

***TOWN OF MIDDLEBURY
PUBLIC WORKS SPECIFICATIONS***

GENERAL SPECIFICATIONS:	1
1.0 INTRODUCTION	1
1.1 BASIC DESIGN STANDARDS	2
1.2 ENGINEERING PLANS	5
1.3 DEVELOPMENT TRAFFIC STUDIES	5
1.4 PLAN APPROVAL FOR CONSTRUCTION	6
1.5 PROJECT LETTER OF CREDIT OR CASH ESCROW	7
1.6 WORK TO CONFORM	7
1.7 PROTECTION OF WORK PERSONNEL AND THE PUBLIC	7
1.8 PROTECTION AND REPAIR OF EXISTING UTILITIES	8
1.9 RECONSTRUCTION OF EXISTING UTILITIES	8
1.10 PERMITS	9
1.11 WORK OUTSIDE OWNED PROPERTY LIMITS OR WITHIN PUBLIC RIGHTS OF WAY	9
1.12 SUPERVISORS ON THE JOB SITE	9
1.13 CONSTRUCTION/WARNING SIGNS	9
1.14 MAINTENANCE AND PROTECTION OF TRAFFIC	10
1.15 PRE-CONSTRUCTION MEETING	10
1.16 TESTING AND INSPECTION REQUIREMENTS	10
1.17 SUBMITTAL OF RECORD DRAWINGS	13
1.18 SPECIAL CONTROLS	14
1.19 OTHER REFERENCED STANDARDS	16
1.20 OTHER MISCELLANEOUS REQUIREMENTS	17
STREETS	19
2.0 GENERAL	19
2.1 EXCAVATION, BACKFILLING, AND COMPACTING:	19
2.2 CONTROLLED BLASTING, EARTH AND ROCK EXCAVATION	26
2.3 TRENCHING, BACKFILLING, AND COMPACTING	34
2.4 DRAINAGE GEOTEXTILES	39
2.5 EROSION CONTROL GEOTEXTILES	41
2.6 SEPARATION GEOTEXTILES	44
2.7 TEMPORARY SILT FENCE	47
2.8 UNDERDRAINS:	50
2.9 SAND:	51
2.10 GRAVEL BASE - BOTTOM COURSE:	52
2.11 GRAVEL BASE - TOP COURSE:	53
2.12 BITUMINOUS CONCRETE (ASPHALT) PAVEMENT	54
2.13 CEMENT CONCRETE CURB:	61
2.14 CEMENT CONCRETE SIDEWALK:	63
2.15 CEMENT CONCRETE DRIVEWAY APRONS:	64
2.16 BITUMINOUS CONCRETE DRIVEWAY APRONS:	65
2.17 STREET GUARD RAIL OR BARRIER:	67
2.18 STREET SIDELINE MONUMENTS:	67

2.19 PLANTING OF TREES:	67
2.20 STREET SIGNS, MARKINGS, SIGNALS AND GEOMETRIC IMPROVEMENTS	68
2.21 STREET LIGHTING	69
2.22 LANDSCAPING	69
2.23 STUMP DISPOSAL	70
STORM DRAINAGE SYSTEM	72
3.0 GENERAL	72
3.1 MATERIALS	72
3.2 CONSTRUCTION METHODS	73
WATER DISTRIBUTION SYSTEM	76
4.0 WATER DISTRIBUTION SPECIFICATIONS	76
4.1 GENERAL	76
4.2 WATER PIPE MATERIALS	76
4.3 FITTINGS	76
4.4 GATE VALVE RESILIENT SEAT	76
4.5 VALVE BOXES	77
4.6 FIRE HYDRANTS	77
4.7 HYDRANT BRANCHES	77
4.8 TAPPING SLEEVES	78
4.9 WATER SERVICE CONNECTION	78
4.10 CONSTRUCTION METHODS	80
SANITARY SEWER SYSTEM	84
5.0 SANITARY SEWER SPECIFICATIONS	84
5.1 GENERAL	84
5.2 MATERIALS	84
5.3 CONSTRUCTION METHODS	88
5.4 WASTEWATER PUMPING STATION	94

PREFACE

This manual, entitled "Middlebury Public Works Specification", is intended to serve a long-established need. Its major usefulness lies in the design and construction of streets, sanitary sewers, water distribution systems, storm sewers, and related work.

It is applicable to any new construction and to many aspects of reconstruction due to obsolescence or deterioration. Variations from these specifications and details will not be permitted unless approved supplemental specifications or special provisions are included in the proposed work. In cases where the design of a facility is not governed by these specifications and details, the latest design methods shall be used and included on the plans for acceptance by the Officials of the Municipality. It shall be policy that all engineering design be based on the latest methods and technology when determining sizes, strengths, and amounts. All plans and specifications shall have a note stating, "All work to be performed in accordance with the Town of Middlebury Public Works Specification".

GENERAL SPECIFICATIONS

	<u>Page</u>
1.0 Introduction	1
1.1 Basic Design Standards	2
1.2 Engineering Plans	5
1.3 Development Traffic Studies	5
1.4 Plan Approval for Construction	6
1.5 Project Bond/Highway Letter of Credit and Agreement with the Project Engineer	7
1.6 Work to Conform	7
1.7 Protection of Work Personnel and the Public	7
1.8 Protection and Repair of Existing Utilities	8
1.9 Reconstruction of Existing Utilities	8
1.10 Permits	9
1.11 Work Outside Owned Property Limits or Within Public Right of Way	9
1.12 Supervisors on the Job Site	9
1.13 Construction/Warning Signs	9
1.14 Maintenance and Protection of Traffic	10
1.15 Pre-Construction Meeting	10
1.16 Testing and Inspection Requirements	10
1.17 Submittal of Record Drawings	13
1.18 Special Controls	14
1.19 Other Referenced Standards	16
1.20 Other Miscellaneous Requirements	17

STREETS

2.0 General	19
2.1 Excavation, Backfilling and Compacting	20
2.2 Controlled Blasting, Earth and Rock Removal	26
2.3 Trenching, Backfilling and Compacting	34
2.4 Drainage Geotextiles	39
2.5 Erosion Control Geotextiles	41
2.6 Separation Geotextiles	44
2.7 Temporary Silt Fence	47
2.8 Underdrains	50
2.9 Sand	51
2.10 Gravel Base - Bottom Course	52
2.11 Gravel Base - Top Course	53
2.12 Bituminous Concrete (Asphalt) Pavement	54
2.13 Cement Concrete Curb	61
2.14 Cement Concrete Sidewalk	63

2.15	Cement Concrete Driveway Aprons	64
2.16	Bituminous Concrete Driveway Aprons	65
2.17	Street Guard Rail	67
2.18	Street Sideline Monuments	67
2.19	Planting of Trees	67
2.20	Street Signs, Markings, Signals and Geometric Improvements	68
2.21	Street Lighting	69
2.22	Landscaping	69
2.23	Stump Disposal	68

STORM DRAINAGE SYSTEM

3.0	General	69
3.1	Materials	69
3.2	Construction Methods	71

WATER DISTRIBUTION SYSTEM

4.1	General	72
4.2	Water Pipe Materials	76
4.3	Fittings	76
4.4	Resilient Seat Gate Valves	76
4.5	Valve Boxes	77
4.6	Fire Hydrants	77
4.7	Hydrant Branches	77
4.8	Tapping Sleeves	78
4.9	Water Service Connections	78
4.10	Construction Methods	80

SANITARY SEWER SYSTEM

5.1	General	84
5.2	Sanitary Sewer Materials	84
5.3	Construction Methods	88
5.4	Wastewater Pumping Station	94

APPENDIX I

Figure No.***List of Illustrations***

1	Street Details - Urban Road Cross-Section
2	Street Details - Rural Road Cross-Section
3	Street Details - Concrete Sidewalk Detail
4	Street Details - Typical Tapered Curb
5	Street Details - Concrete Curb
6	Street Details - Concrete Driveway Apron & Curb Cut
7	Street Details - Driveway Apron & Curb Cut
8	Street Details - Sidewalk Ramp Detail
9	Street Details - Construction Detail "A"
10	Street Details - Construction Detail "B"
11	Street Details - Typical Pavement Repair Detail
12	Street Details - Rural Driveway
13	Street Details - Cleanout Detail
14	Street Details - Street Name Signs
15	Street Details - Typical Street Light
16	Water Details - Hydrant Detail
17	Water Details - Typical Water Trench
18	Water Details - Thrust Block Detail
19	Water Details - Tapping Valve and Sleeve Detail
20	Water Details - Water Service Detail
21	Sanitary Sewer Details - Typical Precast Sanitary or Storm Manhole
22	Sanitary Sewer Details - Manhole Channel
23	Sanitary Sewer Details - Manhole Channel/Insertion Detail
24	Sanitary Sewer Details - Typical Sanitary Sewer Trench
25	Sanitary Sewer Details - Service Connection
26	Storm Sewer Details - Precast Catch Basin
27	Storm Sewer Details - Typical Storm Sewer Trench
28	Storm Sewer Details - Storm Outfall Detail
29	Storm Sewer Details - Typical New Stone Ditch
30	Storm Sewer Details - Typical Special Drainage Swale
31	Erosion Control Details - Stabilized Construction Entrance
32	Erosion Control Details - Haybale Dam Erosion Control Barrier
33	Erosion Control Details - Haybale Dam
34	Erosion Control Details - Temporary Erosion Control Fence
35	Erosion Control Details - Inlet Protection

GENERAL SPECIFICATIONS:**1.0 INTRODUCTION**

This document details the requirements for all new construction as well as many aspects reconstruction projects involving roads and ancillary infrastructure within the Town of Middlebury.

These Middlebury standards are considered the minimum acceptable standard Specifications for the Town of Middlebury. The acceptability of any deviations from these specifications shall be determined by the Town Engineer.

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

The primary purpose of this document is to establish a uniform level of quality for all infrastructure within the Municipality and to reduce the engineering time necessary for review of all proposed improvements. Plan submittals on new improvements will not be required to duplicate the contents of these standards providing these standards are referenced on submitted plans and further, providing a copy of the standards are physically available at the construction site.

It should be noted that all projects involve a degree of uncertainty, especially with regard to subsurface conditions. Adherence to these minimum Municipal standards does not guarantee acceptance on the part of the Municipality for the final installation. When unexpected subsurface conditions are encountered, the Contractor must report the changed conditions to the design/project engineer who in turn reports the situation to the Municipality before the work is allowed to proceed. A review will be made of conditions and if necessary, site specific changes to the plans will be determined which will likely exceed the Municipality's minimum standards. Providing the installation is then constructed on the basis of the revised and approved standards and all installations meet the required tests, Municipality acceptance will follow.

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

Within the Public Works Specifications, the terms contractor, developer, design/project

engineer, town, municipality, and town engineer are used. In this document, they are defined as follows:

TOWN, means Municipality.

CONTRACTOR, means the party actually responsible for performing the construction activity.

DEVELOPER, means the individual, partnership, corporation or authorized agent developing a parcel or parcels of land.

The **DESIGN/PROJECT ENGINEER** is a Vermont registered professional engineer experienced in the design of streets and appurtenances, sewer and water systems and/or storm water systems, hired by the developer to perform planning, design and construction related engineering services.

The **TOWN ENGINEER** or **ENGINEER** is the individual or firm appointed by the Town to perform the duties of this position.

Utilization of this document by any party does not constitute a liability on the part of the Town or the Town Engineer.

1.1 BASIC DESIGN STANDARDS

All new proposed streets, utilities, and other public improvements shall be designed and constructed in accordance with the latest minimum accepted standards and practices contained in these *Public Works Specifications; the Middlebury Subdivision Regulations, the American Association of State Highway and Transportation Official (AASHTO) Standards, the Vermont Agency of Transportation Standards, Specifications and Details, the Guideline recommended by the Institute of Transportation Engineers (ITE), and other standards stated herein.*

The minimum width of rights-of-way, measured from property line to property line shall not be less than sixty feet (60'). Street grades shall not exceed ten percent (10%). In no case shall a grade of greater than eight percent (8%) be longer than three hundred feet (300'). Street grades longer than three hundred feet (300') shall have a maximum grade of eight percent (8%). The minimum grade shall not be less than one-half of one percent (0.5%). The maximum grades within one hundred feet (100') of the centerline intersection of two streets shall not be greater than three percent (3%).

The width of the bituminous concrete wearing course surface of any public street may not be less than thirty feet (30'). All new public streets will be paved. The municipality shall require sidewalks on all residential and urban collector streets and may require bike

paths in new developments. The minimum width of concrete sidewalks shall be five feet (5') and the minimum width of pavement for bike paths shall be ten feet (10'). Bike paths shall be designed in accordance with the latest edition of the AASHTO Guide for the Development of Bicycle Facilities.

Any street lines within a block deflecting from each other at any one point shall be connected with a curve the radius of which at the centerline shall not be less than one hundred fifty feet (150') for minor streets and two hundred fifty feet (250') for collector streets.

Commercial, industrial, collector, and residential streets or drives shall have a minimum curb or edge of pavement radius of not less than thirty feet (30').

Every change in grade shall be connected by a vertical curve constructed so as to afford a minimum sight distance of one hundred and fifty feet (150') for minor streets and two hundred fifty feet (250') for collector streets.

A tangent of at least fifty feet (50') in length shall be introduced between reverse curves on all proposed streets.

The minimum centerline offsets of adjacent intersections will be;

125 feet for local to local,
150 feet for local to collector, and
200 feet for collector to collector.

Street intersections shall be at right angles and no intersection shall be at an angle of less than 80 degrees.

A cul-de-sac is a street terminating in a turn-around at one end. Cul-de-sac streets shall be permitted; however, the length of a cul-de-sac shall not exceed twelve times the minimum required lot frontage for the district(s) involved or maximum of one thousand eight hundred feet (1,800'). All dead-end streets shall have a cul-de-sac.

The turn-around on a dead-end street (cul-de-sac) shall have a minimum diameter of right-of-way of one hundred twenty feet (120'), a minimum outside diameter of the paved traveled way of ninety feet (90'), and a 30 feet (30') diameter landscaped island in the center. The cul-de-sac may also be offset to the right or left.

Where the subdivision borders on an existing road or an abutting developable parcel of land and when the Town determines that a realignment or widening of the road or a future road right-of-way would be in the public interest, the Town may require that such areas be shown and marked on the Final Property Plat "Reserved for Road Alignment and/or Widening Purposes or Future Road". Areas shown in this manner shall be dedicated to the Town. Subdivisions with 50 or more existing or new lots or dwelling units shall have more than one public street connection to other existing public streets.

No street shall be approved unless its elevations are above the elevation of the historic flood or record (100 year flood elevations).

In order to provide adequate fire protection for any new subdivision with a private driveway over 200 feet serving up to two (2) lots, the driveway shall have at least a 14 feet wide improved travel way capable of supporting the weight of a two-axle, 40,000 pound vehicle and have an adequate turnaround at the end.

Any other type of access serving three (3) or more dwellings, or any commercial, retail, or industrial activities shall be developed and constructed in accordance with these Public Works Specifications.

Private roads shall be developed to the same standards as public roads.

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

- 1) Standard sieve analysis and grain size distribution curve for each representative soil in the cross sections.
- 2) Plasticity index and liquid limit for each representative soil in the cross section.
- 3) The highest seasonal ground water elevation shall be determined.

The Town Engineer may waive the necessity for soil borings altogether or modify the spacing or depth requirements depending upon the specific 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 design/project engineer. Sufficient lead time must be established for acquiring the approvals of materials prior to placement.

1.2 ENGINEERING PLANS

At each stage of a project's development, engineering plans and documentation are required to determine project compliance with Town standards. The level of engineering

detail required for approval generally increases with each stage of development approval. All engineering plans or documentation of an engineering nature submitted to the Town must be prepared by a Vermont licensed professional engineer.

1.3 DEVELOPMENT TRAFFIC STUDIES

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

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

1. The scope of the study shall include the impacts of project driveways and intersections, adjacent signalized and un-signalized intersections, and other locations as stipulated by the Planning Commission.
2. The analysis periods shall be
 - a. Base year - time of project or major phase completion.
 - b. Planning year
 - (1) If the project is fully completed in the base year - base year plus five years.
 - (2) If the project is not fully completed in the base year - base year plus five years or year of final completion, whichever is longer.
3. Study content
 - a. Listings of project development characteristics, trip generation rates, and related travel patterns.
 - b. Tabular summaries of existing, development, and combined vehicular volumes for the analysis periods.
 - c. Documented warrant evaluations for:
 - (1) Geometric needs including but not limited to right-turn lanes, left-turn lanes, radii, etc., in terms of 30th highest hour volumes.
 - (2) Signal needs in terms of average weekday volumes.
 - d. Traffic performance evaluations for all study locations in terms of 30th highest hour volumes for the selected analysis periods.
 - (1) Numerical measures of capacity.
 - (2) Level of service descriptions, delay and gap calculations.
 - e. Study of proposed driveway(s) features
 - (1) Sight distances
 - (2) Non-interfering approach speeds on the intersecting street or

- road.
- (3) Acceptable spacings with respect to adjacent intersections and/or major driveways.
- (4) Recommend driveway configuration in terms of number and use of lanes, lane widths, and edge of pavement designs.
- f. Safety evaluation on main roadway or intersection at project driveway(s).
 - (1) Summary of accident characteristics for the past five years by:
 - a: Cause
 - b: Type
 - c: Severity
 - (2) Comparison of actual and critical accident rates.
 - a: Roadway - accidents per 1,000,000 vehicle miles.
 - b: Intersection - accidents per 1,000,000 incoming vehicles.
 - (3) Recommend improvements for any accident prone locations.
 - (4) Evaluation of existing geometrics and alignment with respect to both vehicles and pedestrian safety and level of service.
- 4. Summary of any recommended geometric and/or control improvements to provide proper traffic performance and safety.
- 5. Miscellaneous items as requested by the Planning Commission.
 - a. Facilities for pedestrians, bicyclists, and/or handicapped persons.
 - b. Evaluation of internal circulation.
 - c. Parking requirements.
- 6. Any roadway improvements necessary as a result of the project access and impact shall be paid for and constructed by the Developer in accordance with Section 2.21.

1.4 PLAN APPROVAL FOR CONSTRUCTION

Upon receipt of acceptable final engineering plans, the Town Engineer will approve the plans for construction. Three sets of paper working drawings will be submitted. Prior to proceeding with construction, a pre-construction meeting will be required. Also, an estimate of the project cost must be submitted as part of the requirement for a project bond.

1.5 PROJECT LETTER OF CREDIT OR CASH ESCROW

All of the public works improvements to be dedicated to the Town shall be guaranteed by a letter of credit or cash escrow provided to the Town at no cost. The letter of credit or cash escrow shall be in an amount sufficient to cover the total estimated costs of the improvements as approved by the Town Engineer. The letter of credit or cash

escrow shall be conditioned upon the satisfactory condition of the improvements for a period of three years, from the date of construction acceptance by the Town.

Prior to establishment of a satisfactory dollar value for the letter of credit or cash escrow, the Developer shall submit an accurate construction estimate. The completed document shall be submitted to the Town Engineer for review and approval prior to posting of a letter of credit or cash escrow.

Prior to start of construction, the Developer shall also submit an Agreement with a Project Engineer to the Town Engineer for review and approval which will include a scope of services adequate to meet all the construction inspection, certification and record drawing requirements in these specifications particularly those found in Section 1.16 and 1.17.

1.6 WORK TO CONFORM

All materials, design and workmanship must meet with nationally accepted standards and practices as set forth in Section 1.19 and all applicable standards of the Town. The Town recognizes AASHTO design requirements and the State of Vermont Agency of Transportation Standard Specifications for Construction, latest edition as a supplemental source for standards not detailed in the Town specifications. Where a conflict arises between the published standards established in this manual and other published standards, the published standards of the Town shall take precedence.

During the progress of construction and upon completion, all work shall conform to these standards and the lines, levels and grades as indicated on plans approved by the Town. Field revisions necessitated by the conditions of the site must be approved by the design/project engineer and the Town prior to acceptance of the completed work. The work shall be performed in a thoroughly substantial and workmanlike manner.

1.7 PROTECTION OF WORK PERSONNEL AND THE PUBLIC

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

1.8 PROTECTION AND REPAIR OF EXISTING UTILITIES

The Contractor shall notify Dig-Safe prior to any excavation in the public right of way or utility easement limits. Wherever culverts, sewers, drains, manholes, catch basin connections, water mains, valve chambers, electric conduits, telephone conduits, utility poles, overhead lines or other existing facilities are encountered they shall be protected and firmly supported by the Contractor at his/her own expense, by methods approved by the authority having control of the above or below ground structure, until excavation is backfilled and the existing structures are made secure. Injury to any such structures caused by or resulting from the contractor's operations, shall be repaired at the contractor's expense within a time period that will not place an unreasonable burden on the users. The authority having charge of any particular underground structure shall be notified promptly of injury to its structure.

Pipes or other underground structures encountered in excavating or trenching shall be permanently supported by methods acceptable to the utility owner.

1.9 RECONSTRUCTION OF EXISTING UTILITIES

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

1.10 PERMITS

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

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

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

1.12 SUPERVISORS ON THE JOB SITE

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

1.13 CONSTRUCTION/WARNING SIGNS

Construction approach signs shall appear at each end of a public highway under construction and on all intersecting public highways. The exact placement of any sign will depend upon the alignment of the highway and the character of the roadside. The location, measurements, and minimum spacing shall comply with Section E plans of the State of Vermont design standards.

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

The signs shall be of metal, wood, plywood, hardboard, or any other material satisfactory to the Town Engineer. No material shall be approved that will deteriorate by exposure to the weather during the required life of the sign.

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

1.14 MAINTENANCE AND PROTECTION OF TRAFFIC

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

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

right of way.

The cost of traffic police services deemed necessary by the Town shall be paid for by the contractor.

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

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

1.15 PRE-CONSTRUCTION MEETING

Prior to the start and each phase of construction, a pre-construction meeting will be held with the Developer, Contractor, Developer's Project Engineer, Town Staff, Public Works Director, and Town Engineer present. In the event that any of the representatives are unable to attend, the meeting shall be rescheduled. Upon completion of the meeting, the developer shall be required to sign a statement indicating that he or she has been presented with and understands the information covered at the pre-construction meeting.

1.16 TESTING AND INSPECTION REQUIREMENTS

1. General

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

General site improvements	4 hours/week
Sewer line installation	2 hours/day
Water line installation	2 hours/day
Storm line installation	2 hours/day
Embankment installation	2 hours/day
Road base installation	2 hours/day
Paving operations	Constant

All check sheets and tests are required to be completed and filed in a timely basis.

Upon completion of the construction, the Developer's Design Engineer shall certify that required testing and inspection has been conducted, that the improvements inspected

are in full conformance with the approved plans and specifications, and that the entire project is in reasonable conformance with the approved plans and specifications. The certification is required prior to the acceptance of the project by the Town.

A final walk-through inspection will be made of the project by the Developer, Contractor, Developer's Project Engineer, the Director of Public Works, and the Town Engineer.

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

2. Road Inspection Schedule

24 hours notice for all inspections will be given to the Town and the Town Engineer. Failure to provide required notices may result in non-acceptance of the completed improvements.

A sample of all subbase materials will be tested by a testing lab approved by the Town in accordance with these Specifications. Sieve analyses shall be performed for all base materials at minimum intervals of every 500 feet in length for each course or as required by the Town Engineer at the Contractor's expense. Approximately 48 hours should be allocated between submittal of material for testing and placement of the material.

The sub-base material compaction will be tested by AASHTO-T-99, Method A (Standard Proctor) test in fill sections at minimum intervals of every 500 feet in length and two feet (2') of depth and changes in material. The responsibility and payment for testing shall be the Contractor's.

In addition to the standard Proctor test, a fully loaded tandem dump truck with a total weight not less than 24 tons shall be driven over the compacted subgrade in the presence of the Town's Engineer or the Design Engineer and the depression left by the truck wheels shall be used to make a judgement on the acceptability or unacceptability of the subgrade.

The Town's Engineer will be notified 24 hours in advance to inspect the construction of any and all roads at the following phases of construction:

- Preparation of subgrade;
- Installation of subbase material;
- Completion of finished grading;
- During the placement of the base coat of asphalt;
- During and after the placement of the top coat of asphalt.

The Town's authorized representative will inspect work during the placement of curbs, sidewalks, and driveway aprons.

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

Settlement, depression, or imperfections in finish surface;
Seeding and erosion control on cut and fill slopes;
Surface drainage (during rainstorm);
General appearance;
Material testing results, lab reports, and record drawing complete and on file.

3. Utility Systems

No backfilling of trenches shall occur until the installation of pipelines and structures have been inspected and approved by the Project Engineer, Town Engineer or Public Works Director. 24 hours notice for all inspections will be given to the Municipality and the Town Engineer. Failure to provide required notices may result in non-acceptance of the completed improvements.

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

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

1.17 **SUBMITTAL OF RECORD DRAWINGS**

1. General

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

a. Roads

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

Width of pavement from curb to curb or shoulder to shoulder;
Right of way dimensions for streets;
Width of sidewalk and bike paths;
Location of street lights;
Location of driveways;
Location and size of planter islands, if any;

Typical cross-section of streets as installed;

Location of electric and telephone lines, structures and poles;
Street monuments.

b. Water

Accurate locations of all water lines.

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

All curb boxes will be marked with 4"x4" stakes so contractors can easily locate them before building services are connected.

c. Sewer

Accurate locations of all sewer lines and clean-outs.

Accurate measurements to all tees and/or wyes for building connections (shown on tie drawings.)

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

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

d. Storm Drainage

For storm drainage facilities, the following shall be shown:

Depth, size, location and type of all storm drain lines and culverts, including underdrains and services;

Location and elevations of all catch basins;

Location and details for all storm drainage facilities such as detention ponds;

Location of all drainage ways, water courses, etc;

After the initial set of record drawings have been submitted, there will be a field inspection by the Town to verify that the hydrant, valve boxes, curb

boxes, etc., are properly raised to ground level.

e. Final Drawings

Prior to final construction approval of the project by the Town, a final set of record drawings, including one set in digital format and two sets of prints, shall be submitted to the Town within 60 days of the completion of a project or project phase. The final set of the project record drawings shall be stamped by the Design/Project Engineer. The record drawings shall also contain a stamped and signed statement by a licensed Land Surveyor that all property corner markers have been set in accordance with the approved property plat.

1.18 **SPECIAL CONTROLS**

1. Dust Control:

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

2. Water Control:

The Contractor shall take all necessary measures to handle all water in excavations and shall furnish all materials and equipment and shall do all incidental work to keep the excavation entirely clear of water while pipelines, structures, and their foundations are being built. The Contractor shall be responsible for choosing the method for control of water and shall assume all responsibility for the adequacy of the methods chosen. No construction shall be undertaken if, in the opinion of the Town, adequate control of water is not assured.

3. Pollution Control:

During the construction period, the Contractor shall exercise every reasonable precaution to prevent pollution of the waters of the State. Pollutants such as chemicals, paints, fuels, lubricants, bitumens, raw sewage, and other harmful waste shall not be discharged into or alongside these waters or into natural or man-made channels leading thereto. Applicable statutes and regulations of the Vermont State Agency of Natural Resources relating to the prevention and abatement of pollution shall be complied with.

4. Erosion Control:

The Contractor shall carry out his or her operations in such a manner to give adequate protection of watercourses and minimize surface erosion.

Development or construction plans shall include detailed information on the proposed methods for erosion control. No work shall be started on areas that are highly susceptible to erosion, as indicated by the Town, or within existing drainage channels until the methods of erosion control to be employed on the project have been approved.

The Town Engineer and Design Engineer have the authority to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to order the Contractor to provide immediate erosion control measures to prevent contamination of adjacent streams or other watercourses, and areas of water impoundment. These measures shall include but not be limited to, haybale check dams, haybales for mulch, matting, and silt fencing. As the excavation proceeds, cut slopes shall be seeded and mulched to the extent considered desirable and practicable by the Town. The exposure of uncompleted cut slopes and embankments to the elements shall be as short as practicable. Seeding, mulching, installation of erosion control shrubbery or other designed treatment should be initiated promptly, and concurrently with the other work.

If and when conditions develop that will suspend construction operations for any appreciable length of time, the excavation and embankment areas shall be shaped in such a manner that the runoff of water may be intercepted and diverted to points where least erosion shall result. Slope drains shall be installed as soon as possible to assist in carrying this runoff. If these preventative measures should fail and an appreciable amount of material begins to erode into a watercourse or impoundment, the Contractor shall act immediately to correct and prevent further erosion.

Erosion control measures shall be continued until the permanent drainage facilities have been constructed and until grass on seeded slopes or specially installed shrubbery is established sufficiently to be an effective deterrent against erosion.

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

The Contractor shall perform all of the storm water and erosion control specifications and details shown on the approved plans including installation, maintenance and removal of temporary dams and inlet protection.

1.19 OTHER REFERENCED STANDARDS

Standard Specifications for Construction, State of Vermont, Agency of

Transportation

American Association of State Highway and Transportation Officials, (AASHTO)

Transportation and Traffic Engineering Handbook, ITE

American Society of Testing Materials Standards

American Water Works Association Standards

American Concrete Institute Standards

Water Pollution Control Federation Standards

American Society of Civil Engineer Standards and Manuals of Practice

American National Standards Institute

National Plumbing Code

National Electric Code

Portland Cement Association Standards

New England Water Works Association

Ten States Standards on Water and Sewage

American Public Works Association Standards

VOSHA Safety and Health Standards

New England Interstate Water Pollution Control Commission "Guides for the Design of Wastewater Treatment Works"

Public Water Supply Regulations of the State of Vermont

1.20 OTHER MISCELLANEOUS REQUIREMENTS

1. Traffic Control Devices

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

In the event other traffic control devices such as signals are warranted, according to the Manual of Uniform Traffic Control Devices (MUTCD), the developer shall be responsible for installing signalization at his or her own expense.

In addition, any road striping such as walkways, stop bars, median striping and the like shall be installed by the developer at his or her own expense. All striping other than lane dividers shall be durable.

2. Street Names

No duplicate, or near duplicate, names for streets or developments within the Town will be allowed. When a developer chooses names for any development, subdivision, street, or road, the proposed names shall be submitted on the Preliminary Plans to the Town Staff. The Town Staff shall review the proposed names with the Planning Commission. The final approval authority for all street names is the Board of Selectmen.

3. Street Numbers

Prior to submittal of the property plat for Municipality approval and recording, the developer shall obtain the street numbers for each building from the Town Assessor's Office. The final plans will include street numbers as well as lot numbers.

Within each development, the developer as a condition of sale of a lot or structure, shall ensure that street numbers are installed per the following:

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

4. Emergency Vehicle Access

In order to provide adequate emergency protection, any plans submitted for consideration to the Town for all residential, commercial or industrial buildings shall have suitable access provided for fire and emergency vehicles.

The need for a separate emergency access road for these buildings will be considered by the Town on a case by case basis.

If required, a separate emergency access road must be able to support the weight of a two-axle forty thousand pound (40,000#) truck. Preferred construction should be bituminous concrete, as per the specifications for paved public roadways although gravel roadways will be accepted if they conform to the weight specification above.

Emergency access roads must be passable year round.

STREETS**2.0 GENERAL**

The developer is required to have a qualified Project Engineer inspect the project during construction for the purpose of providing verification of materials and tests in conformance with Section 1.16, item 2, and to verify that the project was constructed in accordance with the approved plans.

2.1 EXCAVATION, BACKFILLING, AND COMPACTING:*A. GENERAL*

DESCRIPTION

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

QUALITY ASSURANCE

1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
3. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Engineer.

B. PRODUCTS

SOIL MATERIALS

1. Fill and backfill materials:
 - a. Fill material is subject to the approval of the Engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soils free from roots and other deleterious matter.
 - b. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill or embankment.

C. EXECUTION

SURFACE CONDITIONS

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

GENERAL CONSTRUCTION REQUIREMENTS

1. Prior to the beginning of excavation, grading and embankment operations in any area, all necessary clearing and grubbing in that area shall have been completed.
2. All slopes in cut and embankment sections, ditches and waterways, whether old or newly constructed, shall be satisfactorily cleaned and cleared of obstructions and left in a neat and trim condition. Excavation shall be made in reasonably close conformity with the lines, grades and requirements indicated in the contract or ordered by the Engineer.
3. The construction area shall be maintained so that it will be drained at all times. Where traffic is maintained, care shall be exercised to keep the portion open to traffic in a satisfactory condition.
4. All suitable material removed from excavation shall be used in the formation of embankments as indicated on the plans or as directed by the Engineer. Any excavation that cannot be incorporated in embankments shall be disposed of as directed and no material shall be wasted without permission of the Engineer.
5. The Contractor shall be responsible for the stability of all constructed embankments and shall replace at his or her own expense any portions

which have become displaced.

6. Unless authorized by the Engineer, borrow material shall not be placed until all suitable material has been excavated and placed in the embankments except when Sand Borrow or Granular Borrow is called for on the plans or when Granular Borrow is required by the Engineer for use under embankments or used with material from excavation in making embankments.

EXCAVATION

1. Any loose material resulting from breakage and slides shall be removed and disposed of as directed by the Engineer.
2. Excavation shall be sorted so that only clean non-frost susceptible soils are placed in embankments beneath the travelled way.

DISPOSAL OF SURPLUS MATERIAL

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

EMBANKMENTS

1. Preparation of Embankment Area - When embankments are to be made on a hillside, the slope of the original ground on which the embankments are to be constructed shall be stepped and properly drained as the fill is constructed.
2. Use of Materials - The excavated rock, ledge, boulders and stone, except where required in the construction of other items or otherwise directed, shall be used in the construction of embankments to the extent of the project requirements and, generally, shall be placed so as to form the base of an embankment.

Frozen material shall not be used in the construction of embankments, nor shall the embankments or successive layers of the embankments be placed upon frozen material. Placement of material other than rock shall stop when the sustained air temperature, below 32°F, prohibits the obtaining of the required compaction. If the material is otherwise acceptable, it shall be

stockpiled and reserved for future use when its condition is acceptable to the Engineer for use in embankments.

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

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

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

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

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

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

constructed each day shall be graded, crowned and rolled to insure adequate drainage.

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

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

When soft or wet clay or silt excavation is being used between layers of reasonably clean stable rockfill, the rock embankment layers shall not exceed two feet in loose measurement and the clay or silt layers shall not exceed eight inches in loose measurement.

4. Compaction - each layer between the design embankment limits shown on the plans shall be uniformly compacted by the use of compaction equipment. Each layer shall be compacted to not less than 95% of material's maximum dry density determined by AASHTO Standard Method of Test, T-99, Method C. Field density determination will be made in accordance with AASHTO Standard Methods of Test, T-191 (sand cone method), T-238 (nuclear method) or other approved procedures. Field moisture determination will be made in accordance with AASHTO Standard Method of Test T-99, or measured in accordance with AASHTO T-239 (nuclear method). Locations within the embankment limits where waste materials have been placed shall be compacted to the extent that stability is assured.

All fill material shall be compacted at a moisture content determined by the Engineer to be suitable for obtaining the required density. In no case, shall the moisture content in each layer under construction be more than two percent above the optimum moisture content, and shall be less than that quantity that will cause the embankment to become unstable during compaction. Sponginess, shoving or other displacement under heavy equipment shall be considered prima facie evidence for an engineering placement of material in the area affected shall be stopped or retarded to allow the material to stabilize.

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

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

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

SUBGRADE

1. The subgrade shall be constructed in close conformity with the lines, grades and cross section shown on the plans. After all drainage structures and piping have been installed and the subgrade has been shaped correctly, it shall be brought to a firm, unyielding surface compacted to attain at least 95 percent of the maximum dry density. This density shall be determined by the Standard Method of test for the Moisture-Density Relations of Soils, AASHTO T-99, Method C.

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

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

All loose rock or boulders encountered at subgrade in the earth excavation shall be removed or broken off to a depth not less than 12 inches below the

subgrade. Within the area to be lined with fabric, no stones larger than 1/2" in diameter may be in the top 6" of subgrade material.

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

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

A tolerance of 1/2 inch above or below the finished subgrade will be allowed provided that this 1/2 inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the required cross section is maintained. Where placement of the subbase is not part of the work, a tolerance of one inch above or below the finished subgrade will be allowed, provided that this one inch above or below subgrade is not maintained for a distance longer than 50 feet, and that the road cross section is maintained.

FIELD QUALITY CONTROL

1. Secure the Engineer's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon.
2. Provide at least the following tests to the approval of the Engineer:
 1. At paved areas, at least one field density test for every 10,000 sq ft of paved area, but not less than three tests;
 2. In each compacted fill layer, one field density test for every 2000 cubic yards of fill material placed, but not less than one per lift.
3. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of these Specifications.

MAINTENANCE

1. Protection of newly graded areas:
 - a. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
 - b. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.
2. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

2.2 CONTROLLED BLASTING, EARTH AND ROCK EXCAVATION

A. DESCRIPTION OF WORK

1. The work to be done under this section includes:

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

B. DEFINITIONS

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

2. Earth: All excavated materials not defined as rock.
3. Flyrock: Fractured rock propelled through the air resulting from blasting if not prevented by use of blasting mats.
4. Geophone or vibration transducer: A sensor used to monitor ground vibrations (particle velocity components).
5. Grades or elevations: The design vertical levels to which excavation shall be conducted and thereby define the design vertical limits of excavation. The actual vertical limits of excavation will be determined by the amount of overbreak below the design grades after removal of overbreak and cleaning of the resulting rock surface as specified.
6. Overbreak: The excess amount of rock removed by and/or resulting from blasting outside beyond the A-line or below the design excavation grades indicated on the drawings.
7. Peak particle velocity: The maximum of any one of the three mutually perpendicular ground motion velocity components of a vibration measured in directions vertical, radial, and perpendicular to the vibration source.
8. Rock: Material which is geologically classified as intact, untransported rock, and requires systematic drilling and blasting for removal. Rock does not include boulders or loose rock fragments less than one (1) cubic yard in volume.
9. Seismograph: An instrument used to record the magnitude and frequency of ground vibrations sensed by a geophone.

C. QUALITY ASSURANCE

1. Qualifications

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

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

2. Codes, Permits, and Regulations:

A. The Contractor shall comply with all applicable laws, rules, ordinances, and regulations of the Federal Govt., the State of Vermont, and the municipality governing the transportation, storage, handling, and the use of explosives. All labor, materials, equipment, and services necessary to make the blasting operations comply with such requirements shall be provided without additional cost to the owner. The Contractor shall comply with the following regulations:

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

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

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

3. Blasting Limit Criteria:

A. Peak Particle Velocity Limits:

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

4. Blasting Monitoring:

A. The Contractor shall monitor peak particle velocity resulting from all blast rounds

fired for the project as required.

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

5. Blast Monitoring Reports:

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

6. Blast Monitoring Instrumentation:

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

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

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

D. *SUBMITTALS*

1. Advance Submittals:

The Contractor shall submit the following information to the Engineer at least three (3) weeks prior to commencing drilling and blasting operations:

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

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

1. Diameter, spacing, burden, depth, and orientation of each blast hole for each round design.

2. Nomenclature and amount (in terms of weight and number cartridges) of explosives and distribution of charge to be used within each hole, on each delay, and the total for the blast.
 3. Nomenclature and type of detonators; delay pattern wiring diagram for the round: type and capacity of firing source, size, type, and location of safety switches and lightning gap.
 4. Type and location of stemming to be used in holes.
 5. Calculations of anticipated vibration levels at nearest adjacent structure.
- C. Methods of matting or covering of the blast area in open excavations to prevent flyrock.
- D. Written evidence of the licensing, experience, and qualifications of the blasters who will be directly responsible for the loading of each shot and for firing it.
- E. Name and qualifications of the Superintendent responsible for directing the blasting. This submittal shall document by project lists and samples of blasting round design calculations that the Contractor and his or her personnel have the required experience in production and control blasting required to adequately and safely perform this work.
- F. Details of an audible advance signal system to be employed at the job site as a means of informing workers, engineer, owner and the general public that a blast is about to occur.
- G. List of instrumentation that the Contractor proposes to use to monitor vibrations.
- H. Recent calibration certificate(s) (within previous six (6) months) for the entire proposed blast monitoring instrumentation. Calibration shall be over the required frequency response ranges specified for blast monitoring instrumentation and to a standard traceable to the National Bureau of Standards.
- I. Submit a shop drawing indicating the location(s), limits, and details of initial test blast(s) proposed by the Contractor to define the relation between charge weight per delay and peak particle velocity level.
3. Progress Submittals:
- A. Within 24 hours following each blast, the Contractor shall submit to the Engineer a Blast Monitoring Report. Each Blast Monitoring Report shall include all of the following applicable items:

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

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

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

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

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

E. JOB CONDITIONS

1. Blasting:

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

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

C. Prior to construction, the Contractor shall have prepared by an independent consultant satisfactory to the Town, a survey of all existing structures and utilities on

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

2. Vibration Control:

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

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

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

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

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

F. *SAFETY PRECAUTIONS*

1. Special Hazards:

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

2. Clearing the Danger Area Before Blasting:

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

cleared and guards shall be stationed to prevent entry until the area has been cleared by the blaster following the blast.

3. Explosives shall be stored, handled, and employed in accordance with federal, state, and local regulations and in accordance with N.F.P.A. No. 495 as referenced above.
4. No explosives, caps, detonators, or fuses shall be stored on the site during non-working hours until a permit has been obtained from the State and Town and submitted to the Engineer.
5. The Contractor shall be responsible for determining any other safety requirements unique to blasting operations on this particular site so as not to endanger life, property, utility services, any existing or new construction, or any property adjacent to the site.
6. Immediately after each blast, the sidewalls of rock excavations shall be scaled by experienced scalers to dislodge loose or shattered rock liable to fall. Previously excavated portions shall also be routinely tested and scaled.
7. No requirement of, or omission to require, any precautions under this contract shall be deemed to limit or impair any responsibility or obligations assumed by the Contractor under or in connection with a project; and the Contractor shall at all times maintain adequate protection to safeguard the public and all persons engaged in the work, and shall take such precautions as will accomplish such end, without undue interference to the public. The Contractor shall be responsible for and pay for any damage to adjacent structures resulting from work executed under this Section.

G. MONITORING PROCEDURE

1. Mount, place, and locate instrumentation as specified in this Section.
2. Align the axis of vibration measurement:
 - Axis 1: Vertical
 - Axis 2: Horizontal, radial direction to the blast location.
 - Axis 3: Horizontal, perpendicular to the radial direction.
3. Set the strip chart(s) speed in accordance with instrumentation manufacturer's recommendations.
4. Make a calibration strip chart before blast detonation in accordance with instrumentation manufacturer's recommendations.

5. Clearly label the strip chart with calibration levels, control settings, location, time, and date of blast.
6. Coordinate closely with the blaster such that the strip chart is advancing at the time the blast is detonated.
7. During the measurement period, observe instrumentation to ensure that recorded vibrations correspond to blasting and not some other source.

2.3 TRENCHING, BACKFILLING, AND COMPACTING

A. GENERAL

DESCRIPTION

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

QUALITY ASSURANCE

1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.
3. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the soil engineer.

B. PRODUCTS

SOIL MATERIALS

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

- b. Fill material is subject to the approval of the soil engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soil free from roots and other deleterious matter.
- c. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill.
- d. Cohesionless material used for backfill: Provide sand free from organic material and other foreign matter, and as approved by the soil engineer.

OTHER MATERIALS

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

C. EXECUTION

SURFACE CONDITIONS

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

PROCEDURES

- 1. Utilities:
 - a. The Contractor shall contact all utilities before excavating to verify the location of any underground lines. The Contractor shall notify "Digsafe" prior to any excavation.
 - b. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, the Contractor shall repair or replace at no additional cost.
 - c. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - d. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility.
 - e. If the existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his or her instructions.
 - f. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

2. Protection of persons and property:
 - a. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
3. Dewatering:
 - a. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.
 - b. Keep trenches and site construction area free from water.
4. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
5. Maintain access to adjacent areas at all times.

TRENCHING

1. Comply with pertinent provisions of this Section.
2. Provide sheeting and shoring necessary for protecting of the Work and for the safety of personnel.
 - a. Prior to backfilling, remove all sheeting.
 - b. Do not permit sheeting to remain in the trenches except when, in the opinion of the Engineer, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, the Engineer may permit portions of sheeting to be cut off and remain in the trench.
3. Open cut:
 - a. Jack or bore for all new pipelines under existing paved Town roads or streets.
 - b. If conditions at the site prevent jacking or boring, and if approved by the Public Works Director, trenching may be used.
 - c. Short sections of a trench may be tunneled if, in the opinion of the Town Engineer, the pipe can be installed safely and backfill can be compacted properly into such tunnel.
 - d. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects as directed by the soil engineer.
 - e. When the void is below the subgrade for the pipe or utility bedding, use suitable earth materials and compact to the relative density directed by the soil engineer, but in no case to a relative density less than 90%.
 - f. When the void is in the side of the pipe or utility trench, use suitable earth or sand compacted or consolidated as approved by the soil

- engineer, but in no case to a relative density less than 80%.
- g. Remove boulders and other interfering objects, and backfill voids left by such removals.
 - h. Excavating for appurtenances:
 1. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 2. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or high slump concrete as directed by the soil engineer.
4. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
 5. Depressions:
 - a. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 - b. Except where rock is encountered, do not excavate below the depth indicated or specified.
 - c. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified.
 6. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
 7. Cover:
 - a. Provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed utility item below the finish grade.
 1. All areas:

(a) Sanitary sewers:	54"
(b) Storm drains:	36"
 2. All areas:

(a) Water lines:	72"
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BACKFILLING

1. General:
 - a. Do not completely backfill trenches until required pressure and leakage tests have been performed, and until the utilities systems as installed conform to the requirements specified in the pertinent Sections of these Specifications.
 - b. Except as otherwise specified or directed for special conditions, backfill

- trenches to the ground surface with selected material approved by the soil engineer.
- c. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the soil engineer.
 - d. Do not allow or cause any of the work performed or installed, to be covered up or enclosed by work of this Section prior to required inspections, tests, and approvals.
 - e. Should any of the Work be so enclosed or covered up before it has been approved, uncover all such Work and, after approvals have been made, refill and compact as specified, all at no additional cost to the Owner.
2. Lower portion of trench:
 - a. Deposit approved backfill and bedding material in layers of 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil, or grade as specified herein, until there is a cover of not less than 24" over sewers and 12" over other utility lines.
 - b. Take special care in backfilling and bedding operations to not damage pipe and pipe coatings.
 3. Remainder of trench:
 - a. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is smaller, in any dimension.
 - b. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the soil engineer.
 4. Adjacent to buildings: Mechanically compact backfill within ten feet of buildings.
 5. Consolidation of backfill by jetting with water may be permitted, when specifically approved by the soil engineer, in areas other than building and pavement areas.

PIPE JACKING OR BORING

1. The Contractor will install steel pipe casings, tongue-and-groove reinforced concrete pipes, and steel pipes under existing roads or pavements by jacking or boring into place using procedures approved by the Town Engineer.

TUNNELLING OPERATIONS

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

FIELD QUALITY CONTROL

1. The Town Engineer will inspect and approve open cuts, trenches, jacking, boring and tunneling before installation of utilities for the following:
 - a. Assure that trenches are not backfilled until all tests have been completed;
 - b. Check backfilling for proper layer thickness and compaction;
 - c. Verify that test results conform to the specified requirements, and that sufficient tests are performed;
 - d. Assure that defective work is removed and properly replaced.

2.4 DRAINAGE GEOTEXTILES

A. DESCRIPTION

This work shall consist of furnishing and placing geotextiles for drainage applications.

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 1.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

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

2. Geotextile Placement: Prior to placement of the geotextile the surface will be prepared to a smooth condition free of debris, depressions, or obstructions which may damage the geotextile. The geotextile shall be placed in the trench, followed by the aggregate which should be placed so as to prevent damage to the geotextile. The geotextile shall be overlapped twelve inches or the full width of the trench, whichever is less, at the top of the trench. Fill material will be placed over the fabric and compacted to hold the fabric in place. Successive pieces of geotextile shall be overlapped a minimum of twelve inches in

the direction of flow. Any damage to the geotextile shall be repaired by placing a patch extending three feet in all directions beyond the damaged area.

TABLE 1
PHYSICAL REQUIREMENTS¹
DRAINAGE GEOTEXTILES²

Property ³	Class A ⁴	Class B ⁵	Test Method
Tensile Strength - lbs.	180	80	ASTM D 4632
Elongation - %	N/A	N/A	ASTM D 4632
Puncture Strength - lbs.	80	25	ASTM D 4833
Burst Strength - lbs.	290	130	ASTM 3786
Trapezoidal Tear	50	25	ASTM D 4533
Apparent Opening Size	70 min.	70 min.	ASTM D 4751
Permittivity, gal/min/ft ²	70	70	ASTM D 4491
Ultraviolet Degradation ⁶ - %	70	70	ASTM D 4355

1. Acceptance of geotextile material shall be determined according to ASTM D 4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe applications. Lots sampled according to ASTM D 4354.
4. Class A Drainage applications are for fabrics where installation stresses are more severe than Class B applications, i.e., very coarse sharp angular aggregate is used, a heavy degree of compaction (95% AASHTO T99) is specified or depth of trench is greater than 10 feet.
5. Class B Drainage applications are those where fabric is used with smooth graded surfaces having no sharp angular projections, no sharp angular aggregate is used; compaction requirements are light, (<95% AASHTO T 99), and trenches are less than 10 feet in depth.
6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM-D-4355 for 150 hrs.

2.5 EROSION CONTROL GEOTEXTILES

A. DESCRIPTION

This work shall consist of furnishing and placing geotextiles for erosion control.

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the physical requirements of Table 2.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

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

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

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

TABLE 2
PHYSICAL REQUIREMENTS¹ - EROSION CONTROL GEOTEXTILES²

<i>Property³</i>	<i>Unprotected⁴</i>	<i>Protected⁵</i>	<i>Test Method</i>
<i>Tensile Strength - lbs.</i>	200	90	<i>ASTM D 4632</i>
<i>Elongation - %</i>	15	15	<i>ASTM D 4632</i>
<i>Puncture Strength - lbs.</i>	80	40	<i>ASTM D 4833</i>
<i>Burst Strength - lbs.</i>	320	140	<i>ASTM 3786</i>
<i>Trapezoidal Tear</i>	50	30	<i>ASTM D 4533</i>
<i>Apparent Opening Size</i>	> #30 Sieve ⁷	> #30 Sieve ⁷	<i>ASTM D 4751</i>
<i>Permittivity, sec⁻¹</i>	.5	.5	<i>ASTM D 4491</i>
<i>Ultraviolet Degradation⁶ - %</i>	70	70	<i>ASTM D 4355</i>
<i>Seam Strength - lbs.</i>	180	80	<i>ASTM D 4632</i>

1. Acceptance of geotextile material is to be determined according to ASTM-D-4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM D 4354.
4. Unprotected Erosion Control applications are those where fabrics are used under conditions where installation stresses are more severe than class B, i.e., stone placement height should be less than 3 feet and stone weights should not exceed 250 pounds.
5. Protected Erosion Control applications are those where fabrics are used in structures or under conditions where the fabric is protected by a sand cushion or by "zero drop height" placement of stone.
6. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM 4355 for 500 hours.
7. Apparent Opening Size
 1. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)
 2. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

2.6 SEPARATION GEOTEXTILES

A. DESCRIPTION

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

B. MATERIALS

The geotextile shall consist of a material composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. The geotextile shall be resistant to chemical attack, rot and mildew, and shall be resistant to chemical attack, rot and mildew, and shall have no tears or defects which adversely alter its physical properties. The fabric shall meet the requirements of Table 5. The choice of a geotextile for this application is determined by the ability of the geotextile to survive installation stresses. These stresses include subgrade strength, wheel loads, and lift thickness as shown in Table 4.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

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

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

3. Fabric Placement: The geotextile shall be unrolled on the subgrade and laid smooth without excessive wrinkles. The geotextile shall not be dragged across the subgrade. The geotextile shall be overlapped or sewn depending upon subgrade conditions as shown in Table 3.

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

Any damage occurring during placement of the aggregate must be repaired immediately.

The backfill shall be removed over the damaged area so as to allow placement of a patch extending three feet on all sides beyond the damaged area, followed by replacement of the fill material.

Table 3
OVERLAP REQUIRED

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

Table 4
CONSTRUCTION SURVIVABILITY RATINGS

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

H = High
M = Medium
NR = Not Recommended

TABLE 5
PHYSICAL REQUIREMENTS¹
SEPARATION GEOTEXTILES²

Property ³	Survivability Medium ⁵	Survivability High ⁵	High Flow/ Groundwater ⁶	Test Method
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Tensile Strength - lbs.	180	270	270	ASTM D 4632
Elongation - %	15	15	15	ASTM D 4632
Puncture Strength - lbs.	70	100	100	ASTM D 4833
Burst Strength - lbs.	400	600	600	ASTM 3786
Trapezoidal Tear	70	100	100	ASTM D 4533
Apparent Opening Size	> #30 Sieve ⁷	> #30 Sieve ⁷	min #40 Sieve	ASTM D 4751
Permittivity, sec ⁻¹	.02	.02	.5	ASTM D 4491
Ultraviolet Degradation ⁴ - %	70	70	70	ASTM D 4355

1. Acceptance of geotextile material is to be determined according to ASTM-D-4873.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll values (i.e., exceed the minimum values in the table). Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM-D-4354.
4. Percent of tensile strength retained (ASTM-D-4632) after conditioning for 500 hours per ASTM 4355.
5. Construction survivability as defined in Table 2.
6. High flow/high groundwater properties refers to those site conditions where groundwater flow through the fabric exceeds that which can be managed with conventional stabilization (separation) fabrics. These conditions are usually evaluated on a qualitative basis, with the condition that the flow rate through the fabric should generally be an order of magnitude greater than that of the soil or base material being filtered.
7. Apparent Opening Size
 1. Soil with 50% or less particles by weight passing US No. 200 Sieve, AOS less than 0.6mm (greater than #30 US Std. Sieve)
 2. Soil with more than 50% particles by weight passing US No. 200 Sieve, AOS less than 0.297mm (greater than #50 US Std. Sieve)

2.7 TEMPORARY SILT FENCE

A. DESCRIPTION

This work consists of furnishing, installing, maintaining, and removing a water permeable filter fence to remove suspended particles from the drainage water.

The quantity of temporary silt fence to be installed will be affected by the actual conditions which occur during the construction of the project. The quality of temporary silt fence may be increased, decreased, or eliminated entirely at the direction of the Town Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

B. MATERIALS

1. Posts: Posts shall be a minimum of 4 feet long and either wood or steel posts may be used. Soft wood posts shall be at least three inches in diameter, or nom. 2" x 4" and straight enough to provide a fence without noticeable misalignment. If oak posts are used the size may be reduced to 1-1/2" x 1-1/2" with a minus tolerance of 1/8" providing the cross sectional area is a minimum of 2.25 sq. in. Steel posts shall be round or U.T. or C shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the wire to the fence.

2. Geotextile Fabric: Fabric shall be composed of a strong rot-proof synthetic fibers formed into a fabric of either the woven or non-woven type. The fabric shall contain stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat.

The edges of the fabric shall be finished to prevent the outer yarn from pulling away from the fabric. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties. The fabric shall have a minimum width of 36 inches. Sheets of fabric may be sewn or bonded together. No deviation from any physical requirements will be permitted due to the presence of the seam.

The fabric may be manufactured with pockets for posts, hems with cord or with posts pre-attached using staples or button head nails.

During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protected covering which will protect the cloth from sunlight, mud, dust, dirt, and debris. The fabric shall not be exposed to temperatures greater than 140 degrees F.

The fabric shall meet the physical requirements of Table 6.

3. Fasteners for Wooden Posts:

- a. Wire Staples will be a No. 17 gage minimum and shall have a crown at least 3/4 inch wide and legs at least 1/2 inch long. Staples shall be evenly spaced with at least 5 per post.
- b. Nails shall be 14 gage minimum, 1 inch long with 3/4 inch button heads. Nails shall be evenly spaced with at least 4 per post.

C. CONSTRUCTION REQUIREMENTS/INSTALLATION

The Contractor shall install temporary silt fence according to this specification, as shown on the plans or as directed by the Engineer.

1. Installation: A trench four to six inches in depth shall be excavated with equipment such as a trenching machine or motor grader; or, if equipment cannot be operated on the site, by hand.

Post installation shall start at the center of the low point (if applicable) with the remaining posts spaced 6 feet apart. Post shall be installed with at least eighteen inches in the ground. Where an 18-inch depth is impossible to achieve, the posts should be adequately secured to prevent overturning of the fence due to sediment loading. Filter fabric shall be attached to the post by wire, cord, pockets, staples, or other acceptable means. The filter fabric shall be installed in such a manner that six to eight inches of fabric is left at the bottom to be buried and a minimum overlap of eighteen inches is provided at all splice joints. The fabric shall be installed in trench such that four to six inches of fabric is against the side of the trench two to four inches of fabric across the bottom in the upstream direction. The trench is then backfilled and compacted so that no flow can pass under the barrier.

At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

2. Maintenance and Removal: The Contractor shall maintain the silt fence until the project is accepted or until the fence is removed, and shall remove and dispose of silt accumulations at the silt fence when so directed by the Town Engineer. Filter fabric shall be removed and replaced whenever it has deteriorated to such extent that it reduces the effectiveness of the silt fence.

Silt fence shall remain in place unless the Town Engineer directs that it be removed. Silt fence which has been removed will remain the property of the Contractor and may be used at other locations provided it is in a condition acceptable to the Town Engineer. Upon removal of silt fence, the Contractor shall dress the area to give a pleasing appearance.

TABLE 6

PHYSICAL REQUIREMENTS¹TEMPORARY SILT FENCE GEOTEXTILES²

Property ³	Standard Fence Requirements	High Performance Requirements ⁵	Test Method
Tensile Strength - lbs.	90	Warp 190 Fill 100	ASTM D 4632
Elongation - %	40 max.	40 max.	ASTM D 4632
Permittivity - gal/min/ft ²	15	15	ASTM D 4491
Apparent Opening Size	> #20 Sieve	> #30 Sieve	ASTM D 4751
Ultraviolet Degradation ⁴ - %	70	70	ASTM D 4355

1. Acceptance of geotextile material to be determined according to ASTM D 4759.
2. Contracting agency may require a letter from the manufacturer certifying that its geotextile meets specification requirements.
3. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll value (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table) - Stated values are for non-critical, non-severe conditions. Lot sampled according to ASTM D 4354.
4. Percent of minimum tensile strength (ASTM-D-4632) retained after weathering per ASTM 4355 for 500 hours.
5. High performance geotextile should be used on projects requiring high flow rates through fabric or requiring higher strength for sediment retention. Physical requirements for high performance fence are Georgia Department of Transportation requirements with exception of Permittivity. Georgia DOT requirement is 25 gallons/min/ft sq. In addition the geotextile must have tape yarns in one principle direction only.

2.8 UNDERDRAINS:

A. DESCRIPTION

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 Engineer.

B. MATERIALS

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

Perforated Corrugated Steel Pipe: Pipe shall conform to AASHTO M36. Minimum sheet metal thickness required is 0.052 inches for six inch diameter underdrain and 0.064 inches for eight inch diameter or larger. For pipe sizes 4", 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

Perforated Corrugated Aluminum Alloy Pipe: Pipe shall conform to AASHTO M196. For pipe sizes 4", 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

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

Drainage Fabric: The fabric shall meet the requirement of Section 2.4 - Drainage Geotextiles.

C. CONSTRUCTION METHODS

Trenches for underdrain shall be excavated to the dimensions and grade shown on the plans or as ordered by the Town Engineer. 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 Town Engineer.

Underdrain shall be placed in the center of the trench and firmly embedded in the

material. The underdrain trench shall be backfilled to the gravel road base with three-fourths inch to one and one-half inch (3/4" to 1 1/2") clean stone. Placing shall begin at the outlet end and shall proceed toward the upper end. The under-drain shall be placed with perforations down unless otherwise ordered by the Town Engineer.

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

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

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

Drainage fabric shall be placed in the trench around the stone fill with a twelve inch (12") fabric overlap at the top (see underdrain detail).

2.9 SAND:

A. DESCRIPTION

This item shall consist of a sub-base course of sand as approved by the Engineer and constructed on a prepared subgrade in accordance with the sections as shown on the accepted drawings.

B. MATERIALS

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

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

2.10 GRAVEL BASE - BOTTOM COURSE:

A. DESCRIPTION

This item shall consist of a sub-base course composed of bank run gravel and filler as approved by the Engineer and constructed on a prepared subgrade in accordance with the sections as shown on the accepted drawings.

B. MATERIALS

All materials shall be secured from approved sources. Such gravel shall consist of hard, durable stones, which show uniform resistance to abrasion and which are intermixed with sand or other approved binding material as directed by the Engineer. It shall meet the requirements of Vermont Standard Specification for Construction, #704.04, Gravel for Sub-base, or as periodically amended. The gravel shall be uniformly graded from coarse to fine and shall meet the grading requirements set forth in this table:

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
#4	20 - 60
#100	0 - 12
#200	0 - 6

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

C. PREPARATION OF GRADE

The sub-base material shall be placed on a prepared surface with an approved spreader box or by use of some other approved mechanical spreading equipment. The material shall be deposited so as to meet the requirements of the Vermont Standard Specifications for Construction, Section 301, or as periodically amended, and compacted to a 95 percent dry density by the AASHTO- T-99 Method A (Standard Proctor) test. Where there is high groundwater or frost susceptible soils, sub-base fabric and underdrains shall be installed beneath the roadway as required on the street details found in Appendix I of these specifications.

2.11 GRAVEL BASE - TOP COURSE:**A. DESCRIPTION**

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

B. MATERIALS

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

Sieve Designation	Percentage By Weight Passing Square Mesh Sieve
2"	100
1 ½"	90 - 100
#4	30 - 60
#100	0 - 12
#200	0 - 6

This upper course of crushed gravel shall be deposited and spread in a uniform layer

and compacted to a 95 percent dry density by the AASHTO-T-99 Method A (Standard Proctor) test.

2.12 BITUMINOUS CONCRETE (ASPHALT) PAVEMENT

A. GENERAL

SUMMARY

1. The work of this section consists of furnishing all labor, materials, tools and equipment necessary to construct all temporary and permanent bituminous bases and surfaces to the dimensions and in the areas shown on the Drawings. The Contractor shall maintain all temporary surfaces to the satisfaction of the Engineer until the permanent surface is constructed.
2. Roadway, drives and parking area subgrade excavation, embankment and fill shall be in accordance with the appropriate portions of the Earthwork Section of these Specifications.

REFERENCE STANDARDS

1. Reference is made in this section to the following standard specifications:
 - a. VAOT Spec. - "Standard Specifications for Highway and Bridge Construction", Department of Highways of the State of Vermont, as adopted March, 1976.
 - b. ASTM - "Standard Specifications for Materials and Testing of the American Society of Testing Materials."

WEATHER LIMITATIONS ON PAVING OPERATIONS

1. Bituminous material shall not be applied between November 1 and May 1. The courses shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is below 40° F. Placing shall not begin until the air temperature is at least 40° F. and rising. The Engineer may authorize in writing construction of bituminous concrete pavements at lower atmospheric temperatures than those specified or may extend the dates of the paving season. No pavement shall be laid in the rain and the underlying course shall be dry during paving operations.
2. Each load shall be covered with canvas or other suitable material of ample size to protect it from the weather. Deliveries shall be made so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight. The mixture shall be delivered to the area to be paved in such a manner that the temperature at the time of dumping into the spreader will not be less than that specified. Hauling over freshly laid material will not be

permitted.

SUBMITTALS

1. Contractor shall submit bituminous concrete mix formula for approval prior to commencing paving. The mix formula shall include the temperature range at which the hot-mix shall be laid to obtain the optimum compaction.

B. PRODUCTS

MATERIALS

1. Aggregate for Base and Surface Courses
 - a. Aggregate for base and surface courses shall consist of clean, hard, durable particles of crushed stone, gravel, sand and fine mineral particles conforming to "VAOT" Spec. Section 704 as follows:
 1. Base course - Section 704.06, Table 704.06A - Dense Graded Crushed Stone for Subbase.
 2. Surface Course - Section 704.07, Table 704.07A - Crushed Gravel for Sub-Base.

AGGREGATES FOR BITUMINOUS CONCRETE PAVEMENT

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

ASPHALT CEMENT FOR BITUMINOUS CONCRETE PAVEMENT

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

EMULSIFIED ASPHALT

1. Emulsified asphalt shall be used as specified herein or on the Drawings or as directed by the Engineer and shall conform to Standard Specifications for

Emulsified Asphalt, ASTM D977-69.

BITUMINOUS CONCRETE

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

PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVE				
Sieve Size	Type I	Type II	Type III	Type IV
1½"	100			
1"	95-100	100		
¾"	74-86	95-100	100	
½"	60-80	76-88	95-100	100
"	-	62-82	78-90	95-100
#4	35-60	44-62	54-75	62-80
#8	25-45	30-48	39-60	39-60
#16	-	20-38	24-45	24-45
#30	10-25	13-30	14-35	14-35
#50	-	6-22	6-24	6-24
#200	2-6	2-6	2-6	2-6
Total Agg.	94-97	93-97	92-97	92-95
Bitumen (% of Total Mix)	3-6	3-7	3-8	5-8

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

PAVEMENT MARKINGS

1. The Contractor shall thoroughly clean the areas upon which durable markings will be placed.
2. All durable markings shall be accurately placed as indicated on the Drawings.
3. The Contractor shall apply durable markings in accordance with the manufacturer's recommendations and referenced standards, using all means necessary to protect durable markings until cured.

C. WORK

BASE AND SURFACE COURSES (GRAVEL BASE)

1. Before any sub-base course material is laid, the subgrade shall be prepared in a proper manner. All embankments shall be constructed as specified in the Earthwork Section of these Specifications and in all cases the top 6 inch layer of subgrade material shall be compacted in such a manner as to secure not less than 95% of the maximum density as determined by the Standard Method of Test for the Moisture-Density Relationship of Soils, AASHTO T-99 Method of Test.
2. All materials used for the construction of the subgrade, subbase and surface shall be unfrozen and free from organic or other deleterious matter. No subgrade base or surface construction shall take place at temperatures below 40° F unless otherwise approved by the Engineer.
3. Mineral aggregate subbase and surface courses shall be placed in layers not to exceed 8 inches loose depth and 6 inches compacted depth. Materials for each layer shall be distributed from moving dump trucks, spreader boxes of self propelled spreaders. Material may also be spread by depositing it in one of two windrows and then spreading it with a blade grader.
4. After each layer is placed it shall be compacted with an approved roller weighing not less than 8 tons, or a rubber tired roller approved by the Engineer. Rolling of each layer shall be continued until a firm, solid and unyielding base is established before the next layer is begun. During compaction, the surface shall be graded to obtain a true even surface. Compaction to be the same as described in Paragraph 3.1A.

PLACING BITUMINOUS CONCRETE PAVEMENT

1. Placing Equipment
 - a. The bituminous concrete paver shall be a self-propelled unit with an

- activated screed or strike-off assembly, the mixture without segregation for the widths and thicknesses required.
- b. The screed shall be adjustable to provide the desired cross-sectional shape.
 - c. The finished surface shall be of uniform texture and evenness and shall not show tearing, shoving, or pulling of the mixture.
 - d. The machine shall, at all times, be in good mechanical condition and shall be operated by competent personnel.
2. Surface Preparation
- a. Prior to laying the surface course, the underlying course shall be cleaned of all foreign or objectionable matter.
 - b. If the bottom course of bituminous concrete pavement is left over 30 days, the existing surface shall be cleaned. All longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the finish coat. Any large cracks in a bituminous surface shall be thoroughly cleaned and filled with a bituminous material or mixture approved by the Engineer. Emulsified asphalt shall then be applied to the existing pavement in a manner approved by the Engineer.
 - c. Contact surfaces such as curbing, gutters and manholes shall be painted with a thin, uniform coat of Emulsified Asphalt, immediately before the bituminous concrete mixture is placed against them.
 - d. If there are deficiencies in the base course that require corrective action, a bituminous concrete mix which meets the approval of the Engineer shall be used to bring the base course to the designed grade and contour.
3. Delivery
- a. The range of acceptable temperatures of mixture delivered to the spreader shall be not less than 225° F. nor more than 325° F. Material not within this temperature range shall be rejected.
4. Placing and Finishing
- a. The mechanical spreader shall be adjusted and speed regulated so that the surface of the course will be smooth and of such depth that, when compacted, it will conform to the cross section, grade, and contour shown on the Drawings.
 - b. Unless otherwise directed, the placing shall begin along the center line of areas to be paved on a crowned section and on the high side of section with a one-way slope.
 - c. The mixture shall be placed in strips having a minimum width of 10 feet, and the 6-inch strip adjacent to the area on which additional material is to be laid shall not be rolled until such additional material is placed, except when the work is to be discontinued.
 - d. After the first strips have been placed and rolled, the second strips and

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

- e. Placing of the mixture shall be as continuous as possible.
- f. A sufficient number of experienced shovelers and rakers shall follow the spreading machine, adding hot mixture and raking the mixture as required to produce a course that, when completed, will conform to all requirements specified. In areas where the use of machine spreading is impractical, the mixture may be spread by hand.
- g. The mixture shall be dumped on approved dump boards outside the area to be paved. The mixture shall be distributed into place from the dump boards by means of hot shovels and then spread with hot rakes in a uniformly loose layer of such thickness. The loads shall not be dumped any faster than they can properly be handled by the shovelers and rakers.

COMPACTION OF BITUMINOUS CONCRETE PAVEMENT

1. Compaction shall be done by three wheel rollers or tandem rollers having a gross weight of not less than 8 tons and capable of providing a minimum compactive effect of 250 pounds per inch of width of drive roller. The rollers shall also be equipped with tanks and sprinkler bars for wetting the rollers.
2. Rolling of the bituminous concrete pavement shall begin as soon after placing as the mixture will bear the roller without undue displacement.
3. Rolling will start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, over-lapping successive trips by at least 1/2 the width of the rear wheel of the roller. Alternate trips of the roller shall be of slightly different lengths. The initial longitudinal rolling shall be effected by the use of 3 wheel rollers. Tests for conformity with the specified crown, grade and smoothness shall be made by the Contractor under the supervision of the Engineer immediately after initial compression. Before continuing the rolling, any variations shall be corrected by removing or adding materials as directed. The course shall also be subjected to diagonal rolling using the tandem rollers crossing the lines of the first rolling while the mixture is hot and in a compatible condition. The speed of the rollers shall not exceed 3 miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture. Any displacement of the mixture occurring as the result of reversing the direction of the roller, or from any other cause shall be corrected at once by the use of rakes and fresh mixture applies of mixture removed as required. Rolling shall be continued until all roller marks are eliminated and a density of at least 93 percent of the density of a laboratory specimen of the same mixture, subjected to 50 blows of a standard Marshall hammer, has been obtained for both

courses.

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

JOINTS IN PAVEMENT

1. Joints between old and new pavements or between successive day's work shall be made so as to insure a thorough and continuous bond between the old and the new pavement. Whenever the spreading process is interrupted long enough for the mixture to attain its initial stability, the paver shall be removed and a joint constructed.
2. Butt joints shall be formed by rutting the pavement in a vertical plane at right angles to the centerline, at a location approved by the Engineer. The butt joint shall be thoroughly coated with Emulsified Asphalt just prior to depositing the paving mixture.
3. Longitudinal joints that have become cold shall be coated with Emulsified Asphalt before the adjacent mat is placed. If they have been exposed to traffic, they shall be cut back to a clean vertical edge prior to painting with the emulsion.

PAVEMENT SURFACE TOLERANCES

1. The surface will be tested by the 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 shall be provided by the Contractor.

EXISTING PAVING

1. Where new paving adjoins existing roads, extend new paving over existing and level paving to a smooth, hard surface. Installation shall be in full conformity with the local and/or State of Vermont Highway Department requirements.

MARKER PAINTING

1. General - Plain solid lines where indicated on the Drawings in the manner hereinafter specified. Paint lines immediately after all aspects of the paving operations have been completed and before dirt or moisture can accumulate on pavement surfaces.
2. Protection - Install adequate barricades at, points where trespassing may occur, immediately after paving is completed so as to prevent vehicles or pedestrians from impeding the painting operation.
3. Method
 - a. Carefully layout and define all painted lines on the surface of the pavement, by means of chalk markings, before painting, and accurately paint all lines within the limits and to the dimensions indicated on the Drawings. All surfaces must be thoroughly cleaned before lines are painted.
 - b. All lines shall be clear and distinct with sharply defined edges. Apply two coats of paint. At least 24 hours shall elapse between the painting of the first and second coats.
4. Removal of Equipment - Upon completion of the painting operation and once the paint has dried, remove all barricades and other debris which has resulted from this operation.

CLEANING

1. Remove all bitumen from exposed surfaces of concrete curbs.
2. Remove all excess bituminous material from the project site.

2.13 CEMENT CONCRETE CURB:

A. DESCRIPTION

This item shall consist of a Portland cement concrete curb constructed on a prepared subgrade in accordance with these specifications and the cross-section shown on the drawings.

B. MATERIALS

All concrete used in the construction of roadway curbs shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 4,000 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for

Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

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

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

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

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

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

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

Curing the concrete: When completed, the concrete shall be kept moist for a period of not less than three days or longer if the Engineer deems necessary and shall be protected from the elements in an approved manner. If the Contractor elects, he or she may apply an approved curing compound according to directions of the manufacturer.

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

Anti-Spalling Compound: When the initial curing period is over (approximately 28 days after placement), all exposed surfaces shall receive two coats of anti-spalling compound. The surfaces shall be cleaned and then the compound shall be applied; the first coat at a

rate of 0.025 gallons per square yard, the second at a rate of 0.015 gallons per square yard. Anti-spalling compound shall only be applied when the air temperature is above 50 degrees Fahrenheit.

Curb cuts: Each house or business shall be allowed one curb cut unless otherwise approved by the Director of Public Works. Curb cuts within existing curbs shall be performed in accordance with these specifications as well as the requirements within the Middlebury highway ordinances.

2.14 CEMENT CONCRETE SIDEWALK:

A. DESCRIPTION

This item shall consist of sidewalk made of one course Portland cement concrete not less than five inches (5") thick and with a width of not less than five feet (5'). Where the sidewalk crosses a driveway, the depth of concrete shall not be less than seven inches (7") for residential driveways and eight inches (8") for commercial and industrial driveways for the full width of the driveway. The sidewalk shall be constructed in accordance with these specifications and the cross-sections shown on the accepted drawings.

B. MATERIALS

All concrete used in the construction of cement concrete sidewalks shall be Air Entrained not less than five percent nor more than seven percent so determined by an air meter approved by the Engineer. This concrete shall have a 28-day compressive strength of 4,000 psi and shall meet Section 501 of the State of Vermont Standard Specifications for Construction for Class B concrete or as periodically amended.

C. CONSTRUCTION METHODS

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

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

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

until the concrete has set.

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

Expansion joints and scoring concrete: Half inch (1/2") transverse expansion joints shall be placed at intervals not exceeding twenty feet (20'). Sidewalks shall be scored to a depth of one inch (1") every five feet (5').

Curing concrete: Same as for Cement Concrete Curb.

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

Anti-Spalling Compound: When the initial curing period is over (approximately 28 days after placement), all exposed surfaces shall receive two coats of anti-spalling compound. The surfaces shall be cleaned and then the compound shall be applied; the first coat at a rate of 0.025 gallons per square yard, the second at a rate of 0.015 gallons per square yard. Anti-spalling compound shall only be applied when the air temperature is above 50 degrees Fahrenheit.

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

2.15 CEMENT CONCRETE DRIVEWAY APRONS:

A. DESCRIPTION

This item shall consist of a Portland cement concrete drive-way apron not less than six inches (6") thick or as indicated on the plans to be constructed on a prepared subgrade in accordance with these specifications and as shown on the accepted drawings.

B. MATERIALS

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

C. CONSTRUCTION METHODS

Preparation for subgrade: Same as for Cement Concrete Sidewalk.

Forms for concrete: Same as for Cement Concrete Curb.

Placing and finishing concrete: Same as for Cement Concrete Sidewalk.

Expansion joints: Half inch (1/2") transverse expansion joints shall be placed where the driveway apron and driveway joins the sidewalk and curb or pavement.

Curb: Curbs shall be constructed so as to protrude one and one-half inches (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.

Curing concrete: Same as for Cement Concrete Curb.

Seasonal limits: Same as for Cement Concrete Curb.

2.16 **BITUMINOUS CONCRETE DRIVEWAY APRONS:**

A. DESCRIPTION

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 courses on the prepared or existing base in the same courses and thicknesses as the road cross-section in accordance with these specifications and in conformity with the lines, grades, thickness and type of pavement.

B. MATERIALS

The course aggregate shall consist of clean, hard crushed rock or screened 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 Sections 702 and 704.10 of the Vermont Standard Specifications for Construction, or as periodically amended.

C. CONSTRUCTION METHODS

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 Town Engineer before being used.

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

WEATHER LIMITATIONS: Bituminous material shall not be placed between November 1 and May 1. Material shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is 40 degrees Fahrenheit or below.

CONDITIONING: Prior to placing the bituminous material, the existing surface shall be cleaned then sprayed with a coat of Emulsified Asphalt, RS-1.

COMPACTION: Immediately after the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. 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 mechanical tampers. On depressed areas, a trench roller may be used; or cleated compression strips may be used under the roller to transmit compression to the depressed area.

SURFACE TOLERANCES: The surface will be tested by the Engineer using a 16 foot straight-edge at selected locations parallel with the centerline. Any variations exceeding three-sixteenths of an inch (3/16") between any two contacts shall be satisfactorily eliminated. A 10-foot straight-edge may be used on a vertical curve. Straight-edges shall be provided by the Contractor.

2.17 STREET GUARD RAIL OR BARRIER:

This item shall consist of the construction of twelve gauge standard steel

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

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

2.18 STREET SIDELINE MONUMENTS:

A. DESCRIPTION

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

B. MATERIALS

Reinforced concrete monuments shall be those as manufactured by S.T. Griswold, or equivalent, and shall be 4"x 4"x 36". The top shall have a marked center which shall be the point of reference.

C. CONSTRUCTION METHODS

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

2.19 PLANTING OF TREES:

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

Such trees shall be preferably of a type indigenous to the neighborhood. Such trees shall be planted in fertile or fertilized ground and shall be watered and nurtured after planting until growth is assured.

Trees shall have a minimum diameter of trunk at a point four feet (4') above ground level of at least two inches (2"). They shall be planted at intervals of no more than sixty

feet (60') on both sides of the street. Such trees shall be clear of any branches from a point of ground level to a point six feet (6') above ground level. All new trees shall be planted outside of the street right-of-way and utility, drainage, or other public easements.

2.20 STREET SIGNS, MARKINGS, SIGNALS AND GEOMETRIC IMPROVEMENTS:

A. DESCRIPTION

This item shall consist of street name signs, traffic signs, pavement markings and traffic signals constructed in accordance with these specifications and as shown on the accepted drawings. The Developer is responsible for the design and installation of the street improvements, signs, markings and signals that are warranted.

Driveways, streets and intersections shall be designed and constructed to meet the latest standards of the State of Vermont Agency of Transportation (VAOT), the American Association of State Highway and Transportation Officials (AASHTO), the Manual on Uniform Traffic Control Devices (MUTCD), and the Institute of Transportation Engineers (ITE).

Geometric improvements for new or existing streets and intersections shall be constructed by the Developer in accordance with the latest VAOT, AASHTO, MUTCD and ITE specifications if the improvements are warranted in accordance with the following methods;

1. Right and/or left turn lanes shall be constructed if warranted in accordance with the latest methodology used by the VAOT.
2. Traffic signals shall be installed if warranted in accordance with the methodology found in the latest edition of the MUTCD.
3. New project intersections or affected adjacent existing intersections shall be constructed or reconstructed by the Developer to maintain the following level of service (LOS):
 - a. Signalized intersections will be improved to maintain an over all minimum level of service D, and to maintain a minimum level of service E on any turning movement.
 - b. Unsignalized intersections will be improved to maintain a minimum level of service C for the major road, and a minimum level of service E for the minor road.

B. MATERIALS AND METHODS

The signs, posts, markings and signals shall conform to sections 646, 675, 677 and

678 of the Vermont Standard Specifications for construction, as required in these Specifications and as required by the Town Engineer.

2.21 STREET LIGHTING:

Streets and roadways shall be illuminated by standard down-shielded street lights, approved by the Municipality, a maximum of four hundred feet (400') apart and at all street intersections. The street lights will be installed on the sidewalk side of the street. Poles, brackets, and lights for street lighting are to be approved as to size, type, and location by the Town. They shall be complete and fully energized prior to acceptance of the street by the Town.

2.22 LANDSCAPING:

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage.

All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched in accordance with the following:

1. Seed mixture in lawn areas around dwellings and within street limits shall be urban mix conforming to the adjacent Table. For seeding between September 1 and October 1, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

URBAN MIX GRASS SEED		
% BY WEIGHT	LBS. LIVE SEED PER ACRE	TYPE OF SEED
37.5	45	CREeping RED FESCUE
37.25	37.5	KENTUCKY BLUEGRASS
31.25	37.5	WINTER HARDY, PERENNIAL RYE
100	120 # LIVE SEED PER ACRE	

2. Seed mixture in all other disturbed areas shall be conservation mix conforming to the adjacent Table. For seeding between September 1 and October 1, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

CONSERVATION MIX GRASS SEED		
% BY WEIGHT	LBS. LIVE SEED PER ACRE	TYPE OF SEED
35	35	CREeping RED FESCUE
23	23	KENTUCKY BLUEGRASS
15	15	ANNUAL RYE
11	11	WINTER HARDY, PERENNIAL RYE (VARIETY PENNFINE, MANHATTAN OR SIMILAR VARIETY)
6	6	WHITE CLOVER
10	10	HIGHLAND BENTGRASS
100	100# LIVE SEED / ACRE	

2.23 STUMP DISPOSAL:

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

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

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

STORM DRAINAGE SYSTEM**3.0 GENERAL:**

This item shall consist of catch basins, manholes, and pipe meeting the specifications for the diameter of pipe required and installed as indicated on the drawings. The Developer's Engineer shall submit the stormwater collection and detention system calculations to the Town Engineer for review and approval.

3.1 MATERIALS:**A. *TYPES OF PIPE***

Types of pipe which may be used for storm drain lines are Reinforced Concrete Pipe (RC), Corrugated Polyethylene Pipe (PE), Polyvinyl Chloride Pipe (PVC), or an approved equal. Types of pipe which may be used for culverts are Reinforced Concrete Pipe (RCP), Corrugated Polyethylene Pipe (PE), or an approved equal.

B. *REINFORCED CONCRETE PIPE*

Pipe shall conform to the Vermont Standard Specifications for Construction, Section 710, and AASHTO, M170.

C. *POLYVINYL CHLORIDE PIPE*

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

D. *CORRUGATED POLYETHYLENE PIPE*

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

E. *MANHOLES*

Where indicated on the plans, the Contractor shall furnish and install manholes which meet the requirements of the sanitary sewer manholes of these specifications. Frame and covers shall be Neenah R-1642-A with self-sealing O-Ring gasket, concealed pick hole, and shall say DRAIN on the cover.

G. CATCH BASINS

Catch basins shall be constructed of reinforced concrete and shall be provided with cast iron frames and grates. Frames and grates shall be Neenah R-3405-A, R-3210-L (for grades exceeding 5%), or an approved equal.

Precast risers and base sections shall conform to the Vermont Standard Specifications for Construction, Section 604, or as periodically amended. Frames shall be brought to grade with not more than two adjusting rings and not more than 12 inches total thickness. Risers shall be sealed with soft Butyl joint sealer (rope form).

Precast risers and bases for manholes shall conform to ASTM Specifications C-361. The pipe opening in the precast manhole riser shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Engineer. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

The frames shall be set to final grade only after the curbs have been completed.

3.2 CONSTRUCTION METHODS:

A. LAYING PIPE

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

Metal pipe and CPP shall be firmly joined with coupling bands, concrete pipe joints shall be a rubber-gasket type, and PVC pipe shall be joined with standard push-on type using elastomeric gaskets.

Storm drains and culverts with water flow velocities greater than 12 feet per second shall require special design that must be approved by the Engineer. Storm drains and culverts shall have minimum velocities of 2 feet per second.

B. BACKFILLING

All material for backfilling shall be free of roots, stumps, and frost. Backfill for all pipelines shall be placed in six-inch (6") layers, each layer being thoroughly compacted to not less than 95 percent of maximum dry density as determined by the ASTM D698 Standard Proctor by a means approved by the Town Engineer.

C. PIPE BEDDING

Reinforced concrete pipe shall be bedded from the trench bottom to the centerline of the pipe to a height of one foot (1') above the top of the pipe with material excavated from the trench having no stones larger than one and a half inches (1½") in the longest dimension. Should no excavated material be suitable, sand or gravel shall be used.

PVC and CPP pipe shall be bedded with crushed stone and then backfilled with material excavated from the trench having no stones larger than one and a half inches (1½") in the longest dimension. Sand or gravel shall be used if no excavated material is suitable.

D. HEADWALLS/FLARED END SECTIONS

The use of Flared-end pipe sections are preferred to Headwalls. However, the Contractor shall construct pipe headwalls at the outfall end of all storm lines as ordered by the Town Engineer. Headwalls shall be either specifically designed polymeric-coated corrugated galvanized metal end sections, concrete, or rubble masonry construction.

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

E. DETENTION BASINS

If necessary storm water detention swales, drains, or basins will be constructed down gradient of all new developments to detain and store the storm runoff volumes equal to or less than pre-development quantities for a minimum ten-year, twenty-four hour storm event.

WATER DISTRIBUTION SYSTEM**4.0 WATER DISTRIBUTION SPECIFICATIONS****4.1 GENERAL:**

All development shall include provisions for the construction of water distribution facilities complete with valves, fire hydrants and other appurtenances designed in accordance with this CHAPTER. As a minimum, the water distribution shall provide a service connection(s) near the front property line of each individual lot or parcel within the development. Curb valves shall be located 10 feet right of centerline of front property line. Where more than one building is located or planned on one lot or parcel of property, for fire protection, the proposed construction shall also include all water main construction and appurtenances within the lot or parcel except service lines. No more than 4 valves shall be required to turn off any section of water main. No more than 20 services shall be affected by any turn-off. Main valves shall be located in the parkway(grass) and the maximum distance between valves shall be 1000feet unless exempted by the Town.

Specification references made herein for manufactured materials, such as pipe, hydrants, valves and fittings refer to designations of the American Society for Testing and Materials (ASTM), the American Water Works Association (AWWA), or of the American National Standards Institute (ANSI).

This item shall consist of the labor, equipment, and material required for the complete construction of the water mains and services, which shall include excavation, backfilling, pipe, valves, tees, hydrants, elbows, reducers, and all other appurtenances necessary for a complete water main system as indicated on the accepted drawings. All material and installation shall be approved by the Town.

4.2 WATER PIPE MATERIALS:**WATER MAINS**

1. All water main shall be Push-on Joint Class 52 Ductile Iron Water Pipe, meeting reference standards and the following requirements, as applicable:
 - a) Pipe and fittings shall be cement mortar lined and seal coated.
 - b) Pipe and fittings shall be coated with bituminous coating.

- c) Pipe joints shall be push-on bell and spigot type with rubber gaskets.
 - d) Pipe shall be furnished in 18-20 foot laying lengths.
 - e) Pipe shall be furnished with two bronze conductivity wedges per joint.
 - f) Pipe shall be manufactured by Atlantic States Pipe Company, Clow, U.S. Pipe, Griffin or McWane Pipe Company.
2. Each pipe length shall be clearly marked with the manufacturer's name or trademark, nominal pipe size, material designation, pressure class and AWWA/ASTM designations.
 3. Water mains shall be a minimum diameter of eight inches (8"). High capacity Building Services shall be a minimum of four inch (4") diameter.
 4. Pipe encasement tubing shall be 8-mil linear low density polyethylene "Polywrap" for ductile iron pipe, as manufactured by Trumbull Manufacturing, or approved equal.
 5. Encasement tubing tape shall be 10-mil, 2-inch width black polyethylene tape as manufactured by Trumbull Manufacturing, or approved equal.

4.3 FITTINGS:

1. Ductile Iron Fittings shall conform to AWWA C110 and be Class 350 compact style with mechanical joints with ductile iron tee bolts as recommended by the manufacturer.
Ductile iron fittings larger than twelve inches (12") shall have a standard body length equal to Class 250 cast iron fittings. Cast iron Class 250 fittings will be allowed in lieu of ductile iron fittings in sizes larger than twelve inches (12").
2. All mechanical joint fittings shall have "Mega-Lug" mechanical joint restraints as manufactured by EBAA Iron Sales Inc., or Uni-Flange Mechanical Joint Restraints.
3. Couplings for joining pipes of different diameters and/or materials shall have ductile iron coupling body and ductile iron end rings. Coupling body and end rings shall have shop coat finish on all surfaces. Couplings shall be of appropriate style and size for the pipes being connected.

4.4 VALVES:

- (a) All valves installed in valve vaults, shall be epoxy coated, resilient wedge type, with non-rising stem by Mueller model "2360 series", Kennedy model Ken-Seal II, or approved equal with restrained mechanical joints.
- (b) Valves shall be bubble tight, zero leakage at a minimum working pressure of 200psi.
- (c) All valves shall be counter-clockwise (left) open with a two-inch square

- operating nut. Opening direction arrow shall be cast into the valve body.
- (d) Fire hydrant auxiliary valves shall be equipped with a Tyler sliding-type adjustable, flanged, 5-15 inch cast iron valve box with a flush cover marked "WATER". The box shall enclose the valve operating nut and stuffing box. Box length shall be adequate to allow a minimum of four inches of overlap of box sections with the top extended to final grade. Boxes shall not transfer traffic load to the valve. Valve box stabilizer shall be used to keep the valve centered in the box.
 - (e) Twelve inch and smaller – Epoxy coated, resilient wedge type with non-rising stem gate valves, counter-clockwise to open, AWWA C-509.
 - (f) Fourteen inch and larger – Epoxy coated iron body, rubber seat, butterfly valve, counter-clockwise to open, AWWA C-504.
 - (g) Regardless of any named manufacturer, all water main valves shall be "No-Lead". "No-Lead" shall mean that the gate valve shall have a weighted average lead content of less than 0.25%. In addition, all gate valves shall be in compliance with Vermont's Lead in Consumer Products Law "No-Lead" provision of Act 193.

4.5 VALVE VAULTS:

- (a) Valves shall be installed in vaults, 4000psi, steel reinforced, H-20 Rated Pre-cast manhole as manufactured by S.D. Ireland or approved equal. Vaults shall be 4' minimum inside diameter unless otherwise required. Lockjoint cast-in place flexible connector with stainless steel clamp shall seal the pipe penetration through the manhole.
- (b) Frame and cover- Neenah R-1642-A with self-sealing O-Ring cover and concealed pick holes, or approved equal. Cover shall read "WATER".
- (c) A maximum of 2 – 3" Infra-Riser rings as manufactured by East Jordan Iron Works shall be used and installed per the manufacturers instructions
- (d) Steps shall be M.A. Industries Copolymer Polypropylene Plastic
- (e) When valves cannot be centered within an opening or multiple valves are located within the vault, the contractor shall core the concrete top directly above the valve operator and install a cast iron valve box and cover flush with grade. A Cor-N-Seal shall be used to make a water tight fitting.

4.6 FIRE HYDRANTS:

- (a) Mueller Super Centurian 250, AWWA C502. Hydrant shall be primed with Glidden white primer and painted with Glidden Safety Yellow.

- (b) Valve, 5-1/4 inches, counter-clockwise to open.
- (c) Nozzles: Two at 2-1/2 inch, one at 4-1/2 inch with threads conforming to National Standard Specifications.
- (d) Breakaway type with the break line flanges located one inch above finished grade.
- (e) Hydrant assemblies shall consist of a hydrant tee, six (6) inch mechanical joint gate valve, valve box and Class 52 pipe.
- (f) All hydrants shall be minimum 4'-6' from the edge of pavement.
- (g) Auxiliary Valve shall be same manufacturer as hydrant. Boxes shall be Tyler, cast iron, 5-1/4' shaft. Lid embossed "WATER". Stabilizer for box shall be used.
- (h) Drains shall be sealed unless directed by the Town.

4.7 HYDRANT BRANCHES:

Hydrant assemblies shall consist of a six inch (6") mechanical joint gate valve conforming to AWWA C509; a four foot (4') length of six inch (6") ductile iron cement-lined, Class 52, pipe; and the fire hydrant. Longer pipe lengths may be permitted.

The hydrant shall have at least twelve inches (15") between the bottom of the steamer cap and the ground and not more than 21". There shall be at least one hydrant at each street intersection and a maximum of 500 feet (500') between hydrants. Rural and industrial areas will be given special consideration. Hydrant locations shall be approved by the Fire Chief.

4.8 TAPPING SLEEVES:

A. FOR EXISTING ASBESTOS CEMENT OR GRAY CAST IRON PIPE

Tapping sleeves shall be of the split sleeve design constructed with two solid half-sleeves bolted together. Sleeves shall be constructed of cast iron and shall have a working pressure of 150 psi. Cast iron sleeves shall have mechanical joint ends with side gasket seals. All bolts used with all pipe sleeves shall, upon final tightening and testing, be brush-coated heavily with bitumastic cold-applied material to thoroughly cover all exposed surfaces of the bolts and nuts.

B. FOR EXISTING DUCTILE IRON PIPE

1. Tapping Sleeves shall be suitable for direct taps on pressurized mains.
2. Tapping sleeves shall be furnished with a test port, and shall be pressure tested by the tapping contractor prior to backfill. The test shall be witnessed by the Engineer.

3. Tapping sleeves shall be:

Stainless steel, model "3490MJ PowerMJ, as manufactured by Powerseal Pipeline Products Corp., or approved equal, with a mechanical joint gate valve that complies with Section 4.4.

- a. Stainless Steel tapping sleeve shall have a mechanical joint outlet. Stainless Steel tapping sleeve with flanged outlet shall not be acceptable.
- b. Stainless Steel tapping sleeve shall have end rings/shoulders to prevent lateral blowout of gasket.
- c. All materials of construction and hardware shall be stainless steel (304) construction.

4.9 WATER SERVICE CONNECTION:

A. GENERAL REQUIREMENTS

The Contractor shall install three-fourths inch to two-inch (3/4" - 2") copper type K services as indicated on the Contract Drawings or as directed by the Engineer. Each service shall consist of a corporation, curb valve, copper tubing, and a curb box with a stainless steel service rod. Corporation shall be attached to the ductile iron pipe by means of a direct tap.

B. CORPORATIONS

1. Corporations shall be open left, full flow, ball valve type as manufactured by Mueller, McDonald, or approved equal.
2. Corporations shall be Waterworks Brass and manufactured in accordance with AWWA C800. Corporations shall have AWWA threads at the inlet and Mueller "110". McDonald "McQuick Q Series" or approved equal compression fitting on the outlet. Both inlet and outlet shall be of the same size. Corporations shall be used for all taps three-fourths inch (3/4") to two-inch (2) in diameter.
3. Services larger than 2-inch shall be installed utilizing an in-line tee (see Section 4.3).
4. Corporations tapped into any pipe other than ductile iron, CL 52 shall utilize a service saddle with double stainless steel straps and nuts, of the appropriate style for the pipe type. Service saddles with U-bolt type straps are unacceptable.
5. Regardless of any named manufacturer, all corporations shall be No-Lead. No Lead shall mean that the brass alloy used to manufacture the corporation shall have a lead level equal to or less than 0.1%. In addition all corporations shall be in compliance with NSF-61, Section 8.

Corporations shall be directly tapped into ductile iron pipe larger than two inches (2") in diameter. In no other instance, except when a tapping sleeve and valve is used, shall a tap be made without a corporation. Corporations shall be Mueller 110 model B-25008N,

McDonald, or approved equal.

C. CURB VALVES

1. Curb valves shall be open left, full flow, ball valve type as manufactured by, Mueller B-25209N, McDonald, or approved equal.
2. The curb valve shall open left and have a positive stop. No curb valve shall have the ability to drain the service line. Curb Valves shall have McDonald "McQuick Q Series" Mueller "110", or approved equal compression fittings on the inlet and outlet. The tee head of the curb- stop shall have provision for the connection of a stainless steel service rod.
3. Regardless of any named manufacturer, all corporations shall be No-Lead. No Lead shall mean that the brass alloy used to manufacture the corporation shall have a lead level equal to or less than 0.1%. In addition all corporations shall be in compliance with NSF-61, Section 8.

D. COPPER

Copper tubing shall be by type "K", soft-temper, conforming to ASTM B88. The name or trademark of the manufacturer and type shall be stamped at regular intervals along the pipe.

E. CURB BOXES AND RODS

1. Curb boxes shall be of the sliding adjustable-type capable of adjusting from five and one-half (5.5') feet to six and one-half (6.5) feet. The base of the box shall be arch-type so as to prevent the box from resting directly on the curb valve. The adjustable upper section shall be one and one-fourths inches (1/4") in diameter.
2. Stainless steel stationary rods affixed to the key of the curb valve with a stainless steel cotter pin shall be thirty-six inches (36") in length. The cover of the box shall have a pentagon plug type marked "WATER". Both the cover and the upper section of the box shall be able to be located with an aqua-type metal locator.

F. HOUSE SERVICES CONSTRUCTION METHODS

The Contractor shall make all necessary taps into the water main and will install for each lot an approved brass corporation stop.

The Contractor shall also connect the type "K" copper service pipe to the flanged joint, which shall be connected to the brass type curb valve with inlet and outlet for the appropriate type "K" copper service pipe. Such curb valves shall be located not less than

five feet six inches (5'6") below the ground surface and shall be accessible from the surface through an approved valve box.

House Connections: The house connections shall be made by installing three-fourths inch ($\frac{3}{4}$ " type "K" copper pipe or approved equal on the end of the approved brass curb valve and proceeding through the cellar wall to an approved meter connection furnished by the Municipality, and installed by the Contractor in accordance with good plumbing practices (see House Services Detail Sheet).

4.10 CONSTRUCTION METHODS

A. INSPECTION AND TESTING

All pipe and fittings shall be inspected and tested in accordance with the manufacturer's specifications and the aforementioned AWWA Specifications. The Contractor shall furnish for approval certification from the pipe manufacturer that all tests have been performed with satisfactory results. Pipe shall not be installed without the Engineer's or Town's approval.

B. INSTALLATION

Pipes, fittings, and accessories shall be carefully handled to avoid damage. Prior to the date of acceptance of the project work by the Owner, the Contractor shall replace any new pipe or accessory found to be defective at any time, including after installation, at no expense to the Owner. All installation and testing shall be done in accordance with AWWA Standard C600 and ANSI Specification A21.11.

All pipes showing cracks shall be rejected. 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 Owner.

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. If the equipment manufacturer's specifications include that piping loads are not to be transferred, the Contractor shall submit certification of compliance.

Concrete thrust blocks shall be installed on all plugs, tees, and bends deflecting 11 1/4 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 Engineer.

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 a water that is, or may be, contaminated. In instances where the use of different types of pipe require joining, the Contractor shall furnish and install all necessary adapters.

Marking tape shall be used in all trenches.

All trenching safety standards shall be in conformance with all applicable State and Federal Guidelines and as specified on the Plans.

The Contractor shall, at all times, keep the trenches entirely free of water until all work is finished and ready for backfilling. 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 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 one and one-half inches (1/2") in the longest dimension shall be placed within one foot (1') of the pipeline being backfilled.

Backfill for all pipelines shall be placed in six inch (6") layers, each layer being thoroughly compacted to not less than 95 percent of maximum dry density as determined by the AASHTO-T-99 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. All water mains shall be installed with a minimum cover depth of six feet (6').

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

The Contractor shall provide a stable, temporary PVC marker at all gate valves, curb

stops, and at the end of waterlines to a minimum of six inches (6") above finish grade.

C. DISINFECTION:

Chlorination of the water main shall be conducted only after the main has been flushed and a clear stream is obtained as determined by the Engineer.

The Contractor shall furnish all labor, equipment, materials, and tools necessary to disinfect the pipe and appurtenances in accordance with the AWWA Standard for Disinfecting Water Mains, C651, with the exception of the tablet method.

The method of disinfection shall be by the continuous feed method unless otherwise approved by the Engineer. After filling, flushing, and the addition of chlorine solution, chlorine concentration within the pipe shall be at least 50 mg/l. All disinfection shall be performed under the supervision of the Engineer. The disinfection process shall be deemed acceptable only after two consecutive bacteriological samples of water from the flushed, disinfected main show no evidence of bacteriological contamination. Disinfection shall conform to the latest AWWA C651 revision.

The pipeline and appurtenances shall be maintained in an uncontaminated condition until final acceptance. Disinfection shall be repeated when and where required at no expense to the Owner until final acceptance by the Owner.

De-chlorination of water main disinfection water shall be the responsibility of the contractor.

D. FIELD TESTING

Except as otherwise directed, all pipelines shall be tested. Pipelines laid in excavation or bedded in concrete shall be tested prior to backfilling or the placing of concrete, and any exposed piping shall be tested prior to field painting. The Contractor shall furnish all gauges, testing plugs, caps, and all other necessary equipment and labor to perform leakage and pressure test in sections of an approved length. Each valved section or a maximum of one thousand feet (1,000') of the pipe shall be tested. All water required for testing shall be potable. All testing shall be conducted in the presence of the Engineer.

For the pressure test, the Contractor shall develop and maintain 200 pounds per square inch for two hours. Failure to hold the designated pressure for the two-hour period constitutes a failure of the section tested. The leakage test shall be performed concurrently with the pressure test. During the test, the Contractor shall measure the quantity of water required to maintain the test pressure. Leakage shall not exceed the quantity given by:

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where: L = Leakage in gallons/hour
N = Number of joints in line tested
D = Diameter of pipe in inches
P = Average test pressure in psi

All testing shall be conducted in accordance with AWWA C600 latest revision. Should any section of the pipe fail either the pressure or leakage tests, the Contractor shall do everything necessary to locate and repair or replace the defective pipe, fittings, or joints at no expense to the Owner. If, for any reason, the Engineer should alter the foregoing procedures, the Contractor shall remain responsible for the tightness of the line with the above requirements.

E. FROST PROTECTION OF SHALLOW WATERLINES

Waterlines with less than five feet six inches (5'6") of cover over the crown, or where indicated on the plans, shall be protected against freezing by installation of two inch (2") thick Styrofoam SM insulating sheets with a total width of four feet (4') or twice the pipe diameter, whichever is greater. The sheets shall be placed six inches (6") above the crown of the main after compaction of the six inch (6") lift immediately above the crown. Care shall be exercised by the Contractor during backfill and compaction over the styrofoam sheets to prevent damage to the sheets. Styrofoam SM sheets shall meet the compressive strength requirements of ASTM D1621-73 and shall be as manufactured by Dow Chemical Company, Midland, Michigan, or equivalent. In no case shall the waterlines have less than four feet (4') of cover over the top of the pipe.

SANITARY SEWER SYSTEM**5.0 SANITARY SEWER SPECIFICATIONS****5.1 GENERAL:**

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.

5.2 MATERIALS:**A. *TYPES OF PIPE***

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

1. Gravity sewers shall be PVC solid wall pipe meeting ASTM Specifications D-3034 or F679, ductile iron pipe, or an approved equal.
2. Force mains shall be ductile iron with push-on joints, PVC SDR21, or PVC CL150 DR18. HDPE is permissible for force main pending engineer's design.

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

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

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

The pipe shall be furnished in nominal 13 foot lengths. Sufficient numbers of short

lengths and full machine fittings shall be provided for use at manholes, chimneys, and connections. All connections will require the use of manufactured fittings. Field fabricated, saddle-type connections will not be considered acceptable.

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. Bevel the cut end to the same as the factory bevel and remove all interior burrs. Measure and place a homing mark on the pipe before assembling.

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

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

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

The Contractor will submit certification that the materials of construction have been sampled, tested, and inspected, and that they meet all the requirements--including wall thickness--in accordance with ASTM C-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. 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.

C. DUCTILE IRON 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" Through 48" 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 Sections 11-2 through 11-5 and 11-7 through 11-8 of ANSI A21.11.

Mechanical joint, ductile iron pipe shall be the thickness class designated 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.

D. POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE

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

E. MANHOLES

The Contractor shall construct reinforced concrete manholes and drop manholes to the dimensions at the locations shown on the contract drawings. All precast reinforced concrete manhole sections shall conform to the latest version of the ASTM Specifications C478 (latest edition). The exterior of the manhole shall be coated with a waterproof sealant.

The footing shall be Class B precast concrete and shall conform to the dimensions indicated on the plans.

Shelves shall be constructed with Class B concrete as defined in Section 501 of the Vermont Standard Specifications for Construction. Inverts for sewer manholes shall be as shown on the plans and details and shall be constructed with Class B concrete or, for straight runs, segments of pipe cut in half longitudinally. Inverts shall have the exact shape of the sewer to which they are connected, and any change in size or direction shall be gradual and even.

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

All manholes are to be provided with copolymer polypropylene plastic manhole steps; PS2-PF-SL by M.A. Industries or equal. Vertical: 12 inches on center. Width: 10 inch minimum with foot stop. Projection: 4" minimum. There shall be no more than 24 inches to the first step. All manholes shall be provided with tough, gray, cast iron manhole frames and covers. All iron castings shall be thoroughly cleaned and then coated with hot tar before being delivered. Frames and covers shall be Neenah R-1642A with self-sealing gasket and concealed pick holes or approved equal. The groove for the O-ring gasket shall be machined. **Frames shall be ordered without bolt-down holes.** Manhole covers shall have the word SANITARY printed on them.

Precast risers and bases for manholes shall conform to ASTM Specifications C-361 and shall have the date of manufacture and the name or trademark of the manufacturer impressed or indelibly marked on the inside wall. The pipe opening in the precast manhole riser shall have a cast-in-place flexible gasket such as Lock-Joint Flexible Manhole Sleeve, Kor-N-Seal Joint Sleeve or equivalent system for pipe installation as approved by the Engineer. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

The manhole cover frames shall be set to final grade only after the base course paving has been completed. Manholes shall be constructed to grade with INFRA-RISER rubber adjustment risers as manufactured by East Jordan Iron Works, Inc, or approved equal. Risers shall be 80% by weight recycled rubber and minimum 10% by volume recycled RFL coated fiber. Risers shall be of uniform quality, free from cracks, holes and other surface defects. Risers shall be of proper shape, diameter, opening, taper and any other surface defects. The system shall be water-tight. Not more than 3-inches of adjustment is permitted. Chemrex urethane Adhesive/Sealant conforming to ASTM C920 Type S shall be used for joining/ sealing rubber risers, concrete components and cast iron frame. All manhole lift holes shall be grouted inside and out with expandable grout. Chimney seals may be required if groundwater is encountered.

Manholes shall be placed at all changes in slope, size, alignment of pipe, at the ends of each line, and at least every 300 feet.

5.3 CONSTRUCTION METHODS:

A. EXCAVATION:

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

B. LAYING SEWER PIPE:

The bell end of the pipe shall face upgrade at all times and be placed in such a position as to make the invert even when the succeeding section is inserted. Where required by adverse grading conditions, the Contractor shall fill any gully to make a suitable bedding for the sewer pipe. The fill shall be pneumatically compacted to a 95 percent dry density by the AASHTO-T-99, Method A (Standard Proctor) test, upon which the six inches (6") of bedding material shall be placed.

Any pipe which is not laid to grade and alignment shall be re-laid to the satisfaction of the Engineer. The bedding material shall be placed and compacted on each side of the pipe to a height equal to one-half the pipe diameter and for the full width of the excavated trench and as shown on the accepted plans.

C. BACKFILL:

Backfill shall consist of approved material placed in six inch (6") layers with each layer being thoroughly compacted to not less than 95 percent of maximum dry density as determined by the AASHTO-T-99 Standard Proctor by means approved by the Engineer.

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.

D. CONCRETE CRADLE AND ENCASEMENT FOR PIPE:

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

E. FROST PROTECTION FOR SHALLOW SEWERS:

Sewers with less than five and one-half feet (5 1/2') of cover over the crown or where indicated on the plans shall be protected against freezing by installation of two inch (2")

thick Styrofoam SM insulating sheets with a total width of four feet (4') or twice the pipe diameter, whichever is greater. The sheets shall be placed six inches (6") above the crown of the sewer after compaction of the six inch lift immediately above the crown. Care shall be exercised by the Contractor during backfill, and compaction over the styrofoam SM sheets shall meet the compressive strength requirements of ASTM D1621-73 and shall be as manufactured by Dow Chemical Company, Midland, Michigan, or equal. In no case shall the sewer lines have less than four (4') feet of cover over the top of the pipe.

F. LEAKAGE TESTS AND ALLOWANCES FOR GRAVITY SEWERS:

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

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

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

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

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

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

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

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

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

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

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

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

Manhole Testing: All manholes shall be tested prior to backfilling in accordance with ASTM C1244-93 using the following method. This method of testing manholes for leakage involves the use of a device for sealing the top of the manhole iron frame and pumping air out of the manhole, creating a vacuum and holding this vacuum for a prescribed period of time. Testing shall include the frame and any adjusting rings.

1. All lifting holes and exterior joints shall be filled and pointed with an approved non-shrinking mortar. The completed manhole shall not be backfilled prior to testing. Manholes which have been backfilled shall be excavated to expose the entire exterior prior to vacuum testing or the manhole shall be tested for leakage by means of a hydrostatic test. Repairs shall only be made to the exterior of the manhole.
2. All pipe and other openings into the manhole shall be suitably plugged in a manner to prevent displacement.
3. A plate with an inflatable rubber ring the size of the frame cover shall be installed by inflating the ring with air to pressure adequate to prevent leakage of air between the rubber ring and frame wall.
4. Air shall then be pumped out of the manhole through an opening in the plate until a vacuum is created inside of the manhole equal to ten inches (10") of mercury on an approved vacuum gauge. The removal of air shall then be stopped and the test time begun.
5. The vacuum must not drop to below nine inches (9") of mercury with a two minute test period. If more than a one inch (1") drop in vacuum occurs within the two minute test period, the manhole has failed and shall be repaired or reconstructed and then retested.
6. Following satisfactory test results, the manhole may be backfilled.

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

G. LEAKAGE AND PRESSURE TESTING FOR FORCE MAIN

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

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

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

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

H. CLEANING PIPELINES AND APPURTENANCES:

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

I. SEWER SERVICE CONNECTIONS:

Where required on the plans, sewer service connections for one house shall be constructed of four inch (4") pipe 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.

Open ends of pipes shall be properly sealed to prevent damage and intrusion of foreign matter where hookup to the building sewer is not coincident with sewer main construction. Additionally, the Contractor will provide a PVC pipe temporary marker approved by the Engineer from the sewer service invert up to twenty-four inches (24") above the finished grade. The marker shall be seated securely into the ground for ease in relocating the end of sewer service connection for hooking up the building sewer.

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

J. CLEANOUTS FOR SEWERS:

Cleanouts for gravity sewers and force mains shall be provided at locations indicated on the plans or as directed by the Engineer. Cleanout frames and covers shall be of tough gray cast iron. Castings shall be true to pattern and free from flaws. The bearing surface of cleanout frames and covers against each other shall be machined to give continuous contact throughout their circumference. All iron castings shall be thoroughly cleaned and then coated with hot coal tar before being delivered.

K. CHIMNEYS:

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

L. THRUST BLOCKS AND ANCHORS:

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

Thrust blocks and anchors shall be placed between the fitting and the trench wall with bearing on undisturbed earth. The bearing area shall be as shown on the contract drawings or as required by the Engineer.

5.4 WASTEWATER PUMPING STATION**A. GENERAL**

Wherever feasible, gravity sewers shall be utilized rather than wastewater pumping stations. Sewer pipeline depths up to 20 ft. 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.

For wastewater pumping stations serving the equivalent of fifty (50) living units, the Town will consider the use of factory-built, surface or recessed wet-well mounted units. For stations serving in excess of the equivalent flow of fifty (50) living units a wet-well/dry-well design shall be required. Submersible pumps may be allowed, on a case by case basis, for those situations involving failed onsite leaching 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. Submersible wastewater pumping stations shall remain the responsibility of the owner to maintain and/or replace as required.

The design of all pumping stations will be reviewed by the Town Engineer/P.W. Director prior to ordering.

B. FACTORY BUILT WET-WELL/DRY-WELL WASTEWATER PUMPING STATIONS

1. *General*

A minimum dual-pump station shall be furnished, including all clearing and grubbing, excavation and backfill, dewatering, exterior pipe, electrical work, site work, alarms, remote tele-metering, foundation, four hour storage/overflow tank, and other work required for a complete installation. A stand-by power system, including a generator and transfer switch, shall be enclosed in a structure that shall also contain the electrical, control and telemetry equipment. The structure shall be made of brick and compliment the surrounding neighborhood. The generator shall be diesel powered and sufficiently sized to power all pumps and all other electrical needs.

2. *Foundation*

- a. A reinforced concrete foundation shall be provided for the wet well and pump chamber, designed by a structural engineer licensed in the State of Vermont.
- b. The foundation and structure shall be designed to prevent flotation, under empty conditions.

3. *Appurtenant Concrete Structures*

- a. Concrete wet wells shall be provided of the size indicated on the design drawings. The wet well suction inlets shall be designed in accord with the standards set in ASCE Manual #37, Design and Construction of Sanitary and Storm Sewers, to minimize the deposition of solids. All pumping station structures shall be externally coated and tested for watertightness.
- b. An auxiliary discharge connection manhole shall be provided to enable the Town to bypass the pump station with a portable pump.
- c. Emergency storage tanks are not mandated when a back-up generator is provided. However, if required, the pumping station shall have a reinforced concrete emergency storage chamber constructed adjacent to the facility. Storage tanks shall have at least one manhole access to grade with aluminum or CPP rungs 8 inch O.C. and a Neenah R1642-A frame with a self-sealing lid and closed pick holes. The storage chamber shall be designed as a self draining tank to the wet well, with the fill/drain line set above the high water alarm level. The tank capacity shall in combination with all gravity sewers up to the overflow elevation, contain a minimum of four hours storage at the design year flow.

4. *Pump Station*

- a. The pump station shall be equipped a minimum of two vertical, close coupled motor driven, non-clog sewage pumps, electric motors with 3 phase power (for pump motors over 5 HP in size), valves, internal piping, control panel with circuit breakers,

motor starters and automatic level controls, lighting, sump pump, ventilator, dehumidifier, heater, wiring, elapsed time hour meter for each pump and a remote alarm system.

- b. The sewage pumps shall be designed such that one pump will handle the 10 year peak design flow at the lowest rpm and highest efficiency.
- c. The pump shall be arranged such that the rotating element can easily be removed from the volute, without disconnecting the seal system, electrical wiring or removal of the motor from the backhead and seal.
- d. The pump shaft shall be sealed against leakage by a double, mechanical seal. The seal shall be pressurized and lubricated by water taken directly from the pump backhead through a filter to the seal housing.
- e. Pump motors shall be squirrel-cage induction motors of vertical, solid shaft, P-base construction especially designed for sewage pump service. The motors shall be rated per the design specification and shall be suitable for 3 phase, 60 cycle 220 volt service with a 1.15 service factor. They shall not be overloaded at full speed at the minimum head specified under "Operating Condition" for each pump. The motors shall have Class F insulation, suitable for temperatures up to 104 degrees C. The motor insulation temperature shall not exceed 80 degrees C. The motor shall be NEMA design B having normal starting torque and low starting current.
- f. Starting from a low wet well and no pumps operating, the pump operation sequence is as follows (for a two-pump station): When the wet well rises to the low level on position, the base pump shall start, if the flow into the wet well exceeds the capacity of the base pump, the wet will rise to a higher elevation, and the second pump shall then come on and operate in parallel with the base pump. If the flow into the wet well exceeds the capacity of the base pump and second pump operating together, the wet will continue to rise to an even higher elevation, and a high level alarm system will be activated. As the rate of flow to the wet well decreases and the wet-well level drops, the reverse sequence to the above shall occur.
- g. The Control panel for the pumps shall be equipped with controls to allow both automatic and manual sequencing of the pumps such that any pump of the two provided is capable of acting as the first or second in sequence.

5. Design Basis Approval

Prior to approval of a design for a new pump station, the design/project engineer shall submit a basis of design to the Town Engineer/PW Director to include: Limit of service area; minimum, average and peak flow for the initial 10 year, 20 year, and ultimate build-out; static head calculations; force man size, type and velocity at designated pump flow; wet well size and volume between high and low water levels; detention times, at minimum initial flow and average design flow; critical overflow

location and elevation; and design pump characteristics including number and type pump, RPM, impeller size and pump operating characteristics (GPM, TDH, EFF, HP).

6. Accessory Equipment

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

b. A dehumidifier assembly shall be furnished to maintain the relative humidity of the air in the pump chamber low enough to prevent condensation on the walls. The dehumidifier shall be controlled automatically by an adjustable humidistat and low air temperature cutout. The condensate shall be drained to the sump.

c. A ventilating blower shall provide air circulation to the floor of the pump chamber. The exhaust outlet shall be screened to prevent the entrance of foreign matter and insects and shall have a suitable cover to prevent the entrance of rain and snow. Fresh air to the pump chamber shall be drawn from the surface. The air inlet shall be screened to prevent the entrance of foreign matter and insects and shall have a suitable cover to prevent the entrance of rain and snow. The blower shall be sized to exchange the air in the station once every two minutes. The ventilating blower and station lights shall be turned on automatically when the entrance tube cover is raised and shall have a manual switch located on the inside of the entrance tube.

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

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

f. A pressure transducer shall be used to sense the water level in the manhole. Back-up float switches shall be used. High water level mercury float switches shall be provided to be activated by high liquid level in the wet well and high liquid level in the dry well. Float switches shall each have two normally open and two normally closed contacts. Float switches will be wired to the remote alarm system.

g. Spare Parts: A complete replacement pump shaft seal assembly shall be furnished with each lift station. The spare seal shall be securely fastened to the control panel and shall include complete installation instructions. A spare volute gasket shall be provided. A spare filter cone for the seal filter shall also be provided, in the same container as the pump shaft seal.

7. Controls

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

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

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

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

e. To control the operation of the pumps and variations of sewage level in the wet well, a pressure transducer shall be provided.

g. The pressure switches shall be of the mercury tube type, with sensitive pressure elements and independent high and low adjustment for each pump. The minimum differential shall be 18 inches of water.

8. Wiring

a. The pump station shall be completely pre-wired at the factory, except for the power feeder lines. All wires shall meet the requirements of the National Electrical Code and shall be color-coded as indicated on the wiring diagram. All wiring outside the panel shall be in conduit, except for the 115 volt accessory items which are provided with

insulated service cord. Conduit shall be provided from the control panel across the ceiling, and up the entrance tube to receive the feeder lines, and shall terminate in a threaded conduit connection through the wall of the entrance tube. All receptacles shall be of the ground fault type.

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

9. *Interior Piping*

a. Pump suction and discharge line shall be Class 52 Ductile Iron pipe, sized as shown on the drawings. Joints outside the chamber shall be mechanical joint. Joints inside the chamber shall be flanged. All flanged ductile iron pipe shall meet the requirements of ANSI A21.51 (AWWA C151) latest version.

10. *Valves*

a. Solid wedge, bronze fitted, non-rising stem, wheel handled, gate valves shall be located on both the inlet lines and on the discharge lines.

b. Flanged non-slamming bronze mounted swing type check valves with bolted covers, outside levers, and counter-weights shall be placed on the discharge lines between the pumps and the gate valves.

C. FACTORY BUILT SURFACE OR RECESSED WET WELL MOUNTED PUMP STATIONS

1. *General*

A minimum dual-pump station shall be furnished, including all clearing and grubbing, excavation and backfill, dewatering, exterior pipe, electrical work, site work, alarms, remote telemetering, foundation, four hour storage/overflow tank, and other work required for a complete installation.

2. *Foundation*

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

b. The foundation and structure shall be designed to prevent flotation, under empty conditions.

3. *Concrete Structures*

- a. The concrete wet well shall be provided of the size indicated on the design drawings. All pumping station structures shall be externally coated and tested for watertightness.
- b. An auxiliary discharge connection manhole shall be provided to enable the Town to bypass the pump station with a portable pump.
- c. Each pumping station shall have a reinforced concrete emergency storage chamber constructed adjacent to the facility. Storage tanks shall have at least one manhole access to grade with aluminum or CPP rungs 8 inch O.C. and a Neenah R1642-A frame with self sealing cover with closed pick holes. The cover shall be machined for the O-ring gasket. The storage chamber shall be designed as a self draining tank to the wet well, with the fill/drain line set above the high water alarm level. The tank capacity shall in combination with all gravity sewers up to the overflow elevation, contain a minimum of four hours storage at the design year flow.

4. *Pump Station*

- a. The pump station shall be an above ground fiberglass covered or wetwell recessed Factory built pumping station with a minimum of two vertical, close coupled motor driven, non-clog sewage pumps, electric motors with 3 phase power (for pump motors over 5 HP in size), valves, internal piping, control panel with circuit breakers, motor starters and automatic level controls, lighting, ventilator, heater, wiring, elapsed time hour meter for each pump and a remote alarm system.
- b. The sewage pumps shall be designed such that one pump will handle the 10 year peak design flow at the lowest rpm and highest efficiency.
- c. Each pump shall be able to pass a 3 inch sphere.
- d. The pump/motor shaft shall be of one piece solid stainless steel construction.
- e. 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.
- f. The pump shall be arranged such that the rotating element can easily be removed from the volute, without disconnecting the seal system, electrical wiring or removal of the motor from the backhead and seal.
- g. The pump shaft seal shall be sealed against leakage by a double, mechanical seal. The seal shall be pressurized and lubricated by water taken directly from the pump backhead through a filter to the seal housing.

h. Pump motors shall be squirrel-cage induction motors of vertical, solid shaft, P-base construction especially designed for sewage pump service. The motors shall be rated per the design specification and shall be suitable for 3 phase, 60 cycle 220 volt service with a 1.15 service factor. They shall not be overloaded at full speed at the minimum head specified under "Operating Condition" for each pump.

i. The motors shall have Class F insulation, suitable for temperatures up to 104 degrees C. The motor insulation temperature shall not exceed 80 degrees C. The motor shall be NEMA design B having normal starting torque and low starting current.

j. The Control panel for the pumps shall be equipped with controls to allow both automatic and manual sequencing of the pumps such that any pump of the two provided is capable of acting as the first or second in sequence.

5. *Design Basis Approval*

Prior to approval of a design for a new pump station, the design/project engineer shall submit a basis of design to the Town Engineer/PW Director to include: Limit of service area; minimum, average and peak flow for the initial 10 year, 20 year, and ultimate buildout; static head calculations; force man size, type and velocity at designated pump flow; wet well size and volume between high and low water levels; detention times at minimum initial flow and average design flow; critical overflow location and elevation; and design pump characteristics, including number and type pump, RPM, impeller size and pump operating characteristics (GPM, TDH, EFF, HP).

6. *Accessory Equipment*

a. The pumps shall be protected by a hinged fiberglass hood, for access, service, and maintenance. The fiberglass cover shall contain ventilation louvers, an opening handle, and hasp for a padlock.

b. The unit shall be equipped with special hood insulation, the largest heater available, and high capacity, low noise level, squirrel-cage ventilation blowers.

c. Spare Parts: A complete replacement pump shaft seal assembly shall be furnished with each lift station. The spare seal shall be securely fastened to the control panel and shall include complete installation instructions. A spare volute gasket shall be provided. A spare filter cone for the seal filter shall also be provided, in the same container as the pump shaft seal.

7. *Controls*

- a. The pump equipment shall be mounted internally within the pump station enclosure in a NEMA type 4 panel, complete with suitable latching devices. All circuit breakers, motor starter reset buttons pump control switches and run time meters shall be mounted so that they are operable without opening the cabinet. The low voltage, automatic pump control section shall be separate from the high voltage circuit breaker motor starter section and shall be provided with a hinged access door and latch. The control switches shall be mounted on the face of the automatic pump control section door. A grounding-type convenience duplex outlet shall be provided for operation of 115 volt AC devices.
- b. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and over-current protection of all motor, control and auxiliary circuits. Magnetic across-the-line starters with under voltage release and overload coils for each phase shall be provided for each pump motor to give protection against single phasing. Each single phase auxiliary motor shall be equipped with an over-current protection device, in addition to its branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.
- c. An automatic alternator with manual "ON-OFF" switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle. Provisions shall also be made for the pumps to operate in parallel, should the level in the wet well continue to rise above the starting level for a low-level pump, however, the panel shall include a time delay to prevent the simultaneous start-up of both pumps.
- d. A running time meter shall be supplied for each pump to show the number of hours of operation. The meter shall be enclosed in a dust and moisture proof molded plastic case. The flush mounted dial shall register in hours and tenths of hours up to 99999.9 hours before repeating. The meter shall be suitable for operation from a 115 volt, 60 cycle supply and shall be mounted on the surface of the control cabinet.
- e. Level controls in the wet well, including low level shutoff, low level activation, high level activation and high level alarm shall be of the mercury float type. Float switches shall each have two normally open and two normally closed contacts. Float switches will be wired to the remote alarm system.
- f. Dual vacuum pumps shall be provided as well as a duplex priming system.

8. *Wiring*

- a. The pump station shall be completely pre-wired at the factory, except for the power feeder lines. All wires shall meet the requirements of the National Electrical Code and shall be colorcoded as indicated on the wiring diagram. All wiring outside the panel shall be in conduit, except for the 115 volt accessory

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

b. Accessory items such as the heater, blower, and vacuum pumps shall be plugged into polarized grounded convenience outlets located close to their installed position so that such items can be readily removed and serviced if necessary.

9. *Interior Piping*

Pump suction and discharge line shall be Class 52 Ductile Iron pipe, sized as shown on the drawings. Joints outside the chamber shall be mechanical joint. Joints inside the chamber shall be flanged. All flanged ductile iron pipe shall meet the requirements of ANSI A21.51 (AWWA C151) latest version.

10. *Valves*

a. Solid wedge, bronze fitted, non-rising stem, wheel handled, gate valves shall be located on both the inlet lines and on the discharge lines.

b. Flanged non-slamming bronze mounted swing type check valves with bolted covers and outside levers and counter-weights shall be placed on the discharge lines between the pumps and the gate valves.

C. FACTORY TESTS

All pump stations shall be given an operational test of all equipment at the factory to check for excessive vibration for leaks in all piping or seals and for correct operation of the automatic control system and all auxiliary equipment. The pump suction and discharge line shall be coupled to a reservoir and the pumps shall recirculate water for at least one hour under simulated service conditions. The automatic control shall be adjusted to start and stop the pumps at approximately the levels required by the job conditions.

D. SERVICES OF MANUFACTURERS REPRESENTATIVE

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, 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 shall also certify that the installation meets the manufacturers

warranty requirements.

The manufacturer's representative shall be present during field acceptance testing.

E. FIELD 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.

F. OPERATING INSTRUCTIONS

Installation of the pump chamber, entrance tube and related appurtenances shall be done in accordance with written instructions provided by the manufacturer. These instructions shall be delivered with the station.

A convenient maintenance and operating instruction chart and daily maintenance and inspection record chart with ample room for recording daily inspections of the pump station, shall be securely mounted on the interior wall of the main pump chambers.

In addition to the maintenance and operating chart, the manufacturer shall further provide 5 copies of a complete and detailed operating and maintenance manual. This manual shall 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.

G. ALARM SYSTEM

1. 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 receiver at the Town of Middlebury Waste Water Treatment Plant. A flashing red light shall also be provided at the pump station as part of the alarm system.
2. 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.
 - a. When activated, the communicator shall seize the telephone line, then dial

the central station receiver 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.

b. Communicator shall be capable of being activated by any of up to seven different sensing channels. Circuit inputs may be wither a normally open or a normally closed configuration by switch selection. A 5 to 15 V.D.C. position signal may also be used to activate. 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 and all clear code.

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

d. The 5 alarm signals requiring transmission are:

- flooded wet well alarm
- flooded dry well alarm
- power failure alarm
- security alarm
- system test/reset signal (daily/weekly)

The Town will provide a coding list for these alarm conditions.

H. ELECTRICAL SYSTEM AND CONTROL PANEL

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

2. Work of others: Packaged pump station will be furnished completely wired including controls and will require only power wiring from the service panel to the control panel in the pump station and signal wiring for the high level signal from the pump station control to the service panel. The above grade panel and signal communicator are not the responsibility of the pump station manufacturer.

3. Materials and Equipment: 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.

4. Standards of Installation: The latest edition of the National Electric Code, all local ordinances and all regulations prescribed the local Power Company shall be used as a standards covering all electrical work.

5. Codes and Permits: Work performed shall comply with the latest edition of the National Electric Code Underwriters Laboratories regulations and all Municipal, State and other public or private authorities having jurisdiction. It is the responsibility of the developer/contractor to obtain all permits and to pay all fees.

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

7. Tests:

a. The system shall be tested in the presence of the Town representative to demonstrate all equipment as properly working and operating.

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

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MIDDLEBURY PUBLIC WORKS SPECIFICATIONS

Section 1

GENERAL SPECIFICATIONS

MIDDLEBURY PUBLIC WORKS SPECIFICATIONS

Section 2

STREETS

Section 3

STORM DRAINAGE SYSTEM

Section 4

WATER DISTRIBUTION SYSTEM

Section 5

SANITARY SEWER SYSTEM

Appendix 1

LIST OF ILLUSTRATIONS

MIDDLEBURY PUBLIC WORKS SPECIFICATIONS
