b) Ensure that product carrier pipes installed without a casing meet the pressure requirements set by this document and AWWA. If the owner does not require pressure testing, the Project Engineer may require at least one test.

516.4.2 Failed Bore Path

If conditions warrant removal of any materials installed in a failed bore path, as determined by the Engineer, it will be at no cost to the Town. Promptly fill all voids by injecting all taken out of service products that have any annular space with excavatable flowable fill.

Should a failed bore path occur, the contractor shall remove any materials installed at no cost to the Town. The contractor shall fill all voids by injecting all abandoned products with excavatable flowable fill.

516.5 Meter Installation

All water meters for new water service connections will be supplied to the contractor by the Town of Essex. The water meter will remain the property of the Town of Essex. All meters greater than one inch (1") shall be installed by the contractor. The Town of Essex will install meters one inch (1") and smaller.

517 Landscaping

517.1 General

The Contractor shall provide the Engineer with a copy of the Nursery Dealer License and a copy of the Certificate of Nursery Inspection of each supplying nursery.

For best results the initial planting should be accomplished between April 1 and June 1, or between August 15 and November 1, unless otherwise shown on the Plans or directed by the Engineer.

No planting shall be done in frozen ground, when snow covers the ground, or when the soil or weather is unsatisfactory for planting.

517.2 Materials

517.2.1 Trees, Shrubs, and Ground Cover

All plant materials shall be nursery grown stock that have been transplanted or root-trimmed two or more times, according to the kind and size of plants. They shall have average or normal, well developed branches, together with vigorous root systems. Plant materials shall be free of insects, disease, sun scald, injuries, abrasions of the bark, knots, dead or dry wood, broken terminal growth, or other objectionable disfigurements. Thin, weak plants shall not be acceptable.

All plant materials furnished by the Contractor shall be grown within hardiness Zones 1 through 4, and the plant suppliers shall certify that the stock has been grown under Zone 4 or hardier conditions.

The thickness of each shrub shall correspond to the trade classification No. 1.+ Single stemmed or thin plants will not be accepted. The side branches shall be generous, well-twigged, and the plant, as a whole, well-branched to the ground. The plants shall be in a moist vigorous condition, free from dead wood, bruises, or other root or branch injuries. Plants shall not be pruned prior to delivery.

Vines and ground cover plants shall be of the size, age, and condition listed in the quantity sheet. Plants shall be healthy, free of insects and diseases. Ground cover plants shall be potted or in soil.

Container grown stock shall have been grown in a container long enough for the root system to have developed sufficiently to hold its soil together, firm and whole. No plants shall be loose in the container. No plants shall be root bound in the container. Such plants shall be rejected at delivery by the Contractor.

517.2.2 Seed

Seed shall be furnished in new, clean, sealed, and properly labeled containers, either separately or mixed, as appropriate, and shall conform to the seed

formula shown on the Plans. Seed that has become wet, moldy, or otherwise damaged shall not be accepted.

Labels shall conform to all State and Federal regulations and shall be clearly marked with the following:

1. Seed name
2. Lot number
3. Percentage of germination
4. Percentage of purity
5. Percentage of weed seed content

517.2.3 Topsoil

Topsoil shall be of a quality which will support healthy, vigorous plant growth. It shall be a natural, workable loam, free of refuse, roots, stones, brush, weeds, or other material that would be detrimental to the proper development of plant growth. Topsoil shall be obtained from an area that has demonstrated, by a healthy growth of grass, cultivated crops, or wild vegetation, it is of good quality and reasonably free draining. The topsoil and its source shall be inspected and approved by the Engineer before its use.

517.2.4 Mulch

Straw. Straw mulch shall be dry, free from rot or mold and come from wheat or oats and be free from weeds, twigs and debris.

Hay Mulch. Hay mulch shall consist of mowed and properly cured grass or legume mowings, reasonably free from swamp grass, weeds, twigs, debris, or other deleterious material. It shall be free from rot or mold and shall be acceptable to the Engineer.

Wood Chip Mulch. Wood chip mulch shall consist of well composted hardwood chips, 1/8 to 1/4 inch nominal thickness, with 50 percent having an area of not less than 1 square inch or more than 6 square inches. The wood chip mulch material used for landscape plantings shall be approved Cedar, Pine, Hemlock, or Spruce bark material reasonably free from insect pests, eggs, or larvae.

517.2.5 Fertilizer

Fertilizer shall be a standard commercial grade dry fertilizer and shall conform to the requirements of all State and Federal regulations and to the standards of the Association of Official Agricultural Chemists and be applied only after performing a soil test and be applied based on soil deficiencies.

Labels shall be clearly marked with the following:

1. Manufacturer's name
2. Type
3. Mass (weight)
4. Guaranteed analysis

517.2.6 Limestone

Agricultural limestone shall be a calcitic or dolomitic ground limestone containing not less than 85 percent of total (calcium or magnesium) carbonates. The limestone shall conform to the requirements of all State and Federal regulations and to the standards of the Association of Official Agricultural Chemists and shall only be applied as needed based on a soil pH test.

Labels shall be clearly marked with the following:

1. Manufacturer's name
2. Type
3. Mass (weight)
4. Guaranteed analysis

517.2.7 Erosion Matting

Matting for erosion control shall be a polypropylene extruded plastic net with a square or near square mesh of approximately $3/4 \times 3/4$ inch and shall be of a type of polypropylene that will gradually disintegrate in sunlight. The matting shall consist of a uniform web of interlocking hay mulch fibers within the matting net.

517.2.8 Establishment of Turf

This work shall consist of the preparation of the area and the application of topsoil, grubbing material, sod, seed, fertilizer, limestone, and mulch. All materials shall meet the requirements of this document. Turf establishment

may be carried on from the time the ground becomes workable in the spring until October 15, unless otherwise directed by the Town. Regardless of the time of seeding or sodding, the Contractor shall be responsible for a full growth of grass. The Contractor shall establish turf on all cut and fill slopes as soon as practical, unless otherwise directed by the Town. Turf establishment shall be performed in accordance with the current version of the VAOT Standard Specifications for Construction, Section 651.

517.2.9 Site Preparation

The ground surface shall be shaped to the lines and grades shown on the Plans. In areas to be topsoiled and/or sodded, allowance shall be made for the depth of topsoil. The surface shall be thoroughly raked, dragged, or otherwise mechanically smoothed. All stones, lumps, roots, or other objectionable materials shall be removed. When necessary, the soil shall be loosened to a depth of approximately 2 inches.

Stone and rock fill slopes to be covered with grubbing material shall be shaped in reasonably close conformity with the grades and typical cross-sections shown on the Plans or directed by the Town.

517.2.10 Topsoiling

Spreading shall not be done when ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. The topsoil shall be spread evenly to a depth after compaction of approximately 4 inches or as directed by the Town.

All large stones and other unsuitable material shall be removed from the area. Topsoil stockpile areas shall be graded, seeded, and left in a neat and presentable condition. Areas shall be properly drained and all excess or unsuitable materials disposed of to the satisfaction of the Town.

517.2.11 Seeding, Fertilizer, and Mulch

Limestone, fertilizer, and seed shall be spread uniformly by hydraulic or dry methods at the rates below:

- | | |
|------------------|--------------------------------|
| 1. Seed | 100 pounds per acre |
| 2. Limestone | as needed based on a soil test |
| 3. Dry fertilize | as needed based on a soil test |

After the seed, lime, and fertilizer have been applied, lawn areas shall be lightly raked to mix seed with the soil and rolled with a lightweight roller to the satisfaction of the Town.

Mulching shall follow the seeding operation by not more than 24 hours. Hay mulch shall be spread uniformly over the area at a rate of approximately 2 tons per acre. The application of mulch shall be made in such a manner that lumps and thick spots are avoided.

517.2.12 Sodding

The Contractor may substitute the use of Sod for site restoration. All work shall be performed in accordance with the current version of the VAOT Standard Specifications for Construction, Section 651.

517.2.13 Planting Trees, Shrubs, and Ground Cover

This work shall consist of furnishing, transporting, planting, and transplanting trees, shrubs, vines, and ground cover plants. The Contractor shall exercise the utmost care in loading, unloading, and handling of trees and plants to prevent injuries to the branches or to the roots of the plants. Plant material locations and bed outlines shall conform to the lines and grades shown on the plans, and shall be laid out prior to excavating for plant pits beds and the area to be landscaped.

517.2.14 Planting Preparation

The size of plant pits shall bear the following relation to the root spread (or diameter of balls) of the plants to be planted in them. The pit diameters shall be three times the root spread diameter. For further requirements, refer to Detail 600.01, found in Appendix A of this Document.

All excavations for trees and shrubs shall be filled with water, and the water shall be allowed to percolate out prior to planting the tree or shrub. Pruning shall be accomplished before or immediately after planting in such a manner as to preserve the natural character of each plant.

517.2.15 Planting Installation

Plants shall be set plumb and shall stand, after settlement of the backfill, at the same level in relation to the ground in which they are planted as they stood in the ground from which they were dug.

Topsoil shall be carefully worked around and over the roots and be thoroughly and properly tamped. Backfill soil shall be filled in around the plant ball to 50 percent of the depth of the ball and then tamped. The remainder of the soil shall then be placed and tamped. Water basins, at least 4 inches in depth for trees shall be formed about individual plants with a diameter equal to that of the plant pit.

Fertilizer shall be applied and cultivated into the top 2 inches of the plant pit area or shrub bed within five days after planting. All plant material shall be watered thoroughly at planting, and watered a minimum of twice weekly during the establishment period. Trees shall receive a minimum of 10 gallons at each watering, shrubs a minimum of 5 gallons and vines and plants a minimum of 3 gallons. All trees shall be guyed and staked in accordance with this document and shall have a minimum of three guys per tree.

517.2.16 Maintenance of Work

The Contractor shall actively maintain all plantings and seeded areas immediately after planting. Plants shall be pruned and/or cultivated, as appropriate. All mulched areas shall be kept weeded, neat, and maintained to the original layout lines. Stakes and support posts for trees shall be restored or replaced as necessary.

The Contractor shall properly maintain all planted trees, shrubs, vines, plants, ground cover, seeded and mulched areas until acceptance of work. The maintenance will include the following: watering, weeding, fertilizing, spraying with approved insecticides or fungicides, providing protection from rodents, and other work necessary to keep plants in living healthy condition.

Any plants damaged, dried out, or otherwise in poor condition shall be replaced in kind with healthy stock at the Contractor's expense. The Contractor shall repair and replace all areas where seed has failed to germinate or sod has failed to grow, and any areas damaged by pedestrian or vehicular traffic or other causes at no cost to the Town

517.2.17 Mailboxes Within the ROW

There are generally three types of mailboxes that are accepted methods to receive mail at a residential unit. Each address specific needs and whichever option is selected must be approved by the local Post Master and the Town of Essex.

- House Mounted Box / Mail Slot
- Roadside Mailbox
- Community Mailbox

The Town of Essex will require additional requirements on all community mailboxes. Community mailboxes that will serve more than ten residential units and are located within the Town ROW, will be required to include a paved parking along the roadside to allow for the free flow of traffic while in use. This parking area must meet the requirements of the typical road cross-section herein. The United States Postal Service offers guidance that can provide dimensions and setbacks required for each of the above installation.

