WATER AND WASTEWATER CONSTRUCTION SPECIFICATIONS AND STANDARD DETAILS

The attached standards shall generally be applied to work associated with the Town water works unless otherwise waived by the Commission. Variations or deviations from these standards may be allowed following review by a qualified engineer, selected and retained by the Town, for the specific application. However, it is the Town's intention, to the extent practical, to establish the standard of materials and workmanship provided in these Standards.

INDEX OF SPECIFICATIONS

INDEX OF STANDARD DETAILS

SECTION 02232 – PROTECTION AND REPAIR OF PROPERTY

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. All labor, materials, equipment and services necessary for protection and repair of property, as shown or specified.

1.02 REFERENCE STANDARDS
(Not Used)

1.03 SUBMITTALS
(Not Used)

1.04 QUALITY ASSURANCE
(Not Used)

PART 2.00 – PRODUCTS

2.01 MATERIALS
(Not Used)

PART 3.00 – EXECUTION

3.01 NOTIFICATION

A. For the location of existing underground utilities, the following notifications shall be made by the Contractor prior to start of construction:

1. "Dig Safe": 1-888-344-7233 or 8-1-1
2. Other utilities not contracted with "Dig Safe" may include, but are not limited to, local weather, wastewater, and stormwater authorities.
3. Municipality owned utilities.

B. The Contractor is responsible for location of all utilities, including primary and secondary services.

C. For planned interruption of existing wastewater or water services, written notification shall be given to the Town forty-eight (48) hours prior to the interruption.

3.02 PROTECTION AND REPAIR OF PROPERTY

A. Protection, restoration and repair of property shall be included in the Work price at no cost to the Town.

B. Contractor shall conduct the Work so as to interfere as little as possible with private business and public travel. The Contractor shall, at no cost to the Town, wherever

necessary or required, maintain fences, install shoring, provide security personnel, maintain barriers and post danger signs warning against hazards created by the construction work. The Contractor shall also take such other precautions as may be necessary to protect life and property and shall be responsible for all damages occasioned in any way by any act or neglect or that of the Contractor's agents, employees, or workers.

C. The Contractor shall be fully responsible and shall take all necessary precautions to protect all personnel, property, structures, buildings, trees, shrubs, plantings, roads, streets, driveways, curbs, swales, rip-rap, sidewalks, paths, utility poles, light poles, property markers, mailboxes, manholes and covers, catch basins and grates, retaining walls, guideposts/rails and other features.

D. If gravel, silt, or other debris caused by the Contractor's operation is deposited into existing facilities, structures, pipes or other site features, the sediment shall be thoroughly removed and the item completely cleaned, at no cost to the Town.

E. If damage is caused to facilities or equipment, it shall be repaired or replaced at no cost to the Town.

F. Items removed for construction shall be replaced in their original locations, unless directed otherwise by the Town, at no cost to the Town.

G. Items not specified elsewhere in these Specifications that have been damaged during or removed for construction, shall be replaced "in kind".

H. All hazardous materials shall be stored and disposed of in accordance with Federal, State, or local codes, laws, ordinance or regulations.

3.03 PROTECTION AND REPAIR OF SURVEY AND BOUNDARY MARKERS

A. Temporary benchmarks, control points, and reference points shall be maintained and preserved throughout construction. If disturbed or destroyed, they shall be reestablished by the Contractor, at no cost to the Town.

B. Boundary markers, pins, pipes, or monuments shall be protected and preserved throughout construction. If disturbed or destroyed, they shall be reestablished by a Licensed Land Surveyor hired by the Contractor, at no cost to the Town.

3.04 TREE AND SHRUB PROTECTION

A. Any tree or shrub which will not, in the opinion of the Town, hinder construction or landscaping, shall be preserved and protected.

B. The Contractor shall construct a temporary barricade at the dripline of any trees or shrubs designated to be preserved and as indicated on the drawings, to prevent damage to any portion of the tree or shrub. The Contractor shall take special care in setting barricade posts to not damage tree or shrub roots.

C. The Contractor shall not permit stockpiling of material or debris within the barricaded area, nor permit the earth surface to be changed in any way.

D. The Contractor shall use necessary care to protect the roots, trunks and branches of all trees or shrubs not designated to be removed.

E. If necessary to avoid undermining a tree or shrub during construction, trees designated to remain shall be protected with temporary shoring or sheeting. All temporary shoring or sheeting shall be removed when no longer necessary.

3.05 TRIMMING OF TREES OR SHRUBS TO REMAIN

A. If necessary to trim selected trees or shrubs to allow the construction, the Contractor shall use the property tools and skilled workmen to achieve neat severance of tree or shrub limbs with the least possible damage to the tree or shrub. Cut limbs shall be appropriately sealed.

B. If necessary to trim roots of selected trees or shrubs to allow the construction, the Contractor shall apply wet burlap to prevent drying of the severed root. Cut roots shall be appropriately sealed.

3.06 PROTECTION AND REPAIR OF UTILITIES

A. The Drawings do not depict all utilities or exact positions of all utilities that may exist on the site. The Drawings show approximate information regarding the location of known utilities. This information has been obtained from records, information provided by others, surface observation, and/or field measurements, but is not guaranteed to be entirely accurate or complete.

B. The Contractor shall provide his own detection equipment for accurately locating buried utilities approximately shown on the Drawings. The Contractor shall locate underground utilities in the work area by probing and/or other means as required. No extra payment will be allowed to the Contractor for repair of utilities shown on the Drawings, or accurately marked in the field prior to damage of the utility.

C. If utilities are to remain, the Contractor shall provide adequate means of protection during earthwork operations.

D. Should unmapped piping or other utilities be encountered during excavation, the Contractor shall consult with the utility owner immediately for directions. The Contractor shall cooperate with utility companies in keeping respective service and facilities to the satisfaction of the utility owner.

E. The Contractor shall not intentionally interrupt utilities unless permitted in writing by the utility owner, and then only after arranging to provide temporary utility service to necessary facilities or users.

F. Utilities damaged during construction shall be repaired and/or replaced with equal or better quality material as directed by the impacted utility.

G. Repairs shall be inspected by the impacted utility prior to being backfilled. Repair of utilities and inspection by the utility shall be included in the Work price at no cost to the Town.

3.07 PROTECTION AND REPAIR OF UTILITY POLES AND OVERHEAD WIRES

A. The Contractor shall coordinate, arrange, schedule, receive permission, and pay for supporting and/or temporarily or permanently relocating utility poles and/or wires that may be impacted by the project, with the appropriate utility(s), at no cost to the Town.

3.08 REPAIR OF WASTEWATER AND STORMWATER PIPE

A. The Town shall be notified immediately if a wastewater or stormwater pipe is damaged during construction.

B. Wastewater or stormwater pipes damaged during construction shall be immediately repaired.

C. Wastewater or stormwater pipes damaged during construction shall be replaced for a minimum distance of two feet (2') beyond either side of the damage, with a section of same size and material pipe, at no cost to the Town.

D. Wastewater or stormwater pipes damaged during construction and crossing water pipes shall be repaired in accordance with the water/sewer crossing notes on the Drawings, at no cost to the Town.

E. Connections shall be made with approved couplings. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.

F. One (1) wastewater and one (1) stormwater service shall be assumed for each residence/business or building, unless shown otherwise on the Drawings.

3.09 REPAIR OF WATER MAINS AND SERVICES

A. The Contractor shall become familiar with the location of water valves and curb stops, prior to the start of work, to facilitate emergency shutdown and repairs.

B. The Town shall be notified immediately if a water main or service is damaged during construction.

C. Water mains damaged during construction shall be immediately repaired or replaced for a minimum distance of two feet (2') beyond either side of the damage, with a section of same size and material pipe, with approved couplings, and at no cost to the Town. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.

D. Water services damaged during construction shall be immediately repaired or replaced for a minimum distance of two feet (2') beyond either side of the damage, with a section of same size Type K copper water pipe, with approved compression fittings, couplings and adapters, and at no cost to the Town. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.

E. One (1) water service shall be assumed for each residence/business or building, unless shown otherwise on the Drawings.

3.10 REPAIR OF LAWNS, GRASSES, AND OTHER PLANTINGS

A. Lawns and other grass areas shall be restored as required in Specification Section 02930.

B. Plantings or gardens damaged or destroyed during construction shall be replaced "in kind".

3.11 REPAIR OF CURB AND SIDEWALK

A. Curb and sidewalk shall be restored as required in Specification Section 03301.

B. Curb and sidewalk dimensions and type shall match existing, unless indicated otherwise on the Drawings.

3.12 REPAIR OF BITUMINOUS CONCRETE SURFACES

A. Bituminous concrete surfaces including roads, streets, driveways, paths and walks shall be restored as required in Specification Section 02511.

3.13 FENCE, MAILBOX, AND SIGN REMOVAL AND RESETTING

A. Fences, mailboxes, and signs in the way of construction shall be removed and reset in their original locations after construction in the immediate area has been completed, or prior to the end of the work day, whichever is sooner.

B. Mailboxes shall be reset in accordance with USPS regulations. Generally, mailboxes shall be set 42" to 48" from the bottom of the mailbox to the ground and 6" to 9" from the front face of the mailbox to the curb or edge of roadway. Mailboxes shall be reset to conform to USPS regulations, even if they did not conform prior to disturbance.

C. Mailboxes may be permanently relocated if acceptable to the property Town, and meeting USPS regulations.

D. Mailboxes may be permanently relocated if they present a pedestrian or vehicle hazard, as determined by the Town, and meeting USPS regulations.

E. Fences, mailboxes, posts, and signs damaged during construction shall be replaced "in kind" at no cost to the Town.

3.14 GUIDEPOSTS/RAILS REMOVAL AND RESETTING

A. Guideposts/rails in the way of construction shall be removed and reset in their original locations after construction in the immediate area has been completed or prior to the end of the work day, whichever is sooner.

B. Guideposts/rails damaged during construction shall be replaced "in kind" at no cost to the Town.

3.15 REPAIR OF CULVERTS

A. Culverts damaged during construction shall be immediately repaired or replaced with the same size and type of culvert.

B. Connections shall be made with approved couplings for the size and type of pipe.

C. Adequate pipe bedding and compaction is mandatory under pipe repairs to prevent settlement.

3.16 PROTECTION FROM WEATHER

A. In the event of temporary suspension of the Project, or during inclement weather, the Contractor shall, and will cause his Subcontractors to, protect the Project, work and materials against damage or injury from the weather. If in the opinion of the Town, the Project, work or materials are damaged or injured by reason of failure on the part of the Contractor to protect the Project, work or materials, such damaged items shall be removed and replaced at the expense of the Contractor.

B. Protection shall include all erosion prevention and sediment control measures necessary to maintain the site in compliance with State and Federal regulations and permits.

END OF SECTION 02232

SECTION 02300 – EARTHWORK

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Excavating
B. Pipe Bedding and Envelope
C. Trenching
D. Trench Backfilling
E. Structure Bedding
F. Structure Backfilling
G. Filling
H. Grading
I. Subgrade Preparation
J. Geotextiles
K. Embankments
L. Subbase
M. Base
N. Compaction
O. This Section does not include Earthwork related to buildings, footings, foundations.

1.02 REFERENCE STANDARDS

A. State of Vermont, Agency of Transportation (VTrans), "Standard Specifications For Construction", latest version

B. ASTM Standard Test Method D1557 for Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM Standard Test Method D2992 for Density of Soil and Soil-Aggregate In-Place By Nuclear Methods (Shallow Depth).

D. AASHTO Test T96 for Resistance to Degradation of Small-Size Coarse Aggregate By Abrasion and Impact in the Los Angeles Machine.

E. ASTM Standard Classification D2487 of Soils for Towning Purposes (Unified Soil Classification System)

F. AASHTO Standard M145 – Recommended Practice for Classification of Soils

G. State of Vermont, Agency of Natural Resources, Environmental Protection Rules – Chapter 1

H. ASTM Standard Test Method D 4632 for Grab Tensile Strength of Geotextiles

I. ASTM Standard Test Method D 3786 for Mullen Burst Strength Geotextiles

J. ASTM Standard Test Method D 4533 for Trapezoidal Tear Strength of Geotextiles

K. ASTM Standard Test Method D 4833 for Puncture Strength Geotextiles

L. ASTM Standard Test Method D 4355 for UV Deterioration of Geotextiles

M. ASTM Standard Test Method D 4751 for Apparent Opening Size of Geotextiles

N. ASTM Standard Test Method D 4491 for Flow Rate of Geotextiles

1.03 SUBMITTALS

A. The Contractor shall submit supplier's certified laboratory gradation curves and moisture-density compaction curves (modified proctor) for each imported material to be used on the project.

B. The Contractor shall submit representative samples of each imported material to be used on the project, if requested by the Town.

C. The Contractor shall submit certified laboratory gradation curves, moisture-density compaction curves (modified proctor) and ASTM D2487 Soil Classification or AASHTO M145 Soil Classification for each on-site material proposed for fill or backfill on the project.

D. The Contractor shall submit representative samples of each on-site material proposed for Fill or Backfill on the project, if requested by the Town.

E. The Contractor shall submit manufacturer's data for subgrade stabilization/separation fabric, filter fabric, slope stabilization fabric and erosion control fence.

1.04 QUALITY ASSURANCE

A. The Contractor shall allow the Town's testing agency to perform field quality control testing, including, but not limited to, in place compaction testing of Subgrade and each layer of Embankment, Subbase, Base or Fill, at the discretion of the Town. The Contractor shall proceed with subsequent earthwork only after test results from previously completed work comply with requirements.

B. When testing agency reports that any area has not achieved the required degree of compaction, the Contractor shall remove and replace, or uniformly moisten or scarify and aerate to obtain optimum moisture content, and then recompact and retest until specified compaction is obtained. Reworking, replacement of material, recompacting, and retesting will be done at no expense to the Town.

C. Unless modified by the Town, compaction tests may be performed at the following frequencies:

1. Pipe bedding and structure bedding: one test for each 150 feet or less of trench length.

2. Initial backfill/envelope: at least one test for each 150 feet or less of trench length.
3. Trench or Structure Backfill: at least one test for each 150 feet or less of trench length and/or at least one test per vertical foot of trench depth.
4. Subgrade: at least one test for every 2,000 square feet or less of subgrade
5. Embankment, Subbase, or Base: at least one test for every 2,000 square feet or less, and/or at least one test per vertical foot of depth.
6. Gravel Roadway and Driveway, Gravel Shoulder, or Gravel Sidewalk: at least one test for every 2,000 square feet or less, and/or at least one test per vertical foot of depth.
7. Fill: at least one test for every 2,000 square feet or less of Fill, and/or at least one test per vertical foot of depth.

D. Do not place materials on surfaces that are muddy, frozen, or contain frost or ice.

E. Protect newly graded areas from traffic, freezing and erosion. Keep free of trash and debris.

F. Repair and reestablish, to specified tolerances, areas where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

G. Where settling occurs, the Contractor shall remove finished surface treatment, backfill with appropriate Base material, compact and replace surface treatment, all at no expense to the Town. Restore appearance, quality and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

H. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for Earthwork.

I. The Contractor shall protect Earthwork materials and areas before, during, and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town at no cost to the Town.

J. Upon direction of the Town, the Contractor shall remove and/or rework all areas which do not meet the requirements of this Section. The Contractor shall perform all remedial measures at no cost to the Town.

1.05 DEFINITIONS

A. Backfill: materials used to fill an excavation
   1. Initial Backfill/Envelope: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Trench Backfill: Backfill placed over Initial Backfill/Envelope to fill a trench excavation.

B. Base Course: layer placed between the subbase course and either bituminous concrete pavement, curb, sidewalk, or other surface treatment.

C. Bedding: layer placed over the excavated subgrade in a trench before placement of pipe or structure.
D. Borrow: imported materials from off-site sources
E. Embankment: layer placed between subgrade and subbase
F. Excavation: removal of material encountered above Subgrade elevations
G. Fill: soil material used to raise existing grades in lawn and grass areas
H. Onsite material: soil material stockpiled from excavations
I. Rock: refer to section 02301
J. Structures: precast concrete wastewater and stormwater manholes, catch basins, storage tanks, pump stations, and septic tanks
K. Subbase Course: layer placed between the Embankment and base course, or between subgrade and base course if no embankment
L. Subgrade: surface or elevation remaining after completing excavation; surface below embankment or below subbase or bedding, if no embankment

PART 2.0 – PRODUCTS

2.01 BORROW MATERIALS

A. General
1. All Borrow materials shall be obtained from approved sources and be reasonably free from structurally weak pieces, thin or elongated pieces, silt, loam, topsoil, clay, organic or other deleterious material.
2. All Borrow materials shall be uniformly graded from coarse to fine

B. Bank Run Sand
1. Shall conform with Section 703.03 of the VTrans Standard Specifications for Construction.
2. Bank Run Sand shall meet the following gradation requirements:

Sieve Number	Percentage by weight passing square mesh sieve
2 inches	100
1 ½ inches	90-100
½ inch	70-100
No. 4	60-100
No. 100	0-20
No. 200	0-8

C. Bank Run Gravel
1. Shall conform with Section 704.04 of the VTrans Standard Specifications for Construction
2. The percent of wear of the gravel shall not be more than 50 when tested in accordance with AASHTO T 96.
3. The maximum size stone particle shall not exceed two thirds the thickness of the layer being placed, or a maximum of eight inches in largest dimension, whichever is smaller.
4. Bank Run Gravel shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
No. 4	20-60
No. 100	0-12
No. 200	0-6

D. Coarse Crushed Gravel

1. Shall conform with Section 704.05 of the VTrans Standard Specifications for Construction.
2. The percent of wear of the gravel shall not be more than 40 when tested in accordance with AASHTO T 96.
3. At least 30 percent, by weight, of the material coarser than the no. 4 sieve shall have at least one fractured face.
4. Coarse Crushed Gravel shall meet the following gradation requirements:

Sieve Number	Percentage by weight passing square mesh sieve
4 inches	95-100
No. 4	25-50
No. 100	0-12
No. 200	0-6

E. Fine Crushed Gravel

1. Shall conform with Section 704.05 pf the VTrans Standard Specifications for Construction.
2. The percent of wear of the gravel shall not be more than 40 when tested in accordance with AASHTO T 96.
3. At least 30 percent, by weight, of the material coarser than the No. 4 sieve shall have at least one fractured face.
4. Fine Crushed Gravel shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
2 inches	100
1 ½ inches	90-100
No. 4	30-60
No. 100	0-12
No. 200	0-6

F. Plant Mixed Gravel

1. Shall conform with Section 704.03 of the VTtrans Standard Specifications for Construction.
2. Shall consist of clean, hard, crushed stone or crushed gravel, mixed at the plant to give a specific gradation.
3. When the Plant Mixed Gravel is composed of crushed stone or crushed gravel, the percent of wear of the aggregate shall not be more than 35 when tested in accordance with AASHTO T 96. When the Plant Mixed Gravel is composed of

crushed igneous rock, the percent of wear of the aggregate shall not be more than 50 when tested in accordance with AASHTO T 96.

4. When crushed gravel is used for the aggregate, at least 50 percent, by weight, of the material coarser than the No. 4 sieve shall have at least one fractured face.
5. The aggregate fractions shall be uniformly combined in such proportions that the resulting Plant Mixed Gravel gradation conforms to the following:

Sieve Number	Percentage by weight passing square mesh sieve
1 ¾ inches	100
1 ½ inches	95-100
1 inch	60-85
¾ inch	50-70
½ inch	40-60
No. 4	20-40
No. 8	15-30
No. 200	0-4

G. Surface Course Gravel

1. Shall conform with Section 704.12 of the VTrans Standard Specifications for Construction.
2. The percent of wear of the gravel when tested in accordance with AASHTO T 96 shall not be more than 40 for material used as Surface Course or not more than 50 for material used as Shoulders.
3. Surface Course Gravel shall meet the following gradation requirements:

Sieve Number	Percentage by weight passing square mesh sieve
1 ½ inches	100
1 inch	90-100
No. 4	45-65
No. 100	0-15
No. 200	0-12

H. "Sur-Pak" Gravel

1. "Sur-Pak" Gravel shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
¾ inch	100
½ inch	95-100
3/8 inch	80-95
No. 4	50-70
No. 8	30-50
No. 16	20-40
No. 30	15-35
No. 50	10-30
No. 100	5-20
No. 200	2-10

I. Dense Graded Crushed Stone

1. Shall conform with Section 704.06 of the VTrans Standard Specifications for Construction.
2. The percent of wear of the crushed stone shall not be more than 40 when tested in accordance with AASHTO T 96. The percent of wear shall not be more than 50 if crushed igneous rock is used.
3. Dense Graded Crushed Stone shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
3 ½ inches	100
3 inches	90-100
2 inches	75-100
1 inch	50-80
½ inch	30-60
No. 4	15-40
No. 200	0-6

J. Crushed Stone

1. Shall conform with Section 704.02 of the VTrans Standard Specifications for Construction.
2. When the aggregate is composed of crushed stone, the percent of wear of the aggregate shall not be more than 35 when tested in accordance with AASHTO T 96. When the aggregate is composed of crushed igneous rock, the percent of wear of the aggregate shall not be more than 50 when tested in accordance with AASHTO T 96.
3. ¾ inch Crushed Stone shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
1 inch	100
¾ inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

4. 1 ½ inch Crushed Stone shall meet the following gradation requirement:

Sieve Number	Percentage by weight passing square mesh sieve
1 ¾ inches	100
1 ½ inches	90-100
1 inch	20-55
¾ inch	0-15
3/8 inch	0-5

K. Rip-Rap

1. Stone for rip-rap shall be unhewn, rough quarry stone, as nearly rectangular in section as practicable. The stones shall be hard, sound and resistant to the action of water and weathering. Blast rock may be only used for rip-rap if approved by the Town. Rip-rap shall be of the following types:
   a. Heavy Rip-Rap: The individual stones shall have a depth equal to the thickness of the course rip-rap. At least 75 percent of the volume of the rip-rap, complete in place, shall consist of stones that have a minimum volume of 16 cubic feet.
   b. Light Rip-Rap: The individual stones shall have a depth equal to the thickness of the course rip-rap. The rip-rap, complete in place, shall consist of stones that have a minimum volume of ½ cubic foot.

2. Rounded, unfractured or smooth rocks or quarry screenings or tailings shall not be acceptable rip-rap.

L. Topsoil: refer to Specification Section 02930

M. Category I Imported Fill: shall conform to all the requirements for Category I Onsite Material.

2.02 ONSITE MATERIAL

A. Category I Onsite Material
   1. ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols (See Table Below)
   2. AASHTO M145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these group symbols (See Table below)

B. Category II Onsite Material
   1. ASTM D2487 Soil Classification Groups GC, SM-SC, SC, ML, CL, MH, and CH, or a combination of these group symbols (See Table below)
   2. AASHTO M145 Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, or a combination of these group symbols (See Table below)

C. Unsuitable Onsite Material
   1. ASTM D2487 Soil Classification Groups ML-CL, OL, OH, and PT, or a combination of these group symbols (See Table below)
   2. AASHTO M145 Soil Classification Group A-8 (See Table Below)
   3. Debris, waste, frozen materials, clumps, vegetation, roots, stumps, peat, topsoil, boulders, pavement, concrete, muck, rocks over eight inches in dimension and other deleterious material.
   4. Unsuitable Onsite Materials include Category I and Category II Onsite Materials which the Contractor is unable to compact to specified densities.

D. Suitable Blast Rock
   1. Shall consist of hard, angular blasted rock broken into various sizes. The longest dimension of the stone shall vary from one inch to eight inches, and at least 50 percent of the volume of the stone shall have at least dimension of four inches.

The least dimension of the stone shall be greater than 1/3 of the longest dimension.

2. Suitable Blast Rock shall be reasonably well graded from the smallest to the maximum size stone as to form a compact mass without voids when in place.
3. Shall be free from structurally weak pieces, silt, topsoil, clay, organic or other deleterious material.

E. Table of ASTM D2487 Soil Classification Groups:

Group Symbol	Description	Range of Max. dry densities, lbm/cf	Range of optimum moisture content, %
GW	Well-graded, clean gravels, gravel-sand mixtures	125-135	11-8
GP	Poorly-graded, clean gravels, gravel-sand mixtures	115-125	14-11
GM	Silty gravels, poorly graded gravel-sand silt	120-135	12-8
GC	Clayey gravels, poorly-graded gravel-sand-clay	115-130	14-9
SW	Well-graded clean sands, gravely sands	110-130	16-9
SP	Poorly-graded clean sands, sand-gravel mix	100-120	21.12
SM	Silty sands, poorly-graded sand-silt mix	110-125	16-11
SM-SC	Sand-silt-clay mix with slightly plastic fines	110-130	15-11
SC	Clayey sands, poorly-graded sand-clay mix	105-125	19-11
ML	Inorganic silts and clayey soils	95-120	24-12
ML-CL	Mixture of organic silt and clay	100-120	22-12
CL	Inorganic clays of low-to-medium plasticity	95-120	24-12
OL	Organic silts and silt-clays, low plasticity	80-100	33-21
MH	Inorganic clayey silts, elastic silts	70-95	40-24
CH	Inorganic clays of high plasticity	75-105	36-19
OH	Organic and silty clays	65-100	45-21

F. Table of AASHTO M145 Soil Classification Groups:

	Granular Materials (35% or less passing No. 200 Sieve)							Silt-Clay Materials (35% or more passing No. 200 Sieve)				A-8
	A-1		A-3	A-2				A-4	A-5	A-6	A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7					
Sieve Analysis: % passing												
No. 10	50 max.											
No. 40	30 max.	50 max.	51 max.									
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36min.	36 min.	
Characteristics of fraction passing No. 40												
liquid limit				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	
plasticity index	6 max.		non-plastic	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.	peat,
Usual types of significant constituents	stone fragments gravel and sand		fine sand	silty or clayey gravel and sand				silty soils		clayey soils		highly organic soils

2.03 SATISFACTORY PIPE BEDDING AND INITIAL BACKFILL/ENVELOPE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. For ductile iron pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone, or Category I Onsite Material.
   2. Wet trench bottom: Crushed Stone

B. For SDR 35 PVC pipe: Crushed stone

C. For SCH40 and SCH80 PVC pipe: Crushed Stone

D. For C900 PVC pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone
   2. Wet trench bottom: Crushed Stone

E. For CL160 PVC pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone
   2. Wet trench bottom: Crushed Stone

F. For CL200 PVC pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone
   2. Wet trench bottom: Crushed Stone

G. For reinforced concrete pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone
   2. Wet trench bottom: Crushed Stone

H. For solid wall polyethylene pipe:
   1. Dry trench bottom: Sand, Crushed Gravel, or Crushed Stone
   2. Wet trench bottom: Crushed Stone

I. Fore corrugated polyethylene pipe: Crushed Stone

J. Fore corrugated metal pipe: Crushed Stone

K. For copper pipe: Sand.

2.04 SATISFACTORY STRUCTURE BEDDING MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Below precast concrete wastewater manholes, catch basins, stormwater manholes, storage tanks, septic tanks, and pump stations: Crushed Stone.

2.05 SATISFACTORY TRENCH BACKFILL AND STRUCTURE BAFCKFILL MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Below any surface treatment other than the Lawn and Grass areas or when top edge of excavation is within five horizontal feet of any surface treatment other than Lawn and Grass areas (including, but not limited to, bituminous concrete pavement, curb, sidewalk, or other surface treatment):
   1. Bank Run Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone
   2. Suitable Blast Rock – only if thickness of Initial Backfill/Envelope is doubled, at no cost to the Town.
   3. Category I Onsite Materials,
   4. Category I Imported Fill.

B. Below Lawn and Grass areas:
   1. Bank Run Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone
   2. Suitable Blast Rock – only if thickness of Initial Backfill/Envelope is doubled, at no cost to the Town.
   3. Category I Onsite Materials
   4. Category II Onsite Materials
   5. Category I Imported Fill

2.06 SATISFACTORY FILL MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Below Lawn and Grass Areas:
   1. Bank Run Sand, Bank Run Gravel, Coarse Crushed Gravel, Fine Crushed Gravel, Dense Graded Crushed Stone,

2. Suitable Blast Rock,
3. Category I Onsite Materials
4. Category II Onsite Materials
5. Category I Imported Fill

B. Below ALL other areas: refer to Embankment Materials or Subbase Materials

2.07 SATISFACTORY EMBANKMENT MATERIALS SHALL BE ONE OF THE FOLLOWING:

A. All Embankments: Bank Run Gravel, Coarse Crushed Gravel, Dense Graded Crushed Stone, Suitable Blast Rock

2.08 SATISFACTORY SUBBASE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Below Bituminous Concrete Pavement: Bank Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone

B. Below Cast in Place Concrete Curb: Bank Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone

C. Below Cast in Place Concrete Sidewalk: Bank Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone.

D. Below Granite Curb: Ban Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone

E. Below Gravel Roadway and Driveway: Bank Run Gravel, Coarse Crushed Gravel or Dense Graded Crushed Stone.

F. Below Gravel Shoulder: Bank Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone

G. Below Gravel Sidewalk: Bank Run Gravel, Coarse Crushed Gravel, or Dense Graded Crushed Stone.

2.09 SATISFACTORY BASE MATERIALS SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Below Bituminous Concrete Pavement: Fine Crushed Gravel, Plant Mixed Gravel

B. Below Cast in Place Concrete Curb: Fine Crushed Gravel, Plant Mixed Gravel

C. Below Cast in Place Concrete Sidewalk: Fine Crushed Gravel, Plant Mixed Gravel

D. Below Granite Curb: Fine Crushed Gravel, Plant Mixed Gravel

E. Below Gravel Roadway and Driveway: Fine Crushed Gravel, Plant Mixed Gravel

F. Below Gravel Shoulder: Fine Crushed Gravel, Plant Mixed Gravel

G. Below Gravel Sidewalk: Fine Crushed Gravel, Plant Mixed Gravel

2.10 SATISFACTORY SURFACE TREATMENT MATERIAL SHALL BE ONE OF THE FOLLOWING, AS APPLICABLE:

A. Existing surfaces: if not indicated to be replaced otherwise, all disturbed surfaces shall be replaced with materials matching existing, including special finishes, colors, textures or material types.

B. Bituminous Concrete Pavement: refer to Section 02511.

C. Cast in Place Concrete Curb: refer to Section 03301.

D. Cast in Place Concrete Sidewalk: refer to Section 03301.

E. Granite Curb: refer to Section 03301.

F. Gravel Roadway and Driveway: Surface Coarse Gravel

G. Gravel Shoulder: Surface Course Gravel

H. Gravel Sidewalk: "Sur-Pak" Gravel

I. Lawn and Grass areas: refer to Section 02930

2.11 GEOTEXTILES

A. Subgrade Stabilization Fabric: Shall be Mirafi 500X woven polypropylene geotextile, meeting the following minimum standards:

	METRIC	ENGLISH
Grab Tensile Strength	0.89 kN	200 lbs.
Mullen Burst Strength	2756 kPa	400 psi
Trapezoidal Tear Strength	0.33 kN	75 lbs.
Puncture Strength	0.40 kN	90
UV Deterioration	70% of strength	70% of strength
Apparent Opening Size	0.300 mm	50 (U.S. Sieve)
Flow Rate	200 l/min/m^2	5 gal/min/ft^2

B. Filter Fabric: Shall be Mirafi 140N non-woven polypropylene geotextile, meeting the following minimum standards:

Grab Tensile Strength	0.53 kN
Mullen Burst Strength	1654 kPa
Trapezoidal Tear Strength	0.22 kN
Puncture Strength	0.31 kN
UV Deterioration	70% of strength
Apparent Opening Size	0.212mm
Flow Rate	5500 l/min/m^2

PART 3.00 – EXECUTION

3.01 PROTECTION

A. Protect buildings, structures, utilities, pipelines, sidewalks, plantings, pavement, and other facilities from damage caused by settlement, lateral movement, undermining, washout, subsidence due to lowering of groundwater and other hazards created by earthwork operations. The Contractor shall be responsible for any repairs or remedial work necessary, at no cost to the Town.

B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust.

C. Provide all necessary excavation and trench support systems, materials, and equipment necessary to comply with all Local, State and Federal Standards. Excavation and trench support systems shall be kept in place and maintained until no longer required.

3.02 LAYOUT

A. Provide all qualified personnel and calibrated equipment necessary to establish and maintain all necessary controls for line, grade, elevation, and location.

B. Preserve all monuments, pins, pipes, and rods. If disturbed or lost, the Contractor shall immediately have them replaced or reset by a Licensed Surveyor, at no cost to the Town.

C. The Contractor shall be responsible for accurate placement of all work to the locations and elevations show on the Drawings.

3.03 DEWATERING

A. Prevent surface water and groundwater from entering excavations, from ponding on prepared Subgrade, Embankment, Subbase, Base or Fill, and from flooding Project site and surrounding area.

B. Provide all necessary pumps, well points, and other equipment and materials necessary for control and removal of surface and groundwater.

C. Protect all surfaces from softening, undermining, washout and damage by rain or not use excavated trenches as temporary drainage ditches.

D. Install a dewatering system(s) to keep Subgrade dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.

3.04 EXCAVATING

A. Excavate to grades, depths, elevations and dimensions as shown on the Drawings, or as required, within a tolerance of plus or minus one inch.

B. Do not disturb Subgrade.

3.05 UNAUTHORIZED EXCAVATIONS

A. Fill unauthorized excavations with Bedding, Embankment, or Subbase materials, as appropriate, at no cost to the Town.

3.06 STORAGE OF MATERIAL

A. Stockpile material without intermixing. Place, grade, and shape stockpiles to drain surface water.

B. Cover stockpiles to prevent windblown dust if necessary.

C. Provide necessary erosion control measures to prevent migration of stockpiled materials.

D. Stockpile materials away from edge of excavations. Do not store within drip line of trees to remain.

3.07 DISPOSAL OF UNSUITABLE ONSITE MATERIAL, SURPLUS ONSITE MATERIAL AND WASTE MATERIAL

A. Remove Unsuitable Onsite Material, surplus Onsite Material, waste material, trash and debris and legally dispose of it off the Town's property.

B. If surplus material disposal site(s) are indicated on the Drawings, the Contractor shall transport materials to designated areas. Spread or stockpile materials as directed.

3.08 TRENCHING

A. Excavate to indicated grades, depths, elevations, and dimensions and to uniform widths to provide a working clearance on each side of pipe or Structure.

B. Excavate trenches to required depth below pipe or Structure elevation to allow proper depth and width of Bedding course.

3.09 PIPE BEDDING AND STRUCTURE BEDDING

A. Place required Bedding material to depth and width indicated. Shape Bedding course to provide continuous support for bells, joints, and barrels of pipes, fittings and Structures.

B. If the Town determines that unsatisfactory or unstable Subgrade exists, continue excavation and replace with additional Bedding material.

C. Compact Bedding material to density specified in Schedule below.

3.10 PIPE AND STRUCTURE INITIAL BACKFILL/ENVELOPE

A. Place required Initial Backfill/Envelope material to depth and width indicated. Provide proper haunching and support for bells, joints and barrels of pipes and fittings. Bring Initial Backfill/Envelope material evenly up on sides and along full length of piping or Structure. Do not damage or displace pipe or Structure.

B. Compact Initial Backfill/Envelope material to density specified in Schedule below.

3.11 TRENCH BACKFILLING AND STRUCTURE BACKFILLING

A. Place required Trench Backfill and Structure Backfill material in lifts evenly along full length of piping and evenly on all sides of Structure. Do not damage or displace pipe or Structure.

B. Compact each lift of Trench Backfill and Structure Backfill material to density specified in Schedule below.

C. As trench or excavation support system is removed, do not disturb Trench Backfill and Structure Backfill material.

D. Install warning tape directly above pipe at depth indicated on Drawings.

E. Continue backfilling and compacting to bottom of Embankment, Subbase or Base, as applicable.

3.12 SUBGRADE PREPARATION

A. Notify the Town when excavations have reached required Subgrade.

B. Subgrade shall be crowned or sloped to shed groundwater as indicated on the Drawings, or directed by the Town.

C. Proof roll Subgrade with loaded ten-wheel dump truck to identify soft, spongy, or unstable areas or areas of excess yielding or shoving. Do not proof roll wet or saturated Subgrade. If the Town determines that unsatisfactory soil is present, continue excavation and replace with additional Bedding, Embankment, or Subbase material, as appropriate.

D. Reconstruct Subgrade damaged by freezing temperatures, frost, rain, accumulated water or construction traffic or activities, as directed by the Town, at no cost to the Town.

3.13 SUBGRADE STABILIZATION/SEPARATION GEOTEXTILE INSTALLATION

A. Install specified Subgrade Stabilization/Separation Fabric on prepared subgrade according to manufacturer's instructions. Fabric shall be rolled out flat and tight with no folds.

B. Fabric shall be overlapped a minimum of two feet at all seams.

C. Fabric shall be properly anchored as necessary

D. Do not allow traffic or equipment to travel on fabric

E. Protect fabric from damage and weather

F. Any torn or damaged areas shall be replaced or overlaid with new sections of fabric. All seams at replacement sections shall be overlapped a minimum of three feet.

3.14 EMBANKMENT INSTALLATION

A. Place required Embankment material in lifts on prepared Subgrade, evenly across width and length.

B. Compact each lift of Embankment material to density specified in Schedule below.

C. Continue placing and compacting Embankment material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.

3.15 SUBBASE

A. Place required Subbase material in lifts on prepared Embankment, or Subgrade if no Embankment, evenly across width and length.

B. Compact each lift of Subbase material to density specified in Schedule below.

C. Continue placing and compacting Subbase material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.

3.16 BASE

A. Place required Base material in lifts on prepared Subbase, or Subgrade if no Subbase, evenly across width and length.

B. Compact each lift of Base material to density specified in Schedule below.

C. Continue placing and compacting Base material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.

3.17 FILLING AND GRADING

A. Place required Fill material in lifts on prepared Subgrade evenly across width and length.

B. Compact each lift of Fill material to density specified in Schedule below.

C. Continue filling and compacting in lifts to grades, elevations and dimensions shown on the Drawings.

D. The Contractor shall provide positive drainage at all finish surfaces.

3.18 SURFACE TREATMENT INSTALLATION

A. Existing surfaces: unless indicated to be replaced otherwise, all disturbed surfaces shall be replaced to existing or better condition, location and elevation.

B. Bituminous Concrete Pavement: refer to Section 02511

C. Cast in Place Concrete Curb: refer to Section 03301

D. Cast in Place Concrete Sidewalk: refer to Section 03301

E. Granite Curb: refer to Section 03301

F. Gravel Roadway and Driveway, Gravel Shoulder, Gravel Sidewalk:
   1. Place required material in lifts on prepared Subbase, or Base if no Subbase, evenly across width and length.
   2. Compact each lift of material to density specified in Schedule below.
   3. Continue placing and compacting material in lifts to grades, elevations, thickness, dimensions, cross slope and cross section shown on the Drawings.

G. Lawn and Grass areas: refer to Section 02930.

3.19 SCHEDULE OF REQUIRED COMPACTION

A. Material shall be compacted with appropriate equipment, at the optimum moisture content, to the following percentage of the maximum dry density of the material determined by ASTM Standard Method D1557 (modified proctor):

1. Pipe Bedding and Initial Backfill/Envelope Materials: 95%
2. Trench Backfill and Structure Backfill Materials:
    a. Below any surface treatment other than Lawn and Grass areas or when top edge of excavation is within five feet of any surface treatment other than Lawn and Grass areas (including, but not limited to, bituminous concrete pavement, curb, sidewalk, or other surface treatment): 90%
    b. Below Lawn and Grass areas: 85%
3. Fill Materials:
    a. Lawn and Grass Areas: 85%
    b. All other areas: refer to Embankment Materials or Subbase Materials.
4. Embankment Materials: 95%
5. Subbase Materials: 95%
6. Base Materials: 95%
7. Gravel Roadways and Driveways: 90%
8. Gravel Shoulders: 90%
9. Gravel Sidewalks: 90%

B. Jetting is not an acceptable method of compaction.

END OF SECTION 02300

SECTION 02301 – ROCK REMOVAL

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Furnishing all labor, equipment, materials, and services, and performing operations required to remove rock as specified, utilizing controlled blasting techniques such that resulting ground vibrations are consistently maintained below the maximum levels specified.

B. Protecting new and existing facilities, workers, Town, and the general public from damage or injury from improper handling of explosives, fly rock, and excessive ground vibrations.

C. Furnishing, installing, and implementing an audible warning system to indicate impending blasting and familiarize workers, Town, and the general public with the system implemented.

D. Conducting blasting monitoring as required to excavate rock utilizing the blast monitoring procedures and equipment specified and provide monitoring reports to the Town.

E. The Contractor shall obtain and pay for all permits, insurance, and licenses required to complete the work of this Section, at no cost to the Town.

F. Conducting and documenting the required pre-blast and post-blast surveys.

1.02 REFERENCE STANDARDS

A. Federal Mine Safety and Health Administration Safety Standards for Explosives.

B. The Contractor shall comply with all applicable laws, rules, ordinances, codes, permits, and regulations of the Federal Government, 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 cost to the Town.

C. The Contractor shall comply with the following regulations:
   1. Vermont Occupational Safety and Health Administration (VOSHA) Safety and Health Standards for Construction
   2. Codes for the manufacture, transportation, storage, and use of explosives and blasting agents.

D. The Vermont Fire Prevention and Building Code (latest edition) from the Vermont Labor and Industry Specifications, with references to the NFPA 495 Explosive Material Code (latest edition).

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

1.03 SUBMITTALS

A. Advance Submittals:

1. The Contractor shall submit the following information to the Town at least one (1) week prior to commencing drilling and blasting operations:
   a. "Pre-Blast Survey"
      i. The Contractor shall have prepared, by an independent consultant satisfactory to the Town, a "Pre-Blast Survey" of all existing structures and utilities on the site and within 250 feet of the site, or greater if determined necessary by the Blaster. 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.
   b. Blaster's Insurance Certificates.
   c. Methods of matting or covering of the blast area.
   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. Details of an audible advance signal system to be employed at the job site as a means of informing workers, Town and the general public that a blast is about to occur.
   f. List of instruments that the Contractor proposes to use to monitor vibrations.
   g. 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.
   h. 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.

B. Progress Submittals:

1. Within 24 hours following each blast, the Contractor shall submit to the Town a Blast Monitoring Report. Payment shall be withheld if Blast Monitoring Reports are not supplied. Each Blast Monitoring Report shall include all of the following applicable items:
   a. 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.

b. Blast Monitoring Location Plan
c. General Blast Round Design Data including blast pattern, charge weights, and distributions, other pertinent information, and location.
d. Copy of strip chart from seismograph with calibration and monitoring record marked with the date, time, and location of the blast as well as the monitoring location. Copy shall be legible.

2. Prior to changing the blast round designs, the Town shall be informed in writing as to the nature of the change and the reasons therefore.
3. 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.
4. Review by the Town 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.
5. The Contractor shall report to the Town in writing all blasting complaints received by the Contractor within 24 hours of receipt. The Contractor shall provide the following information: complainant, date and time received, date and time of blast complained about, and a description of the circumstances which led to the complaint.

1.04 QUALITY ASSURANCE

A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for the work.

B. The Contractor shall protect materials before, during and after work. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

C. Upon direction of the Town, the Contractor shall rework all rock removal items that do not meet the requirements of this Section. The Contractor shall perform all remedial measures at no cost to the Town.

D. Contractor Qualifications
1. The term "blaster" and "Contractor" shall include, in this specification section, 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 blaster 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 to meet the requirements of these Specifications. The Superintendent shall have a minimum of 5 years of experience in field blasting work.
2. 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 completed. Drillers shall have demonstrated proficiency in collaring and drilling holes precisely.

E. Blasting limit Criteria:
   1. Peak Particle Velocity Limits:
      a. The blaster shall conduct all blasting in such a manner that the resulting peak particle velocity does not exceed 1.0 inches per second at the ground line adjacent to any existing structures in the vicinity of the project.
      b. If circumstances, project conditions, surrounding structures, or facilities require a lower peak particle velocity threshold, the blaster shall alter their methods to meet such limit without additional cost to the Town.
   2. The blaster shall conduct all blasting in such a manner that conforms to chapter 8 of the NFPA 495 titled "Ground Vibrations, Airblast, Flyrock". The more stringent (i.e. lower peak particle velocity) of the two criteria (Section 8-1.1 and Section 8-1.2) cited in this standard shall apply. These vibration criteria shall also apply to all mechanical methods of rock removal (e.g. hoe-ramming).

F. Blasting Monitoring:
   1. The Contractor shall monitor and record peak particle velocity resulting from all blast rounds fired for the project.

G. Blast Monitoring Reports:
   1. Following each blast, a Blast Monitoring Report shall be submitted to the Town within 24 hours of the blast as specified.

H. Blast Monitoring Instrumentation:
   1. All instrumentation shall be in proper working order for each monitored blast.

1.05 DEFINITIONS RELATING TO THIS SPECIFICATION

A. 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 fracture the rock so as to allow excavation of 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.

B. Earth: All excavated materials not defined as rock

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

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

E. Overbreak: The excess amount of rock removed by and/or resulting from blasting outside, below, or beyond Work payment limits.

F. 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.

G. Rock: Material which is geologically classified as intact bedrock or boulders, and requires systematic drilling and blasting for removal, or removal by an excavator mounted demolition "hoe ram". Rock also includes boulders or loose rock fragments that are individually greater than two (2) cubic yards in volume.

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

PART 2.00 – PRODUCTS

2.01 EXPLOSIVES

A. All explosive material shall be of high quality, properly stored and handled to prevent damage by water, heat or weather. Any "duds" are to be immediately removed from the project by the blaster.

PART 3.00 – EXECUTION

3.01 JOB CONDITIONS

A. Blasting:
1. Blasting shall NOT be permitted between the hours of 5:00 p.m. and 8:00 a.m. and all day Saturday, Sunday, and legal holidays.
2. The Contractor shall provide suitable advanced warning prior to detonating a blast.

B. Vibrational Control:
1. The Contractor shall monitor vibrations for all blast(s) during the course of the work.
2. Blasting operations shall be controlled to conform with the requirements in this Section.
3. If the data indicates that these requirements are not being met, the Contractor shall 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.
4. The Contractor shall install a signal system between the location of the blasting 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.
5. The Contractor shall maintain peak particle velocities within the specified limits, and 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.

6. All necessary blasting shall be done before any concrete or masonry work, to avoid damage to "green" cement. All blasting necessary for pipelines shall be done so as not to damage previously installed components.

3.02 SAFETY PRECAUTIONS

A. Special Hazards:

1. 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.

B. Clearing the Danger Area Before Blasting:

1. 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 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.

C. Explosives shall be stored, handled, and employed in accordance with federal, state, and local regulations and in accordance with National Fire Protection Association (NFPA) codes.

D. No explosives, caps, detonators, or fuses shall be stored on the site during non-working hours unless a permit has been obtained from the State and Municipality and submitted to the Town.

E. Th 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 facilities, or any property adjacent to the site.

F. 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.

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

H. No requirement of, or omission to require, any precautions under this Work 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 facilities resulting from work executed under this Section.

3.03 MONITORING PROCEDURE

A. Mount, place, and locate instrumentation to monitor the most critical and/or closest facility in the blasting area, in the probably shock wave path.

B. Alignment of the axis of vibration measurement:
   1. Axis 1: Vertical
   2. Axis 2: Horizontal, radial direction to the blast location
   3. Axis 3: Horizontal, perpendicular to the radial direction

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

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

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

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

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

3.04 EXCESS ROCK EXCAVATION

A. If rock is over broken or excavated beyond the limits of the payment specified, the excess excavation, whether resulting from overbreak or other causes, shall be backfilled as noted below, at no cost to the Town.

B. In pipe trenches, excess excavation shall be filled with material of the same type, placed and compacted in the same manner, as specified for the bedding.

C. In excavations for structures, excess excavation shall be filled with material of the same type, placed and compacted in the same manner, as specified for the structure base.

D. If the rock beyond or below the payment limits is overbroken, "humped" or causes damage or potential damage to the existing surfaces (ie sidewalk, road, etc) due to drilling or blasting operations of the Contractor, the shattered rock shall be removed and the excavation shall be backfilled as previously specified. All such removal and backfilling shall be done at no cost to the Town.

E. If the rock beyond or below the normal depth is shattered due to drilling or blasting operations of the Contractor, and the Town considers such rock to be unfit for foundations or bedding, the shattered rock shall be removed and the excavation shall be backfilled as previously specified. All such removal and backfilling shall be done at no cost to the Town.

3.05 PREPARATION OF ROCK SURFACES

A. When rock surface is to remain and to be incorporated into the Project, the Contractor shall remove all dirt and loose rock and shall clean the surface of the rock. The designated area shall be observed to determine whether seams or other defects exist, and if the rock is competent.

B. The surface of rock foundations shall be left sufficiently rough to bond to masonry, concrete or embankment, as applicable. If necessary, benches or steps shall be excavated.

C. Before any masonry, concrete or embankment is built on or against the rock, the rock shall be completely freed from all vegetation, dirt, sand, clay, earth, boulders, scale, loose fragments, cracked rock, ice, snow and other objectionable substances.

3.06 DRILLING AND BLASTING OF SOLID ROCK ROAD SUBGRADE

A. Blasted rock road subgrade shall be shattered to a depth of four (4) feet below road subgrade elevation to eliminate water pockets. The area of blasted rock road subgrade shall extend sufficiently beyond the beginning and end of cut areas. Any rock that protrudes above the road subgrade elevation shall be removed to the subgrade elevation.

3.07 DISPOSAL OF EXCAVATED ROCK

A. Refer to the Earthwork specification regarding reuse of excavated rock.

B. Surplus excavated rock shall be disposed of by the Contractor at a suitable location, unless Work conditions or Drawings specify otherwise.

END OF SECTION 02301

SECTION 02510- WATER PIPING

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Water mains, services and fittings

B. Fire hydrants and flushing hydrants

C. Gate valves and post indicator valves

D. Testing of water piping

1.02 REFERENCE STANDARDS

Information and requirements contained in this Specification are based on the most recent version of the following standards:

A. AWWA/ANSI Standard C104/A21.4 for Cement-Mortar Lining for Ductile Iron Pipe and Fittings.

B. AWWA/ANSI Standard C111/A21.11 for Rubber Gasket Joints for Ductile Iron Pipe and Fittings.

C. AWWA/ANSI Standard C150/A21.50 for the Thickness Design of Ductile Iron Pipe.

D. AWWA/ANSI Standard C151/A21.51 for Ductile Iron Pipe, centrifugally cast.

E. AWWA/ANSI Standard C153/A21.53 for Ductile Iron Compact Fittings

F. AWWA/ANSI Standard C600 for Installation of Ductile Iron Water Mains and their Appurtenances.

G. AWWA/ANSI Standard C605 for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

H. AWWA Standard C509 for Resilient-Seated Gate Valves for Water and Sewerage Systems.

I. AWWA Standard C515 for Reduced-Wall Resilient-Seated Gate Valves for Water and Sewerage Systems.

J. AWWA/ANSI Standard C550 for Protective Epoxy Interior Coatings for Valves and Hydrants.

K. AWWA/ANSI Standard C502 for Dry Barrel Fire Hydrants

L. AWWA Standard C651 for Disinfecting Water Mains

M. AWWA Standard C800 for Underground Service Line Valves and Fittings

N. ASTM Standard Specification B88 for Seamless Copper Water Tube

O. AWWA Standard C900 for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch

P. AWWA Standard C905 for Polyvinyl Chloride (PVC) Pressure Pipe, 14 inch through 36 inch

Q. AWWA Standard C901 for Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch

R. AWWA Standard C906 for Polyethylene (HDPE) Pressure Pipe and Fittings, 4 inch through 54 inch

S. ASTM Standard Specifications 1248 and 3350 for PE3408 High Density Polyethylene (HDPE) Pressure Pipe, with a cell classification of 345434C

T. ASTM Standard Specification D2241 for SDR21 (CL200) Polyvinyl Chloride (PVC) Pressure Pipe

U. ASTM Standard Specification D1784 for SDR21 (CL200) Polyvinyl Chloride (PVC) Resin Compound

V. ASTM Standard Specification D1869 and F477 for SDR21 (CL200) Polyvinyl Chloride (PVC) Rubber Gaskets

W. NSF standards for all materials used in the production of potable water pipe

1.03 SUBMITTALS

A. The Contractor shall submit manufacturer's certified data for each pipe type to be used on the Project, including: dimensions, specifications of pipe material, gasket material, pipe class/pressure rating, coatings, and linings.

B. The Contractor shall submit manufacturer's certified data for each type of fitting, valve, post indicator valve, hydrant, flushing hydrant, tapping sleeve, corporation and curb stop to be used on the Project, including: dimensions, specifications of fitting material, gasket material, class/pressure rating, coatings, linings, joint restraints and appurtenances.

1.04 QUALITY ASSURANCE

A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for installation and testing of water piping and appurtenances.

B. The Contractor shall protect water piping materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

C. Upon direction of the Town, the Contractor shall remove, replace and/or rework all water piping that does not meet the requirements of this section. The Contractor shall perform all remedial measures at no cost to the Town.

D. Water System Pressure and Leakage Testing (Ductile Iron, PVC, and Copper Pipe only)

1. Town shall witness all testing
2. The maximum length of pipe to be pressure and leakage tested at one time shall not exceed 1,200 feet.
3. Temporary provisions (caps, plugs, valves, etc.) shall be provided and installed by the Contractor as necessary to allow sections of differing pipe types to be isolated and tested independently, due to the differing testing methodologies.
4. The Contractor shall provide all necessary temporary connections, valves and piping to allow proper expulsion of air and connection of test equipment, at no cost to the Town.
5. Flush all piping and exhaust all air from the test section prior to performing pressure and leakage testing.
6. Provide proper temporary or permanent (as applicable) thrust restraints for all system components.
7. Pneumatic (compressed air or gas) testing shall not be allowed, under any circumstances, due to the severe explosive risk danger.
8. Test equipment shall have pressure relief valves so that water system components are not over-pressurized.
9. The pressure and leakage test shall include all services and branch lines. The Contractor shall provide temporary "tails" as necessary to allow air to be bled from each service or branch to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5 ½ feet below grade.
10. The pressure and leakage tests shall be performed as a combined hydrostatic test with duration of two hours at 150% of the normal operating pressure in the piping at the lowest elevation or 200psi, whichever is greater. The test pressure shall not exceed manufacturer's recommendations for any portion of the system.
11. No water system components within the test section will be accepted if the test pressure cannot be maintained within 5 psi of the required pressure for the entire test period. During the test period, the Contractor may repeatedly pump up the test section to maintain the test pressure within 5 psi of the required test pressure, however the total volume of water added shall be logged to compare against the allowable leakage defined below.
12. Leakage is defined as the quantity of water that must be supplied into the piping to maintain the test pressure after the pipe has ben filled with water and the air expelled. The total volume of water added to bring the pressure back up to the

test pressure shall be compared to the allowable leakage, even if the pressure drop is less than 5 psi during the test period.

13. No water system components within the test section shall be accepted if the leakage is greater than that determined by the formula:
    $L = (SD\sqrt{P})/(148{,}000)$
    L = the allowable leakage, in gallons per hour
    S = the length of pipe being tested, in feet
    D = the nominal diameter of the pipe, in inches
    P = the average test pressure, in psi (gauge)
14. The test section must pass both the pressure test and the leakage test
15. The Contractor shall make all repairs or replacements necessary to obtain passing test results, at no additional expense to the Town.

E. Water System Pressure and Leakage Testing (HDPE pipe only)

1. Town shall witness all testing.
2. The maximum length of pipe to be pressure and leakage tested at one time shall not exceed 1,200 feet.
3. Temporary provisions (caps, plugs, valves, etc.) shall be provided and installed by the Contractor as necessary to allow sections of differing pipe types to be isolated and tested independently, due to the differing testing methodologies.
4. The Contractor shall provide all necessary temporary connections, valves and piping to allow proper expulsion of air and connection of test equipment, at no cost to the Town.
5. Flush all piping and exhaust all air from the test section prior to performing pressure and leakage testing.
6. Provide proper temporary or permanent (as applicable) thrust restraints for all system components.
7. Pneumatic (compressed air or gas) testing shall not be allowed, under any circumstances, due to the severe explosive risk danger.
8. Test equipment shall have pressure relief valves so that water system components are not over-pressurized.
9. The pressure and leakage test shall include all services and branch lines. The Contractor shall provide temporary "tails" as necessary to allow air to be bled from each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5 ½ feet below grade.
10. The HDPE pipe hydrostatic leak test procedures consists of filling, an initial expansion phase, a test period, and depressurizing.
11. Fill the restrained test section completely with water
12. Initial Expansion Phase: Gradually pressurize the test section to test pressure, and maintain test pressure for the three (3) hour expansion phase. During the initial expansion phase, polyethylene pipe will expand slightly. Additional water will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

13. Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain within 5 psi of the required test pressure for the two (2) hour test period.
14. The pressure and leakages tests shall be performed as a combined hydrostatic test with duration of two hours at 150% of the normal operating pressure in the piping at the lowest elevation. The test pressure shall not exceed manufacturer's recommendations for any portion of the system.
15. No water system components within the test section will be accepted if the test pressure cannot be maintained within 5 psi of the required pressure for the entire test period. During the test period, the Contractor may repeatedly pump up the test section to maintain the test pressure within 5 psi of the required test pressure, however the total volume of water added shall be logged to compare against the allowance for expansion under test pressure defined below.
16. The maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again.
17. Leakage is defined as the quantity of water that must be supplied into the piping to maintain the test pressure after the pipe has been filled with water and the air expelled, after the expansion period. The total volume of water added to bring the pressure back up to the test pressure shall be compared to the allowance for expansion under test pressure, even if the pressure drop is less than 5 psi during the test period.
18. No water system components within the test section shall be accepted if the total volume of water added to bring the pressure back up to the test pressure is greater than allowance for expansion under test pressure determined from the table below:

Table of Allowance for Expansion Under Test Pressure (HDPE Pipe)

Nominal Pipe Size (in.)	2-Hour Test (Gal/100 ft of pipe)
2	0.11
3	0.15
4	0.25
6	0.60
8	1.0
10	1.0
12	2.3
14	2.7
16	3.3
18	4.3
20	5.5
22	7.0
24	8.9

19. The test section must pass both the pressure test and the leakage test.

20. The Contractor shall make all repairs or replacements necessary to obtain passing test results, at no additional expense to the Town.

F. Bacteriological Testing

1. After disinfection and final flushing, but before the water system components are activated, the first set of samples shall be taken from each sampling point on the new system. After 24 hours, the second set of samples shall be taken from each sampling point on the new system. The system shall not be flushed between the samples. Two consecutive samples, taken 24 hours apart, must be taken from each sampling point on the new system. Each sample shall be tested by an approved laboratory and determined to be absent of coliform bacteria. If one of the tests fails, the sequence shall be repeated until two (2) consecutive passing tests are obtained from each sample point.
2. There shall be one sampling point for every 1,200 feet of new water main, including one sampling point from each end of the main and a minimum of one sampling point from each branch.
3. Sample collection, delivery, preservation and holding times shall comply with the requirements of the laboratory, in accordance with Health Department and AWWA standards.
4. One sample shall be taken where the project involves Building Services only.
5. The Contractor is responsible for sample collection, delivery, analysis and all fees. If deemed necessary by the Town, the Town shall be allowed to take custody and deliver samples to the laboratory.

PART 2.00 – PRODUCTS

2.01 WATER PIPING

A. Refer to Drawings for locations and sizes of various pipe types required.

B. Ductile Iron (DI) Water Pipe shall meet the reference standards and the following requirements, as applicable:

1. Pipe shall be Class 52, ductile iron O.D.
2. Pipe shall be double cement mortar lined and seal coated.
3. Pipe shall be coated on the outside with bituminous coating
4. Pipe joints shall be push-on bell and spigot type with rubber gaskets, where a different joint type is not indicated on the Drawings.
5. Pipe Joints shall be Restrained Mechanical Joint (MJ) type with "Mega-Lug Series 1100" mechanical joint restraint glands as manufactured by EBAA Iron Sales, Inc., "Uni-Flange Series 1400 Wedge Action" mechanical joint restraint glands as manufactured by Ford Meter Box Co., "Tuf Grip" mechanical joint restraint glands as manufactured by Tyler Union, or approved equal, with T-bolts and rubber gaskets, where indicated on the Drawings.
6. Pipe Joints shall be "Field Lock" Gasket System restrained push-on bell and spigot joint type, as manufactured by U.S. Pipe & Foundry Co., equivalent product manufactured by Tyler Union, or approved equal, where indicated on the Drawings, or in this Specification.
7. Pipe shall be furnished in 18 to 20 foot laying lengths.

8. Pipe shall be installed with two bronze conductivity wedges per joint for pipe diameters of 3 inches through 12 inches, and three conductivity wedges for pipe diameters greater than 14 inches.
9. Pipe shall be manufactured by Atlantic States Pipe Company, Clow, U.S. Pipe, Griffin, McWane Pipe Company, or approved equal.

C. HDPE C-901 Tubing Pipe shall meet the reference standards and the following requirements, as applicable:
1. Pipe shall be rated for a working pressure of 200 psi.
2. Pipe shall be supplied in copper tubing size (CTS) outside diameter
3. Pipe shall be furnished in coils
4. Pipe joints shall be made with McDonald "McQuick Q Series", Mueller "110", or approved equal, compression fittings. Insert stiffeners are required for compression connections.

D. Copper Tubing Pipe shall meet the reference standards and the following requirements, as applicable:
1. Tubing shall be soft tempered, Type "K", Copper
2. Pipe shall be supplied in copper tubing size (CTS) outside diameter
3. Pipe shall be furnished in coils
4. Pipe joints shall be made with McDonald "McQuick Q Series", Mueller "110", or approved equal, compression fittings.

E. Each pipe length shall be clearly marked with the manufacturer's name or trademark, nominal pipe size, material designation, pressure class, dimensional ratio (DR), quality control code and AWWA/ASTM designations.

F. Pipe Joint Restraints shall be furnished and installed for the required number of joints back from each fitting, as required by the Drawings and details, regardless of the pipe material type.
1. For ductile iron pipe, Pipe Joint Restraints shall be "Field Lock Gasket System" restrained push-on joint type, as manufactured by U.S. Pipe & Foundry Co., equivalent product manufactured by Tyler Union, or approved equal.

2.02 FITTINGS

A. Ductile Iron fittings shall be Class 350 compact style with restrained mechanical joints with tee bolts as recommended by the manufacturer. Fittings, glands and gaskets shall be appropriate style and size for the pipes being connected.

B. Fittings shall be double cement mortar lined and seal coated.

C. Fittings shall be coated on the outside with bituminous coating.

D. All mechanical joint fittings for DI and PVC pipe shall have "Mega-Lug" mechanical joint restraints as manufactured by EBAA Iron Sales, Inc., "Uni-Flange Wedge Action" mechanical joint restraints as manufactured by Ford Meter Box Co., "Tuf Grip"

mechanical joint restraints as manufactured by Tyler Union, or approved equal, of the proper style for the pipe type being restrained.

E. All mechanical joint fittings for HDPE pipe shall be connected to the HDPE pipe with a butt fusion HDPE restrained mechanical joint adaptor of the proper style for the pipe and fitting type being joined.

F. All mechanical joint fittings for only existing cast iron pipe shall have "Grip Ring" mechanical joint restraints as manufactured by Romac Industries, Inc., equivalent product manufactured by Griffin Pipe, or approved equal, of the proper style for the pipe type being restrained.

G. All couplings shall be restrained mechanical joint solid sleeves with ductile iron long body and ductile iron glands. Sleeves, glands and gaskets shall be of appropriate style and size for the pipes being connected.

2.03 GATE VALVES

A. All Gate Valves shall be epoxy coated, resilient wedge type, with non-rising stem, Waterous model AFC 2500, Mueller 2360 series, Kennedy Ken-Seal II, or approved equal, with restrained mechanical joints.

B. Valves shall be bubble tight, zero leakage at a minimum working pressure of 200 psi

C. All gate valves shall be counterclockwise (left) open with a two-inch square operating nut. Opening directional arrow shall be cast into the valve body.

D. Gate Valves shall have stainless steel (304) nuts and bolts.

E. An operating rod extension shall be provided where the valve depth exceeds six feet.

F. Buried valves shall be equipped with an adjustable, flanged, 5 ¼ inch diameter, 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 sections with top extended to final grade.

G. The Contractor shall supply the Town with quantity three (3), eight foot (8') long, two-inch (2") square, gate valve wrenches, prior to the start of construction.

2.04 FIRE HYDRANTS

A. All Hydrants shall be Kennedy Guardian Model K-81D, Mueller Super Centurion Figure A-423, or approved equal, with two 2 1/2 inch and one 4 ½ inch nozzles with National Standard Thread.

B. Hydrants shall open counterclockwise.

C. All hydrant drains shall be externally sealed by the manufacturer.

D. Contractor shall provide hydrant assembly height appropriate for bury depth of main. Finish grade shall be within three inches of manufacturers recommended bury line.

E. Hydrants shall be installed with standard Hydrant Tee and gate valve.

F. Hydrants shall have stainless steel (304) nuts and bolts.

G. Hydrants shall be factory painted "Chrome Yellow" conforming with NFPA standards. Contractor shall apply one field finish coat of enamel paint, after hydrant installation. Before applying finish coat, contractor shall properly clean and wire brush hydrant to remove all rust and dirt. Finish coat shall have a minimum thickness of 2.5 mils, with no bare spots or dripping.

2.05 FLUSHING/AIR RELEASE HYDRANTS

A. All flushing hydrants shall be full draining and manufactured as flushing hydrants, with operating valve, one 2 ½ inch nozzle with National Standard Thread and a 2-inch female iron pipe inlet. Flushing hydrants shall have cast iron risers with traffic breakaway flange with brass working parts. Flushing hydrants shall be factory painted RED.

B. Contractor shall provide hydrant assembly height appropriate for bury depth of main. Finish grade shall be within three inches of manufacturer's recommended bury line.

C. Flushing Hydrants shall have stainless steel (304) nuts and bolts.

D. Flushing Hydrants shall be installed with isolation corporation stops.

E. Flushing Hydrants shall be provided with a locking cover over the operating nut.

F. Flushing Hydrants shall be fully serviceable without excavating.

G. Flushing Hydrants shall be factory painted "Red" conforming with NFPA standards. Contractor shall apply one field finish coat of enamel paint, after hydrant installation. Before applying finish coat, contractor shall properly clean and wire brush hydrant to remove all rust and dirt. Finish coat shall have a minimum thickness of 2.5 mils, with no bare spots or dripping.

2.06 TAPPING SLEEVES

A. Tapping Sleeves shall be suitable for direct taps on pressurized water mains.

B. 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 Town.

C. Tapping sleeves shall be:

1. Stainless steel, Model "3490MJ Power MJ", as manufactured by Powerseal Pipeline Products Corp., Romac Industries SST, or approved equal, with a mechanical joint gate valve that complies with Section 2.03.

a. Stainless Steel tapping sleeve shall have 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.

2.07 CORPORATIONS

A. Corporations shall be open left, full flow, ball valve type as manufactured by McDonald, Mueller, or approved equal.

B. Corporations shall have AWWA threads on the inlet and McDonald "McQuick Q series", Mueller "110", or approved equal compression fitting on the outlet.

C. Services larger than 2-inch shall be installed utilizing an in-line tee (see Section 2.02 FITTINGS)

D. Corporations tapped into any pipe type other than ductile iron CL 52 shall utilize a service saddle with double stainless steel straps, of the appropriate style for the pipe type. Service saddles with U-bolt type straps are unacceptable.

E. 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.

2.08 CURB STOPS

A. Curb Stops shall be open left, full flow, ball valve type as manufactured by McDonald, Mueller, Cambridge Brass, or approved equal.

B. Corporations shall have McDonald "McQuick Q Series", Mueller "110", or approved equal compression fittings on the inlet and outlet.

C. Services larger than 2-inch shall utilize gate valves (see Section 2.03 GATE VALVES).

D. Curb Stops shall be equipped with a sliding adjustable, cast iron curb box with a two-hole cover or Mueller pentagon plug type marked "WATER". Where box is located in paved or concrete areas, cover shall be pentagon plug type. The box shall be arch-type so as to enclose the curb stop and rest on a concrete base pad and not transfer force to the service or curb stop. Boxes for curb stops larger than 1 inch shall have a heavy foot piece. Box length shall be adequate to allow a minimum of four inches of overlap of sections with top extended to final grade.

E. A 30-inch stainless steel stationary operating rod shall be affixed to the key of the curb stop with a stainless steel cotter pin.

F. 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.

G. The Contractor shall supply the Town with quantity three (3) curb stop wrenches, prior to the start of construction.

2.09 PRODUCT STORAGE AND HANDLING

A. Handle and transport pipe and fittings to insure they are in sound, undamaged condition and to prevent damage to coating and lining, in accordance with manufacturer's instructions.

B. Furnish slings, straps and other devices to support pipe and fittings when lifted. Do not drop or drag pipe or fittings from trucks onto the ground or into the trench.

C. Examine all pipe and fittings before installing. Defective or damaged materials shall be rejected.

D. Pipe or fittings with damaged coatings and/or linings shall be rejected.

E. Cracked or chipped pipe or fittings shall be rejected.

F. If defective pipe or fittings are discovered after installation, the Contractor shall remove and replace the defective piece(s) at no cost to the Town.

PART 3.00 – EXECUTION

3.01 GENERAL

A. Refer to Section 02300 for excavating, bedding, envelope, backfilling and compaction requirements.

B. When cutting of pipe is required, the cutting shall be done with power saws. Cut ends shall be smooth and at right angles to the pipe. Cut pipe ends shall be beveled and de-burred on interior and exterior.

3.02 INSTALLATION

A. Water mains, building services, and appurtenances shall be installed according to the Drawings.

B. Pipe shall be laid accurately to the lines and grades indicated on the Drawings.

C. Pipe shall be fully supported along its length. "Point contact" at fittings, joints or along the pipe length is not allowed.

D. All field cut pipe ends shall be chamfered to avoid damage to the gasket and facilitate assembly.

E. Push-on bell and spigot type joints shall be assembled per the manufacturer's recommendations.

F. Deflection of push-on joint pipe shall not exceed manufacturer's recommended limits.

G. Restrained Mechanical Joints shall be assembled per the manufacturer's recommendations.

H. Butt fusion joints shall be assembled per the manufacturer's recommendations.

I. Install two or three (depending on pipe diameter) bronze conductivity wedges, installed at "3-o'clock, 9 -o'clock, and 12-o'clock", per manufacturer's recommendations, at all ductile iron pipe joints.

J. All fittings shall be adequately supported to prevent undo strain on the pipe, fittings, gaskets and bolts.

K. All hydrants, valves and curb stops shall be set plumb and in compliance with the Drawings.

L. Valve and curb boxes shall be installed plumb with the covers level with final grades.

M. Pipe Joint Restraints shall be installed for the required number of pipe joints back from each fitting, as required by the Drawings and details. Plant batched, poured in place, concrete thrust blocks shall be provided at all directional changes of the main, when restrained pipe joints cannot be used (i.e. connections to existing systems) in compliance with the Drawings. Thrust Blocks shall not be backfilled within ½ hour of being poured to allow sufficient time for setting of the concrete. Onsite mixed concrete, such as "Sakrete", is <u>not</u> acceptable.

N. When pipe laying is not in progress, the open ends of the pipe shall be closed with a water tight plug.

O. Where water mains or building services cross within two feet of drainage pipe or site conditions do not allow the minimum 5 ½ foot cover, the Contractor shall install two inches thick, four foot wide, of rigid insulation, suitable for direct burial, for frost protection.

P. Cover of less than 5 ½ feet, shall be approved by the Town prior to pipe installation. Under no circumstances shall water mains or building services have less than four feet of cover over the top of the pipe. Insulation shall be installed six inches above the pipe

on compacted envelope material with care taken to not damage the sheets during trench backfill and compaction.

Q. Where water mains or building services are required to cross wastewater piping, the installation shall comply with the following requirements:
   1. Water and sewer pipes shall have a minimum vertical clearance of 18 inches.
   2. Water and sewer pipe joints shall be located as far apart as possible.
   3. The Contractor shall provide structural support for exposed water and sewer lines.

R. The minimum horizontal clearance between water and sanitary sewer piping is 10 feet, and the minimum horizontal clearance to storm sewers is 5 feet.

S. in the event that the minimum vertical or horizontal clearances between water and sewer piping cannot be maintained, the sewer piping must be upgraded and tested to water pipe standards.

3.03 FLUSHING

A. All Water Piping shall be flushed at a minimum velocity of 2.5 feet per second. All pipes shall be flushed prior to Leakage and Pressure Testing, Disinfection and Bacteriological Testing.

B. Care shall be taken to protect property from erosion or other damage during flushing operations.

C. The flushing operation shall include all services. The Contractor shall provide temporary "tails" as necessary to flush through each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5 ½ feet below grade.

3.04 DISINFECTION

A. At a point not more than ten feet downstream from the beginning of a new main, water entering the main shall be dosed with chlorine, fed at a constant rate, such that the entire volume of water will have a concentration of not less than 25 mg/l free chlorine. Chlorine levels shall be confirmed with a test kit, however the following table is provided as a general guide to estimate the volume of chlorine required.

Pipe Size (in.)	1% Chlorine Solution (Gal.)
4	0.16
6	0.36
8	0.65
10	1.01
12	1.44

Chlorine required to produce 25 mg/l concentration in 100 feet of pipe, by pipe diameter

B. Disinfection operations shall not cease until the entire main is filled with heavily chlorinated water.

C. The disinfection operation shall include all services. The Contractor shall provide temporary "tails" as necessary to disinfect each service to above grade. After the system has passed the necessary tests and prior to weather below freezing temperatures, the Contractor shall dig up each service, and as appropriate for the project, either connect the new service to the existing service, or turn off the curb stop and install a short stub of service piping out of the curb stop with a compression cap, minimum 5 ½ feet below grade.

D. The Chlorinated water shall be retained for a minimum of 24 hours, during which all curb stops, valves and hydrants in the treated section shall be operated to ensure disinfection of appurtenances. The water in all portions of the main shall have a minimum residual of 10 mg/l of free chlorine after 24 hours.

E. The Contractor shall prevent the introduction of heavily chlorinated water into any active portions of the water distribution system.

F. At the end of the 24-hour period, the main shall be flushed with water from the distribution system until the discharge chlorine concentration is equal to that of the system or 1 mg/l free chlorine.

G. The Contractor shall comply with all laws relevant to the discharge of chlorinated water. Water discharged directly or indirectly to water bodies shall not have a chlorine level greater than 0.1 ppm. Water bodies shall include all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, wetlands, and any body of surface water, artificial or natural.

H. The Contractor shall supply all necessary de-chlorination equipment, materials, chemicals and labor necessary to reduce the chlorine level prior to discharge.

I. Any required permits for the discharge of chlorinated water (local or State), are the responsibility of the Contractor.

END OF SECTION 02510

SECTION 02511 – BITUMINOUS CONCRETE PAVEMENT

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Bituminous concrete pavement for roadways, parking areas, driveways, aprons, sidewalks, pathways, curbs, overlays, replacement of disturbed pavement and associated preparatory work.

B. Painted and durable pavement lines and markings.

1.02 REFERENCE STANDARDS

A. Where referenced, the Contractor shall adhere to the latest version of the State of Vermont Agency of Transportation (VTrans), "Standard Specifications for Construction".

1.03 SUBMITTALS

A. The Contractor shall submit separate project mix designs according to the reference standards for each pavement type to be used on the project, including all calculations, data and information necessary for mix evaluation, placement review and testing. The contractor shall secure the Town's review for the mix design a minimum of 48 hours prior to the start of paving operations.

B. The Contractor shall submit manufacturer's data and secure the Town's review for asphalt cement tack coat, overlay fabric, pavement paint, durable markings, and all other necessary materials prior to the start of paving operations.

1.04 QUALITY ASSURANCE

A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for placement and finishing of bituminous concrete pavement.

B. The Contractor shall protect bituminous concrete pavement materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

C. Testing to verify density of the compacted pavement shall be done with a nuclear density gauge according to the reference standards. Minimum density of the compacted pavement shall be as indicated in Section 406 of the reference standard.

D. The Contractor shall keep a record at the project site showing time and location of each segment of pavement placed, together with mix delivery slips certifying the contents of each load of pavement. One copy of all such records shall be furnished to the Town.

E. The surface may be tested by the Town 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 ten-foot straight edge may be used on a vertical curve. On parking surfaces or other paved areas that have no crown, the surface shall be tested parallel to the drainage slope of the area. Under no circumstances shall standing water or puddling be allowed.

F. Compacted pavement thickness shall be within 1/8 inch of the thickness specified on the Drawings.

G. Finish surfaces of pavement shall be smooth, uniform, and free of voids, cracks, holes, loose or contaminated areas or other irregularities.

H. Upon direction of the Town, the Contractor shall cut out and/or rework all surfaces which do not meet the requirements of this Section. The Contractor shall perform all remedial measures at no cost to the Town.

PART 2.00 – PRODUCTS

2.01 MATERIALS

A. Aggregate for bituminous concrete pavement shall conform to Section 704.10 of the referenced standard.

B. Asphalt cement for bituminous concrete pavement shall be performance grade PG58-28 and shall conform to Section 702 of the referenced standard.

C. Bituminous concrete pavement shall be of the thickness and type indicated on the Drawings. The materials shall be combined and graded to meet the compositions of Section 406 of the referenced standard, for heavy duty bituminous concrete pavement, 75 blows per side.

D. Asphalt cement tack coat shall be emulsified asphalt type RS-1 conforming to Section 702 of the referenced standard.

E. Bituminous joint sealer shall conform with Section 707.04 of the referenced standard.

F. Pavement overlay fabric shall be Mirafi© "Mirapave 400" non-woven geotextile, or equal.

G. Pavement paint shall conform with Section 708.08 of the referenced standard, of the color indicated on the Drawings.

H. Durable pavement markings shall conform with Section 708.10 and Section 646 of the referenced standard, of the color, type and size indicated on the Drawings.

PART 3.00 – EXECUTION

3.01 PREPARATION

A. The existing pavement surface shall be cleaned with power brooms and washers as necessary to allow proper adhesion of the tack coat and bituminous concrete pavement. All loose pieces, objects and debris shall be removed.

B. Any cracks larger than ¼ inch in an existing surface shall be thoroughly cleaned and filled with bituminous joint sealer, to the full depth of the existing pavement, in accordance with Section 417 of the reference standard.

C. The existing bituminous concrete pavement shall be sprayed with emulsified asphalt tack coat before placement of the bituminous concrete pavement. Tack coat is required for all overlays and before placement of the top course when the top course is not immediately placed over the base course.

D. The tack coat shall be applied under pressure at the rate of 0.01 to 0.03 gallons per square yard. The application shall be made just prior to the placement of the bituminous concrete pavement, but shall progress sufficiently ahead of the paving so that the surface to be paved will be tacky.

E. Contact surfaces such as curbing, gutters, manhole and catch basin rims shall be painted with a thin, uniform coat of emulsified asphalt immediately before the bituminous concrete pavement is placed against them. Precautions must be taken to protect non-contact surfaces from excess emulsion.

F. Where bituminous concrete is used to resurface existing pavement and the existing pavement contains irregularities, depressions or waves, such deficiencies shall be eliminated by the use of a bituminous concrete shim course(s) of appropriate mix for leveling to bring the existing base to uniform section and grade before placing of the required courses of bituminous concrete.

G. Where pavement has been removed for trenching, the Contractor shall cleanly cut existing pavement back with a pavement saw in a straight line, a minimum of one foot from the top edge of the trench. Cut must be made such that remaining existing pavement is competent and sound. Cut edge of pavement shall be coated with a uniform coat of emulsified asphalt immediately before the bituminous concrete pavement is placed against it.

H. Where a pavement overlay is required, grinding of the existing pavement is required at the termination of the overlay. Grinding shall be done with proper equipment necessary for grinding the full width of the pavement being overlaid. Depth and length of taper shall be determined by the thickness of the overlay. Minimum depth of grind at termination end shall be equal to the thickness of the pavement overlay to be placed. The grind shall taper at a slope of one inch in twenty-five feet, so that the top of the grinding is flush with the existing pavement at the appropriate distance away from the pavement overlay termination. The entire area ground shall be sprayed with emulsified asphalt tack coat before placement of the bituminous concrete pavement overlay.

I. Where pavement overlay fabric is indicated on the Drawings, sufficient tack coat shall be used to allow saturation of the overlay fabric, while bonding with the existing pavement. Tack coat shall not be of such quantity that pools or puddles form. Install the overlay fabric with the heatset side up, without folds or wrinkles. Immediately following the fabric laydown, place the hot pavement. Only lay out fabric which can be immediately covered.

3.02 EQUIPMENT

A. Equipment for spreading and finishing the bituminous concrete pavement shall be a self-propelled paving machine provided with an articulated and heated screed. The machine shall be capable of maintaining line, grade and minimum thickness specified and spreading the pavement without segregation.

B. When irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the pavement shall be spread, raked and finished with hand tools.

C. Equipment for compacting shall be steel tired power rollers having a minimum weight of ten tons, except that hand held vibratory compactors may be used in areas not accessible to rollers when specifically approved by the Town. Rollers shall be equipped with tanks and sprinkler bars for wetting the rollers.

3.03 WEATHER AND SITE CONDITIONS

A. Bituminous concrete pavement shall not be placed between November 1 and May 1, unless approval is obtained from the Town.

B. Bituminous concrete pavement shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is below 40°F.

C. Bituminous concrete pavement shall not be placed on a wet, frozen or thawing surface or when weather or other conditions would prevent the proper handling, finishing or compacting of the material.

D. No material shall be delivered so late in the day as to prohibit the completion of spreading and compaction of the pavement during daylight hours.

3.04 PLACEMENT

A. The bituminous pavement, at the time of discharge from the haul vehicle, shall be within 10°F of the midpoint of the compaction temperature for the approved mix design. In no instance shall the temperature of the pavement be less than 275°F or more than 325°F.

B. The bituminous concrete pavement shall be placed and finished with the specified equipment and struck off in an uniform layer to the full width required and of such

depth that each course, when compacted, shall have the required thickness and shall conform to the grade and elevation specified.

C. Any pavement which becomes loose, broken or contaminated shall be removed and replaced with fresh pavement and properly compacted and blended with the surrounding pavement. Any area showing an excess or deficiency of asphalt shall be removed and replaced. These corrections shall be done at no additional expense to the Town.

D. Suitable aprons to transition approaches shall be placed at side road and driveway intersections.

3.05 ROLLING AND COMPACTING

A. Immediately after the bituminous concrete pavement has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

B. The surface shall be rolled when the pavement is in the proper condition and temperature, and when the rolling does not cause cracking or shoving.

C. Unless otherwise directed, the longitudinal joint shall be rolled first and then rolling shall begin at the low side of the pavement and proceed towards the center or high side with lapped rolling parallel to the centerline. The speed of the roller shall be slow and uniform to avoid displacement of the pavement. The roller should be kept in as continuous operation as practical. Rolling shall continue until all roller marks and ridges have been eliminated. Stopping or sharp turning of the roller on the fresh pavement is not permitted.

D. Breakdown rolling shall be completed before freshly placed pavement temperature drops below 250°F.

E. Finish rolling shall be completed before freshly placed pavement temperature drops below 175°F.

F. Traffic shall not be allowed on freshly placed pavement until it has been compacted and cooled to 140°F.

3.06 JOINTING

A. Unless otherwise noted by the Town or on the drawings, transverse joints in pavement shall be butt type.

B. Butt joints shall be formed by ending the new pavement in a vertical plane at right angles to the centerline. The butt joint shall be thoroughly coated with emulsified asphalt just prior to butting the adjacent course of pavement.

C. When directed by the Town, tapered joints shall be formed by ramping down the last 18 to 24 inches of the course being laid to match the lower surface. Care shall be taken in raking out and discarding the coarser aggregate at the low end of the taper, and in rolling the taper. The taper shall be thoroughly coated with emulsified asphalt just prior to resumption of paving.

D. Longitudinal joints that have become cold and joints between successive work days shall be coated with emulsified asphalt before the adjacent pavement is placed. If directed by the Town, they shall be cut back to a clean vertical edge prior to painting with emulsion.

E. Unless otherwise directed by the Town, longitudinal joints shall be offset at least six inches from any joint in the lower courses of pavement. Transverse joints shall not be constructed nearer than one foot from the transverse joints constructed in lower courses.

F. Utility covers shall be flush with the surface of the finish course. When finish coarse paving will not be completed within seven days of placement of the base course, the Contractor shall leave the covers flush with the base coarse and raise them at the time of finish coarse paving at no cost to the Town. The base course of pavement shall be patched after raising the covers, prior to placing the finish course of pavement. If the utility covers need to be left higher than the base course, for less than seven days, the Contractor shall provide all necessary traffic control and barricades to protect the utility covers and the public.

3.07 PAVEMENT MARKINGS

A. The Contractor shall thoroughly clean the areas upon which painting or durable markings will be placed.

B. All painting and durable markings shall be accurately placed as indicated on the Drawings.

C. The Contractor shall apply paint and durable markings in accordance with the manufacturer's recommendations and referenced standards, using all means necessary to protect paint and durable markings until cured.

D. Where removal of pavement markings are shown on the Drawings, grinding of the existing pavement is required. Grinding shall be done with proper equipment necessary for grinding the full width of the marking being removed. Depth shall be determined by the thickness of the marking and its penetration into the pavement. Maximum depth of grind shall be 1/8". The grind shall taper so that the top of the grinding is flush with the existing pavement approximately one foot away from the marking limits.

END OF SECTION 02511

SECTION 02930 – LAWNS AND GRASSES

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Preparation, furnishing and installing topsoil, fertilizer, seed and mulch.

B. Maintenance of lawns and grasses

1.02 SUBMITTALS

A. The Contractor shall submit seed mix compositions and analysis for each seed mix type to be used on the project. Each seed mix shall indicate percentage and germination of each seed type in the mixture. Purity and weed seed content of the mixture shall be indicated.

B. The Contractor shall submit the location of source, analysis and sample of off-site topsoil, as required by the Town.

1.03 QUALITY ASSURANCE

A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for the work included.

B. The Contractor shall protect lawn and grass areas and materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

C. Upon direction of the Town, the Contractor shall remove and/or rework all lawn and grass areas that do not meet the requirements of this Section. The Contractor shall perform all remedial measures at no cost to the Town.

D. Lawn and grass areas shall have a healthy, uniform growth upon completion, with no weeds, bare spots, rocks, clumps, or standing water.

PART 2.00 – PRODUCTS

2.01 MATERIALS

A. Topsoil shall be fertile, natural soil, typical of the locality, unfrozen, friable clay loam. It shall be free from clay lumps, stones, roots, sticks, stumps, peat, weeds, sod, brush, noxious seeds, or foreign materials.
   1. Topsoil shall have a pH range of 6 to 8
   2. Topsoil shall not contain toxic material harmful to plant growth
   3. Topsoil shall be removed and stockpiled from the disturbed areas. In the event the topsoil removed during excavation is unsatisfactory or insufficient to obtain

the required finished grades, the Contractor shall furnish the required quantity of satisfactory topsoil from approved off-site sources at no cost to the Town.

4. Under no circumstances may the Contractor remove topsoil from the work area of this project for use elsewhere.

B. Fertilizer shall be a standard commercial grade prepared and packaged material containing a minimum of 10 percent nitrogen, 10 percent phosphoric acid and 10 percent potash. Fertilizer shall comply with local, state and federal laws.

1. Fertilizer shall be delivered in the original, unopened containers, each showing the manufacturer's guaranteed analysis. It shall be stored so that when used it is dry and free-flowing.

C. Seed mixtures shall be of commercial stock of the current or previous season's crop and shall be delivered in unopened containers bearing the dealer's guaranteed analysis. Seed shall be stored in a dry, protected place.

1. Urban mix grass seed meeting the following mixture shall be used for finished lawns, public street grass areas, and any other maintained grass areas.

Type of Seed	Percentage by Weight
Creeping Red Fescue	35%
Kentucky Bluegrass	35%
Pennfine or Manhattan Perennial Rye	30%

2. Conservation mix grass seed meeting the following gradation shall be used for all other grass areas where urban mix is not used.

Type of Seed	Percentage by Weight
Creeping Red Fescue	35%
Kentucky Bluegrass	23%
Annual Rye	15%
Pennfine or Manhattan Perennial Rye	11%
White Clover	6%
Highland Bent Grass	10%

3. Wildflower mix seed shall be suitable for the climate region northeast by American Meadows, Vermont Wildflower Farm, or approved equal.

D. Hay mulch shall consist of mowed and properly cured stalks of oats, wheat, rye, or other approved crops free from weeds, swamp grass, twigs, debris, rot, mold, or other deleterious material. Wildflower seed shall not be mulched with hay; light straw mulch shall be used if recommended by seed supplier.

E. Water shall be furnished by the Contractor which is suitable for irrigation and free from ingredients harmful to plant life. Hose and any watering equipment required shall be furnished by the Contractor.

PART 3.00 – EXECUTION

B. Seed must be rolled in. If mulch is recommended to preserve moisture or control erosion, only straw mulch shall be used.

3.04 MAINTENANCE AND PROTECTION

A. Contractor shall mow all lawn areas before the new grass reaches a height of three inches. Not more than 1/3 of the grass leaf shall be removed by the initial or subsequent cuttings. Contractor shall maintain and mow all lawn areas until Substantial Completion of the Project.

B. The Contractor shall be responsible for protecting and caring for seeded areas until final acceptance of the work. The Contractor shall repair and replace, at no cost to the Town, all areas where seed has failed to germinate, or any areas damaged by erosion, weeds, pedestrians or vehicular traffic or other causes.

END OF SECTION 02930

3.01 PREPARATION

A. Seeding shall only be done with weather and season will allow proper germination

B. Areas to receive topsoil shall be graded to a depth of not less than four inches below the finished grade. If the existing depth of topsoil prior to constructions was greater than four inches, the topsoil shall be replaced not less than the greater depth.

C. Remove all debris, sticks, roots, stones and inorganic material and rake subgrade prior to placing topsoil. Topsoil shall not be placed on frozen or muddy subgrade.

3.02 INSTALLATION – GRASS

A. Specified topsoil shall be spread and lightly compacted on the prepared subgrade to the depth required.

B. Uniformly spread the fertilizer at a rate of 20 pounds per 1,000 square feet and immediately mix with the upper two inches of topsoil.

C. Immediately following this preparation, uniformly apply the seed at a rate of 5 pounds per 1,000 square feet.

D. Lightly rake the seed into the surface. Lightly roll the surface and water with a fine spray.

E. Promptly thereafter or within 24 hours after the seeding, lightly and uniformly mulch the area at a rate of 90 pounds per 1,000 square feet. Mechanical or hand spreaders may be used. Excessive amounts or bunching of mulch will not be accepted.

F. Mulch shall be anchored by an acceptable method.

G. Unless otherwise specified, mulch shall be left in place and allowed to disintegrate. Any anchorage or mulch that has not disintegrated at time of first mowing shall be removed.

H. Seeded areas shall be watered as often as required to obtain germination and to obtain and maintain a satisfactory sod growth. Watering shall be done in a manner to prevent washing out of seed or mulch.

I. All lawn and grass areas shall drain properly. Under no circumstances will standing water or puddling be allowed.

J. Hydroseeding may be acceptable as an alternative method of applying fertilizer, seed, and mulch, upon approval of the Town.

3.03 INSTALLATION – WILDFLOWER SEED

A. Soil preparation and sowing shall exactly follow published instructions by seed supplier. Application rate shall be 1 pound per 1,000 square feet.

B. Seed must be rolled in. If mulch is recommended to preserve moisture or control erosion, only straw mulch shall be used.

3.04 MAINTENANCE AND PROTECTION

A. Contractor shall mow all lawn areas before the new grass reaches a height of three inches. Not more than 1/3 of the grass leaf shall be removed by the initial or subsequent cuttings. Contractor shall maintain and mow all lawn areas until Substantial Completion of the Project.

B. The Contractor shall be responsible for protecting and caring for seeded areas until final acceptance of the work. The Contractor shall repair and replace, at no cost to the Town, all areas where seed has failed to germinate, or any areas damaged by erosion, weeds, pedestrians or vehicular traffic or other causes.

END OF SECTION 02930

SECTION 03301 – CURB AND SIDEWALK

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. Cast-in-place concrete curb, sidewalk and ramps.

B. Granite curb.

C. Detectable Warning Surface (Truncated Domes)

1.02 REFERENCE STANDARDS

A. Where referenced, the Contractor shall adhere to the latest version of the State of Vermont Agency of Transportation (VTrans), "Standard Specifications for Construction".

1.03 SUBMITTALS

A. The Contractor shall submit separate project mix criteria according to the reference standards for each concrete type to be used on the project, including all calculations, data and information necessary for mix evaluation and placement review and testing. The contractor shall secure the Town's approval for the mix design a minimum of 48 hours prior to the start of concrete placement.

B. The Contractor shall submit manufacturer's data and secure the Town's approval for fiber reinforcement, admixtures, curing and sealing compound, exposed aggregate/surface treatment retardant compound and all other necessary materials before the start of concrete placement.

C. The Contractor shall submit the name and address of quarry and supplier of granite. If required by the Town, a granite sample shall also be supplied.

D. The Contractor shall submit manufacturer's data and secure the Town's approval for detectable warning surface (truncated domes) before the start of concrete placement.

1.04 QUALITY ASSURANCE

A. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for placement and finishing of curb and sidewalk.

B. The Contractor shall protect curb and sidewalk materials before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

C. Testing to verify air content and slump of concrete being placed shall be done at the time of placement, at the Town's discretion.

D. Cylinder samples for concrete strength testing shall be taken at the time of placement, at the Town's discretion.

E. The Contractor shall keep a record at the project site showing time and location of each segment of concrete placed, together with mix delivery slips certifying the contents of each load of concrete. One copy of all such records shall be furnished to the Town.

F. Upon direction of the Town, the Contractor shall cut out and replace all curb and sidewalk that does not meet the requirements of this Section. The Contractor shall perform all remedial measures at no cost to the Town.

PART 2.00 – PRODUCTS

2.01 MATERIALS

A. Concrete shall have a minimum compressive strength of 4,000 psi at 28 days, unless otherwise specified, and shall meet all other requirements for Class A Concrete in the referenced standard, unless revised below.
1. Air entrainment shall be between six and eight percent (6%-8%).
2. Maximum Water-Cement ratio shall be 0.45.
3. Min. Cement Factor (Sacks/C.Y.) shall be 7.0.
4. Maximum slump shall be 4-inches.

B. Concrete curbs and sidewalks shall have Grace Construction Products "MicroFiber"™ reinforcement admixture, equivalent product manufactured by Nycon, or approved equal.
1. Fibers shall be ¾ inch polypropylene, maximum 3 denier, complying with ASTM C1116, Type III, Par. 4.1.3.
2. Fibers shall be added at the concrete batch plant to ensure proper mixing. Mix in truck for a minimum of 20 minutes after fiber addition.
3. Fiber application rate shall be one pound per cubic yard of concrete, resulting in not less than 50 million individual fibers per pound.

C. Portland Cement shall be ASTM C150, Type II unless otherwise specified. Use of air-entrained or other types of cements is prohibited without the prior acceptance of Town. Use only one brand of cement. Color variations which prejudice the appearance of exposed concrete are deemed unacceptable.

D. Fine Aggregate for concrete shall meet ASTM C33.

E. Coarse Aggregate for concrete shall meet ASTM C33, ¾-inch maximum size.

F. Concrete Admixtures
1. Air Entraining admixture shall be "Darex AEA" by W.R. Grace, "Pozzolith MB-VR" by Master Builders, or approved equal. Use of air entraining cement is prohibited. Add air entraining admixtures to all concrete which will remain exposed to freezing and thawing.

2. Water Reducing Retarder shall meet ASTM C-494, "Plastiment" by Sika Chemical Corporation, "Pozzolith 322N" by Master Builders, or approved equal. Quantity of retarder to be added per sack of cement shall be as recommended by the approved manufacturer for general use and as required to suit actual ambient or mix temperatures.
3. Water reducing admixture shall be "WRDA with Hycol" by W.R. Grace, "Pozzolith 110N" by Master Builders or approved equal.
4. No other admixtures are permitted without the prior review of the Town.
5. Admixtures shall be compatible with one another and with aggregates, cement, finishing materials, and other materials which may be affected thereby.
6. Chloride based accelerators shall not be permitted.

G. Mixing water shall be fresh, clean and potable. Should Town question the suitability of the water, Contractor shall have it tested in accordance with AASTO T-26.

H. Curing and sealing compound shall be "Kure-N-Seal"© as manufactured by Sonneborn, equivalent product manufactured by Sika, or approved equal.

I. Exposed aggregate/surface retardant compound shall be "Rugasol-S"© as manufactured by Sika Corporation, equivalent product manufactured by W.R. Grace, or approved equal.

J. Expansion joint material shall be preformed type with vegetable fibers, mineral fillers and two asphalt-saturated felt liners, complying with ASTM D994, with a minimum thickness of ½ inch. Depth of expansion joint shall be the thickness of the concrete minus ¼ inch. Expansion joints shall be provided at all joints between building slabs and foundations, joints in sidewalks, driveways, curbs, steps, and at any other locations shown on the Drawings.

K. Detectable Warning Surface (Truncated Domes) shall be a pattern of truncated domes that meets the dimensional and spacing requirements of the Americans with Disabilities Act (ADA) Accessibility Guidelines.
1. Detectable warning surfaces shall be provided on sidewalk ramps at locations shown on the Drawings.
2. Truncated domes shall be a part of either a precast tile/paver, semi-rigid composite sheet or surface applied product. Stamping or imprinting systems shall not be accepted.
3. The Detectable warning surface shall be one of the products on the "Approved Products List" on file with the VTrans Materials and Research Section, telephone number 802-828-2561.

L. Granite Curb shall consist of hard, durable, quarried granite. It shall be gray in color, free from seams, cracks or structural defects and shall be of a smooth splitting character. The curb may have natural color variations that are characteristic of the granite source.
1. The individual curb stones shall be of the dimensions indicated on the Drawings and shall be of uniform thickness in any continuous run. The individual curb stones shall be furnished in minimum lengths of 6 feet, unless otherwise specified.

2. The top surface of the curb stones shall be sawed to an approximately true plane and shall have no projection or depression greater than 1/8-inch. The bottom surface may be sawn or split.
3. The top front arris line shall be rounded as indicated on the Drawings. The exposed arris line shall be pitched straight and true, with no variations from a straight line greater than 1/8 inch.
4. The front face shall be at right angles to the plane at the top and shall be smooth quarry split. Drill holes in the exposed part of the face shall not be permitted. The front face shall have no projections greater than one inch or depressions greater than ½ inch, measured from the vertical plane of the face through the top arris line for a distance of eight inches down from the top. For the remaining distance, there shall be no projections or depressions greater than one inch measured in the same manner.
5. The back surface of the curb stones shall have no projection for a distance of three inches down from the top which would fall outside of a plane having a batter of one horizontal to three vertical from the back arris line.
6. The ends of all curb stones shall be square with the planes of the top and front face and so finished that when the stones are placed end to end as closely as possible, no space more than one inch shall show in the joint for the full width of the top or down on the face for eight inches. The remainder of the end may break back not over six inches from the plane of the joint.

M. Mortar between Granite Curb sections shall be Type I, conforming to the Section 707.01 of the referenced standard.

PART 3.00 – EXECUTION

3.01 CAST IN PLACE CONCRETE CURB AND SIDEWALK

A. WEATHER AND SITE CONDITIONS
1. Cast in place concrete shall not be placed when the air temperature at the site in the shade and away from artificial heat is below 40°F.
2. Freshly placed concrete shall not be allowed to exceed 85°F.
3. Concrete shall not be placed on a frozen or thawing base or when weather or other conditions would prevent the proper handling, finishing or consolidation of the material.
4. The Contractor shall haul, transport and place concrete in manners to prevent segregation of aggregate from the mix.

B. FORMING
1. The contractor may use metal or wood frames appropriate for the purpose. Forms shall be free from warp and sufficiently strong to resist the weight of concrete.
2. Forms shall be cleaned and oiled before placing. The Contractor shall brace and stake forms adequately to hold line and grade until removed.
3. Slip forms may not be used without the written approval of the Town.

C. PLACING CONCRETE

1. The Contractor shall place sufficient concrete to attain full depth at all sections along walk or curb.
2. The Contractor shall thoroughly consolidate the concrete so that all honeycombs will be eliminated.

D. FINISHING CONCRETE

1. Surface is to be finished by float.
2. No plastering or patching is permitted.
3. Edges of walks and curbs are to be rounded with edger with ¼ inch radius.
4. Before the concrete is set, the Contractor shall test for waves or irregularities with a straight edge (10 feet long). All defects above or below the proper surface of more than ¼ inch shall be corrected.
5. After screeding and floating, the Contractor shall finish sidewalks with broom, drawn over surface perpendicular to the line of traffic.
6. The Contractor shall make final pass with edger and jointer after broom finishing.
7. Handicapped ramps and other sections as designated on the Drawings are to have exposed aggregate finish.

E. JOINTS

1. Expansion joints in walk and curb shall be placed every 20 feet, and shall be formed around fixed objects such as, but not limited to, buildings, manholes, utility poles, curb stops, steps and valve boxes.
2. Expansion joints and filler material shall extend full depth of walk and curb.
3. "Dummy" joints in walk and curb shall be placed every 5 feet, unless otherwise specified. Dummy joints shall be 1/8-inch wide and 1 1/2 inches deep, and rounded with edger with ¼-inch radius.

F. CURING

1. The Contractor shall apply first coat of curing and sealing compound, at manufacturer's recommended application rate, uniformly and evenly, as soon as possible after final finishing.
2. The Contractor shall use moist burlap for curing.
3. The Contractor shall apply exposed aggregate retarding compound, where required, at manufacturer's recommended application rate, after surface is finished. The Contractor shall power wash the surface in approximately 12 hours, subject to weather conditions.
4. The Contractor shall ensure a minimum of 3 days without pedestrian traffic and 14 days without vehicle traffic. The contractor shall provide barriers and protection as necessary to prevent damage. Any sections damaged or marked shall be replaced by the Contractor at no cost to the Town.
5. The Contractor shall protect the concrete from rain, freezing or inclement weather.
6. The Contractor shall apply second coat of curing and sealing compound at manufacturer's recommended application rate, uniformly and evenly, after 7 days.

3.02 DETECTABLE WARNING SURFACE

A. Detectable Warning Surface shall be installed by following all applicable supplier's and manufacturer's requirements for environmental conditions, surface preparation, installation procedures, curing procedures, and materials compatibility.

B. The Contractor is responsible for removing any material spatters. The Contractor shall repair any damage that should arise from installation or clean-up effort.

3.03 GRANITE CURB

A. The curb and slope edging shall be set so that the front top arris line conforms to the line and grade required. All space under and behind the curbing shall be filled with concrete (4,000 psi).

B. The curb and slope edging shall be laid so there will be no open joints exceeding one inch between stones. Joints between stones shall be carefully filled with mortar, Type I, and neatly pointed on the top and exposed front portions. After pointing, the stone shall be satisfactorily cleaned of all excess mortar and the joints kept moist until the mortar has set.

END OF SECTION 03301

SECTION 15123 – WATER METERS AND APPURTENANCES

PART 1.00 – GENERAL

1.01 WORK INCLUDED

A. All labor, materials, equipment and services to furnish and install water meter assemblies including meters, remote readers, meter setters, meter pits, ball valves, backflow preventers, copper pipe, fittings, expansion tanks, hangers, supports, plumbing modifications and all other items required for a complete water meter assembly as specified herein and in accordance with the ~~Contract Documents~~ current water standards and specifications, as well as the drawings in the appendix.

1.02 REFERENCE STANDARDS

Information and requirements contained in this Construction Standard are based on the most recent version of the following standards:

A. AWWA Standard C700 for Cold-Water Meters – Displacement Type, Bronze Main Case.

B. AWWA Standard C701 for Cold-Water Meters – Turbo Type

C. AWWA Standard C706-70 for Direct Reading – Remote Registration Systems for Cold-Water Meters

1.03 SUBMITTALS

A. The Contractor shall submit manufacturer's shop drawings, installation instructions and operation and maintenance manuals for the water meters, remote readers, meter setters, ball valves, backflow preventers, copper pipe, fittings and expansion tanks, and meter pits.

B. Manufacturer's Certification that all displacement type meters supplied meet AWWA C-700, latest revision.

C. Manufacturer's Certification that all turbo type meters supplied meet AWWA C-701, latest revision.

D. Prior to beginning work, the Contractor shall submit to the Town, for Town's approval, an implementation plan, detailing the Contractor's schedule, protocols, procedures, and staff for this particular project. Contractor shall not begin work until Town accepts the implementation plan. Town reserves the right to order reasonable changes to the plan without increase in contract price.

E. The Contractor shall provide the names of all field personnel. The Town reserves the right to provide these names to law enforcement authorities for appropriate background checks as deemed necessary to protect the safety of the public. Employees of the Contractor determined by law enforcement authorities to be a risk to public safety shall be reassigned to duties not requiring entry onto private property.

F. The Town utilized NEMRC municipal billing software. The Town currently uses AutoRead and Sensus to read the meters and transfer the information into NEMRC. The Contractor shall supply a certification that the meter reading operating software to be supplied as part of this ~~Contract~~ work to be completed will be fully compatible with the Town's billing software without further expense to the Town.

1.04 QUALITY ASSURANCE

A. The Contractor shall demonstrate successful experience with both meter equipment and software integration with the ~~NEMRC municipal~~ billing software used by the Town.

B. The Contractor shall be thoroughly trained and experienced in the skills and equipment required for installation and testing of water meters and appurtenances.

C. The Contractor shall protect water meters and appurtenances before, during and after installation. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Town and at no cost to the Town.

D. Upon direction of the Town, the Contractor shall remove, replace and/or rework all water piping that does not meet the requirements of this section. The Contractor shall perform all remedial measures at no cost to the Town.

E. All plumbing work shall be performed under the direction of a Vermont Licensed Master Plumber.

F. The Contractor shall have five (5) years experience in the supply and installation of water meter equipment including a minimum of five (5) projects involving the installation of more than 300 meters. Project experience shall demonstrate the Contractor's technical, administrative and managerial capabilities to complete similar projects involving direct contact with the public and work on private property. All installations shall be completed by a Vermont Licensed Plumber.

1.05 WARRANTY

A. The Contractor shall warrant that the installation is free of defects for a period of one year from date of final completion and acceptance by Town. The chamber shall be warranted for 10 years against freeze damage.

B. The water meter manufacturer shall guarantee that its meters shall perform to AWWA new meter accuracy standards for a period of one year after date of final completion and acceptance by Town. The manufacturer shall guarantee that the reading obtained electronically matches the LCD display read on the register when the register is interrogated and that the manufacturer will pay the difference at the current rates whenever a discrepancy appears. Synchronization of electronic reading and mechanical read for any reason is not acceptable.

C. If the Town has data indicating a meter assembly installed under this Contract is registering inaccurately, within the warranty period, the Contractor shall be responsible for moving, resting and/or replacing the meter equipment, as required by the Town.

PART 2.00 – PRODUCTS

2.01 METER ASSEMBLY

A. The Town and Contractor will review each installation and determine:
1. The type and size of water meter required.
2. The non-standard installation equipment required.

B. Each meter installation shall include new equipment as follows:
1. One (1) meter setter (size as appropriate).
2. One (1) water meter (type and size, as appropriate) with a radio transmitter.
3. One (1) backflow preventer (type and size, as appropriate).
4. Two (2) pack joint compression fittings (type and size, as appropriate).
5. One (1) new ball valve (size, as appropriate), on the supply side of the meter.
6. One (1) new expansion tank, if warranted (size, as appropriate).
7. One (1) new pressure reducing valve, where warranted, (size, as appropriate).
8. Copper pipe, fittings and adapters as necessary.

2.02 ~~DISPLACEMENT TYPE~~ WATER METERS

A. Meters shall be ~~Sensus SR~~ I-Perl, matching existing Town-wide meters, or approved Sensus compatible equal.

B. Meters shall be ~~displacement type~~ I-Perl or equivalent, magnetic drive, cold water meters, meeting the following specifications:
~~1. All meter maincases shall be frost-proof and made of a lead-free brass containing a minimum of 85% copper, such as Envirobrass II, that meets the ANSI/NSF 61 standard. Plastic maincases are not acceptable.~~
~~2. The meter serial number shall be stamped between the outlet port of the maincase and the register. Maincase markings shall be cast raised and shall indicate size, model, direction of flow, and NSF 61 certification.~~
~~3. Maincases for 5/8", ¾", and 1" meters shall be of the removable bottom cap type with the bottom cap secured by four (4) bolts on 5/8" and ¾" sizes and six (6) bolts on the 1" size. Intermediate meter maincases shall also be made of the same lead-free brass material in sizes 1-1/2" and 2" with a cover secured to the maincase with eight (8) bolts. Meters with a frost plug, a screw-on design or no bottom cap shall not be accepted in 5/8"-1" sizes.~~
~~4. Frost bottom plates shall be cast iron.~~
~~5. Trim and casing bolts shall be stainless steel.~~
~~6. Only magnetic driven, positive displacement meters of the flat nutating disc or oscillating piston type will be accepted.~~
~~7. The flat nutating disc shall be a single piece made from non-hydrolyzing synthetic polymer and shall contain a type 316 stainless steel spindle. The nutating disc shall be equipped with a synthetic polymer thrust roller located within the disc slot.~~

8. ~~The measuring chamber shall be of a 2-piece snap-joint type with no fasteners allowed. The chamber shall be made of a non-hydrolyzing synthetic polymer.~~
9. ~~The control block shall be the same material as the measuring chamber and be located on the top of the chamber. The control block shall be located after the strainer.~~
10. ~~The measuring chamber outlet port shall be sealed to the maincase outlet port by means of an "O" ring gasket.~~
11. ~~All meters shall contain a removable polypropylene plastic strainer screen. The strainer shall be located near the maincase inlet port, before the measuring chamber. The strainer shall also function as the device that holds the measuring chamber in place within the maincase.~~
12. All meters must be adaptable to a field programmable absolute encoder register without interruption of the customer's service.
13. Meters shall be of a tamper-resistant design.
14. Meters shall have low flow leak detector, full test circle, local odometer reading in 100 gallon increments. Register capacity shall be gallons with two fixed zeros. Registration shall be possible up to 1,000,000 gallons.
15. Accuracy shall be 100± 1.5% of actual throughput. Low Flow Registration shall be 95% at ¼ gpm. Max Pressure Loss shall be 10.8 psi at 20 gpm.
16. Max Operating Pressure shall be 150 psi.

C. Meters shall be sized based upon the anticipated flows, utilizing the following guidelines:
1. 5/8" x ¾" for 1 gpm to 20 gpm
2. 3/4" x ¾" for 1 gpm to 30 gpm
3. 1" for 1 gpm to 50 gpm
4. 1 ½" for 2 gpm to 100 gpm
5. 2" for 2 ½ gpm to 160 gpm

D. Meter shall not be painted.

2.03 TURBO TYPE METERS

A. Meters shall be Sensus SRH, or approved Sensus equal. No multi or single jet meters shall be allowed. Alternatives may only be approved in accordance with Section 01300.

B. Meters shall be turbo type, cold water meters, meeting AWWA C-701 (most recent version) and the following specifications:
1. Housing: Frost-proof with a non-corrosive waterworks bronze outer case.
2. Rotor: Thermoplastic
3. Straightening Vanes: Stainless Steel
4. Trim: Stainless Steel
5. Radial Bearing: Graphite
6. Magnets: Ceramic
7. Thrust Bearings: Tungsten Carbide
8. Frost Bottoms: cast iron
9. Trim and casing bolts: stainless steel

10. All meters shall have cast on them, with raised characters, the size and direction of flow through the meters. Meter serial number shall be imprinted on each meter case.
11. Meters shall be of a tamper-resistant design.
12. Meters shall have low flow leak detector, full test circle, local odometer reading in 100 gallon increments. Register capacity shall be gallons with two fixed zeros.
13. Meters shall have an electronic communications register compatible with the Town's touch read automated system.
14. Accuracy shall be 100± 1.5% of actual throughput.
15. Max Operating Pressure shall be 150 psi.
16. Registration shall be possible up to 1,000,000 gallons.

C. Meter shall not be painted.

D. Meters shall be supplied with matching removable strainer assembly.

2.04 WATER METER REGISTER

A. All water meters shall be equipped with a self-contained sold state absolute encoder register metering system designed to obtain remote simultaneous water meter registration that is guaranteed to exactly match the registration on the register odometer. The metering information shall be obtained through a separate (locally or remotely mounted) integrated radio housed within the encoder register. The system shall be configured as follows:
1. Solid state absolute encoder meter register shall be direct mounting, electro-magnetically encoded measuring element into an electronic solid-state odometer.
2. Encoder shall provide value-added flow data including leak, tamper and back flow detection when connected to a compatible Radio Frequency Meter Interface Unit.
3. Batteries and digital counters using volatile memory are not allowed.
4. Encoder register shall display flow rate information at register.
5. The dial shall have a high resolution nine-digit LCD display for meter testing. The register shall provide at least a nine-digit visual registration at the meter. The register shall display flow rate information.
6. The unit shall provide an 8-digit meter reading for transmission through the radio MIU.
7. The register shall employ a visual LCD leak detection indicator as well as provide remote leak detection through an ASCII format to the Meter Interface Unit (MIUs).
8. Internal batteries shall not be allowed.
9. The register shall accumulate and register consumption without connecting to a receptacle or MIU.

B. Mechanical Construction
1. The basement unit shall possess a hermetic sonic welded polycarbonate enclosure and lens. The pit unit shall have a rolled-seal enclosure with copper shell and glass lens.

2. The register shall be attached to the meter case by a bayonet or other secure attachment. Fastening screws or nuts shall not be required.
3. A tamper-proof seal pin shall be used to secure the register to the maincase.
4. The register shall be removable from the meter without disassembling the meter body and shall permit field installation and/or removal without taking the meter out of service.
5. Provision shall be made in the register for the use of seal wires to further secure the register.
6. The solid-state absolute encoder register shall incorporate an Application measurement, information transmission and data integrity.
7. The Radio MIU will be integrated within the solid-state encoder register housing. The MIU power supply (battery) must be mounted on the outside of the register and be field replaceable.

2.05 RADIO FREQUENCY TRANSMITTERS

A. Each meter shall be equipped with a matched, self-generating, weatherproof, tamper-proof, radio transmitter.

B. The transmitter shall be integrated within the solid-state water meter register. The transmitter shall interrogate the encoder register and transmit the meter reading and other information to a remote reading device every 15 seconds. The same RF Meter Interface Unit (MIUs) must be capable of being read by a walk-by handheld/mobile computer equipped with a RF interface unit.

C. The integrated MIUs shall be manufactured in both basement and pit models. The basement MIU shall have the ability to be mounted in a basement and the pit MIU shall have the ability to be mounted in a pit or an underground vault. The pit MIU shall be a fully potted waterproof design.

D. Integrated Radio Unit
1. The Unit shall provide a location for a tamper deterrent seal. Tampering with the device functions or connections shall not be possible without causing visible damage to the device exterior or to the seal.
2. The Unit must be protected against static discharge without loss of data.
3. The Unit shall be capable of operating at temperatures of -22°F to 149°F (-30°C to +65°C) with a humidity factor of 0 to 95%.
4. The circuit board shall be coated for moisture protection.
5. The battery will be protected by encapsulation in a hard potting material.
6. The system shall operate in the 902 MHz to 957 MHz bandwidth. Should a FCC license be required, it shall be provided by the Contractor at no cost to the Town.
7. A single manufacturer shall produce all components of the system (water meters, RF transmitters, meter reading equipment, and route management software), and provide a turn-key system.
8. To minimize the potential for RF interference from other devices, the MIU shall transmit using the Frequency Hopping Spread Spectrum technique comprised of

alternating pseudo-random frequencies within the 902 MHz to 957 MHz bandwidth.

9. The meter interface unit shall operate within FCC Part 15 regulations for devices operating in the 902 MHz to 957 MHz unlicensed bandwidth. The output power of the devices will be governed by their conformance with these relevant FCC standards.
10. Output power shall meet FCC Part 15.247 requirements and shall be a minimum of 100 milliwatts.
11. Power shall be supplied to the MIU by a lithium battery. The Manufacturer shall warrant that any battery provided and installed in the MIUs shall be free of manufacture and design defects for a period of twenty years – the first ten (10) years from their date of shipment from factory without pro-rating, and the second ten (10) years with pro-rating, as long as the MIU is working under the environmental and meter reading conditions specified.
12. The battery life shall not be affected by outside erroneous wake-up tones (i.e. other water, gas, or electric utilities reading and therefore sending out a wake-up tone).
13. The number of reads performed must not affect the battery life.
14. The batteries shall be field replaceable (the replacement shall be demonstrated) and be designed for minimum twenty (20) years life expectancy. The MIU shall not require reprogramming if the battery discharges before it is replaced.
15. No MIU programming shall be necessary for installation.
16. The MIU shall transmit the meter reading continuously at a predetermined transmission interval. The MIU shall not send readings older than an hour.
17. Each device shall have a unique pre-programmed identification number of 10 characters. ID numbers will be permanent and shall not be altered. Each device shall be labeled with the ID number in numeric and bar code form. The label shall also display FCC approval information, manufacturer's designation, and date of manufacture. A duplicate self-stick tear-off label with barcode data must also be provided. The duplicate can be affixed to the work order and scanned to ensure accurate and efficient data entry.
18. The MIU shall transmit the encoder meter reading and a unique MIU ID number.
19. The handheld/mobile reading equipment shall be available to verify proper operation of the MIU by displaying the MIU ID number and meter reading.
20. The MIU shall be capable of being received by either a handheld receiver and mobile receiver.

2.06 METER SETTERS

A. Meter Setters shall be "Kornerhorn" KH Series, manufactured by the Ford Meter Box Company, Inc., Series 31 manufactured by A.J. McDonald or approved equal, of appropriate size for the meter.

B. Meter setters shall have removable pack joint assembly and meter gaskets.

C. Other fittings such as pack joints or angle meter couplings may be required depending on the installation.

2.07 DUAL CHECK VALVE ASSEMBLY

A. Dual check valves shall be Series KH-HHCH-1, as manufactured by The Ford Meter Box Company, Inc., Series H by A.J. McDonald, or approved equal.

B. Check valves shall have no more than a 10 pounds-per-square-inch headloss at a flow of 15 gallons-per-minute.

C. Check Valves shall be manufactured so that cartridge assemblies may be inspected and/or replaced without removing the valve or meter from service, through a removable O-ring sealed cap located at the top of the valve. Both cartridges are to be identical, interchangeable. Each cartridge assembly shall be so constructed that it can provide backflow prevention even with the other cartridge assembly removed from the valve body. Cartridge Assemblies shall be supplied with O-rings attached to ensure a watertight seal between the cartridge and the inside of the body.

D. Valves to be approved under ASSE Standard 1024-1994.

E. The access cap shall have a 7/8" hex nut on the top for removal with a 7/8" socket wrench.

F. All brass material shall meet the following Standards: Bronze (red brass) – ASTM B62 and/or ASTM B584, UNS No. C83600, AWWA C800 (including the 85-5-5-5 brass specification.)

G. Check assemblies to be made of acetyl plastic with stainless steel springs.

H. Manufacturer shall, upon request, submit a notarized certification of adherence to the above material standards.

2.08 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTERS

A. Reduced pressure principle backflow preventers shall be Watts "Series 009M1QT", equivalent model by Zurn, or approved equal, conforming with AWWA Standards.

B. Reduced pressure principle backflow preventer shall be a complete assembly consisting of two independently acting spring-loaded toggle lever check valves together with an automatically operating pressure differential relief valve located between the two check valves. First check valve shall reduce the supply pressure a predetermined amount so that during normal flow and the cessation of normal flow, the pressure between the checks is less than the supply pressure.

C. In the case of leakage of either check valve, the differential relief valve shall discharge to atmosphere to maintain the pressure between the checks, less than the supply pressure.

D. Unit shall be fitted with properly located test cocks and the unit shall be tested by the Contractor prior to acceptance.

E. Operation shall be completely automatic.

F. All parts must be removable or replaceable without removal of the unit from the line.

G. Total head loss through the complete backflow assembly shall not exceed 15 psi at the "rated flow".

H. Provide a drain to the outside when a floor drain is not available. Should a drain location not be available, the Contractor shall report the location to the Town prior to proceeding with installation.

2.09 PRESSURE REDUCING VALVE

A. Pressure reducing valve shall be Watts "Series U5", equivalent model by Wilkins, or approved equal, conforming with AWWA Standards.

B. Pressure reducing valves (PRV) shall be installed on all residential, commercial, and industrial plumbing with incoming water pressure exceeding 80 psi at the foundation wall.

C. All PRVs shall have bronze body construction with an integral stainless steel strainer, suitable for accommodating a maximum 300 psi inlet pressure, with a reduced pressure range of 25-75 psi, factory set at 50 psi.

D. Pressure reducing valves shall be installed on the supply side of the meter assembly.

E. The Contractor may replace an existing PRV if found to be defective. The Contractor shall document and field verify its inoperability. The Town shall be present to attest to the valve's inoperability prior to replacement. Replacement of an existing PRV will constitute installation of a new PRV.

2.10 BALL VALVES

A. Ball valves shall be Series KHBV-1, as manufactured by The Ford Meter Box Company, Inc., Series 61 by A.J. McDonald, or approved equal.

B. All cast metal components of the Ball Valve shall be certified waterworks red brass, containing 85% copper, 5% tin, 5% lead, and 5% zinc, as per AWWA standard C800 and ASTM B62 and/or ASTM B584, UNS No. C83600.

C. The ball shall be Teflon-coated and shall rotate between two seats made from Buna-N rubber.

D. The water passages shall be full 5/8" diameter, and an O-ring shall seal the stem that turns the ball.

E. Valves shall be watertight at any pressure up to 250 PSI.

F. Valves shall be threaded for easy incorporation into meter setter and pack joints, without additional fittings.

2.11 COPPER PIPE AND FITTINGS

A. Copper tubing for inside structures shall be Type "L", hard tempered copper tubing conforming to ASTM Specification B-306.

B. Fittings shall be wrought-copper solder type fittings. Solder shall have less than 0.2% lead content.

C. Contractor shall provide di-electric unions in piping systems wherever dissimilar types of piping are connected.

D. Contractor shall assume each installation will require up to fifteen feet (15') of appropriately sized copper pipe and associated fittings and adapters.

2.12 EXPANSION TANKS

A. Pre-pressurized diaphragm type water thermal expansion tanks shall be Amtrol "Therm-X-Trol ST-5", Watts DET-5-M1, or approved equal.

B. Expansion tanks shall be AWWA approved.

C. The outer shell shall be high grade steel with exterior epoxy coating.

D. The bladder shall be FDA approved butyl rubber and shall prevent water from contact with the shell interior.

E. The assembly shall incorporate a shrader valve for adjustable air precharge.

2.13 METER PITS

A. Meters serving buildings without basements shall be installed in meter pits located along the building service.

B. The meter pit shall be a Ti-Setter© Meter Box, Ford "Pit-Setter", or approved equal.

C. Pits shall be 20 to 21 inch diameter, 60 inch deep, constructed of PVC or HDPE with open bottom. Cover shall consist of 18-inch diameter cast iron frame and locking cover and 4-inch thick insulated closed cell foam insert.

D. Provide meter pit extensions as necessary to achieve specified bury depth of water service.

E. Install meter pit on 12-inch thick crushed stone base.

F. Provide Town with two (2) cover keys.

2.14 WATER METER INSULATION JACKET

A. Insulation Jackets shall be 2-piece expanded polystyrene molded to custom fit over the specified meters. Jacket shall cover the meter body and coupling nuts on the inlet and outlet ports.

B. Two piece jacket shall be secured around the meter with two "Velcro" straps.

PART 3.00 – EXECUTION

3.01 GENERAL

A. The Town shall be responsible for the location and operation of outside curb valves when required. The Contractor shall assume that all work shall be completed without using the curb stop to shut off water to the building. The Contractor shall anticipate the use of pipe freezing, if necessary. In unusual circumstances the Town will close the curb stop to facilitate installation.

B. The Town will be notified by the Contractor of plumbing found to be of questionable condition, and will notify the homeowner prior to the installation.

3.02 PRODUCT STORAGE AND HANDLING

A. Handle and transport water meters and appurtenances to ensure they are in sound, undamaged condition and to prevent damage.

B. Examine all materials before installing. Defective or damaged materials shall be rejected.

C. The Contractor is responsible for the secure storage of all products.

3.03 INSTALLATION

A. Water meters shall be installed according to the Contract Documents in accordance with the Manufacturer's recommendations.

B. Contractor shall work in an expeditious manner, with all necessary pipes, fittings and meter at the site prior to disrupting service and beginning work. In no case will water service be interrupted overnight, except by special arrangement with the Town.

C. If lead service piping is discovered, the contractor shall report, in writing, to the Town. Meters shall not be installed on lead services.

D. Install hangers, supports and mounting devices as required to provide support for piping and meter assembly.

E. Meter Pits
   1. Meter Pits shall only be installed at locations directed by the Town.
   2. The location of the Pit shall be reviewed with the Town and the property owner prior to the start of work.
   3. The pits shall be installed plumb and true with the frame and cover set one inch above finish grade.
   4. Pits shall be installed on a one-foot bedding of 1" crushed stone.
   5. Ground surfaces shall be restored to the condition which exists prior to the start of work.

F. Meter Insulation Jackets – Meter insulation jackets shall be installed on all meters located in an un-heated space subject to freezing temperatures.

G. Expansion Tanks
   1. A pre-pressurized diaphragm type expansion tank shall be installed in the existing plumbing if, in the opinion of the Licensed Plumber, over-pressurization of the existing interior plumbing may occur.
   2. The plumber shall notify the Town and receive authorization prior to installing expansion tanks and provide justification based on specific location.
   3. It is not intent to install expansion tanks on every customer's service. It shall be left up to the installer's Licensed Plumber to determine when an expansion tank is essential to avoid over-pressurizing the system. An expansion tank may be required when the following conditions exist in the interior plumbing system:
      a. Rapid recovery hot water heaters
      b. Multiple large volume (>80 gallon) hot water heaters.
      c. Multiple "dead end" branches in the interior plumbing.
      d. High static pressures in the interior plumbing
   4. Installation shall be in accordance with manufacturer's published instructions; installed where requested by customer.

H. Where the existing installation is insulated or protected from freezing by heat tape or other methods, the Contractor shall neatly remove existing insulation/heat tape as necessary to complete the installation. Existing frost protection equipment shall be reinstalled to its pre-existing condition. The adequacy of frost protection measures shall be the responsibility of the water customer. The Contractor shall make not of those installations requiring re-insulation on both the installation log and in a summary report submitted monthly with the payment requests.

I. The pack joints will be set and tightened in a manner that will not disturb the overall grounding capability of the piping systems.

J. The meter and connections shall be sealed against unnoticed removal with the use of meter seal wire and a meter seal.

3.04 DISINFECTION AND TESTING

A. Disinfection shall be performed by dipping and swabbing the various components in or with a 15% chlorine solution.

B. Upon completion of the installation, refill the building piping with water, allowing 30 minutes of contact time for the chlorine to react prior to flushing the lines. During this period, check all new work for leaks at normal system pressure, and make any repairs necessary to stop all leaks.

3.05 RECORDS

A. Each installation will be carefully documented for the purpose of progress, as well as the records of the Town.

B. Installation log: The Contractor shall complete an Installation Log for each installation in the form as included in the Appendix to this document or an approved equal.

C. Photographic Record: Digital photos which clearly depict the existing meter installation and the new meter installation. Each photo shall include a placard indicating the account number, installation address, date of installation, and existing versus new installation.

1. Photos shall be provided in JPEG image format, readable in Windows based operating system, on CD media.
2. Each photo electronic file shall be named according to the unique installation customer account number consistent with the Town's master list. Photos of the existing meter and the new meter installations shall be labeled "B" for before and "A" for after.
3. Electronic photos shall be provided to the Town on a regular basis as required by the contract documents.

D. The Contractor shall verify on the completion report that there is not any other water supply connected to the building's drinking water plumbing system.