CLIMATE RESILIENT DESIGN STANDARDS & GUIDELINES
FOR PROTECTION OF PUBLIC RIGHTS-OF-WAY

APPENDIX G. CLIMATE RESILIENT FLOOD BARRIER SAMPLE SPECIFICATIONS

**** Please refer to the Boston Public Works Department (BPWD) Standard Specifications for additional specifications****

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SAMPLE DEWATERING SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of equipment and instrumentation for control of the system.

1.02 RELATED WORK:

A. EARTHWORK (Refer to BPWD Standard Specifications)

B. SUPPORT OF EXCAVATION (Refer to Special Provisions)

1.03 SYSTEM DESCRIPTION:

A. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; preventing rupture or heaving of the bottom of any excavation; and disposing of pumped water.

B. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps. Special dewatering is defined as using single or two stage wellpoints, deep wells, or eductor and ejector systems installed in drilled holes or jetted in place.

1.04 QUALITY ASSURANCE:

A. The Contractor is responsible for the adequacy of the dewatering systems.

B. At the Contractor’s expense, the Contractor shall retain the services of a registered Professional Engineer registered in the Commonwealth of Massachusetts, experienced in dewatering systems, to independently evaluate the boring logs and any other soils information available to determine those areas that will require special dewatering systems and to design the required system. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the dewatering is carried out in accordance with his design.

C. The dewatering systems shall be capable of effectively reducing the hydrostatic pressure and lowering the groundwater levels to a minimum of 2 feet below excavation bottom, unless otherwise required by the Engineer, so that all excavation bottoms are firm and dry.

D. The dewatering system shall be capable of maintaining a dry and stable subgrade until the structures, pipes and appurtenances to be built therein have been completed to the extent that they will not be floated or otherwise damaged.

E. The dewatering system and excavation support (see SUPPORT OF EXCAVATION in Special Provisions) shall be designed so that lowering of the groundwater level within the work area does not adversely affect structures, utilities or wells outside of the work area.

1.05 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. At least two weeks prior to installing his dewatering system, Contractor shall submit the attached Certificate of Design completed and signed by Contractor, identifying the engineer responsible for design of the dewatering system. He shall also submit a schedule showing the timing of installation and operation of the dewatering system.

B. The Contractor shall submit to the Engineer for record purposes only, the following items bearing the Contractor's Engineer's stamp and signature, and identifying the codes and specifications followed in the design.

1. Plans and description of the dewatering system, including the number, location and depth of wells, wellpoints or sumps; designs of filters to prevent pumping of fine soil; method and location for filtering and disposal of pumped water; and flow capacity of proposed system.

2. Locations of observation wells.

C. The Contractor shall submit records of pump operation and groundwater elevations as required by the Owner's Engineer.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.01 DEWATERING OPERATIONS:

A. All water pumped or drained from the work shall be disposed of in a manner which will not result in undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities. Suitable temporary pipes, flumes or channels shall be provided for water that may flow along or across the site of the work. All disposal of pumped water shall conform to the provisions in the BPWD Standard Specifications, Special Provisions, and permits.

B. Dewatering facilities shall be located where they will not interfere with utilities and construction work to be done by others.

C. Dewatering procedures to be used shall be as described below:

1. Crushed stone shall encapsulate the suction end of the pump to aid in minimizing the amount of silt discharged.

2. For dewatering operations with relatively minor flows, pump discharges shall be directed into haybale sedimentation traps lined with filter fabric. Water is to be filtered through the haybales and filter fabric prior to being allowed to seep out into its natural water course.

3. For dewatering operations with larger flows, pump discharges shall be into a steel dewatering basin. Steel baffle plates shall be used to slow water velocities to increase the contact time and allow adequate settlement of sediment prior to discharge into waterways.

4. Where indicated on the contract drawings or in conditions of excess silt suspended in the discharge water, silt control bags are to be utilized in catchbasins.

D. The Contractor shall be responsible for repair of any damage caused by his dewatering operations, at no cost to the Owner.

E. Contractor shall lower the groundwater level to a minimum of 2 feet below the bottom of the final excavation grade prior to installation of structural elements and placement of initial backfill. The Contractor shall maintain groundwater level a minimum of 2 feet below the excavation bottom until the excavation has been backfilled. The groundwater levels shall be monitored by the Contractor's engineer to ensure conformance with the requirements of these specifications. Construction will not be allowed until the Owner's Engineer is satisfied that the above provisions are met.

END OF SAMPLE SECTION

(SAMPLE Certificate of Design follows this page)

SAMPLE CERTIFICATE OF DESIGN

Re: Contract Between:

OWNER: _____
(Name)

and
CONTRACTOR: _____
(Name)

on
CONTRACT: _____
(Number)

Date: _____

Title: _____

Contractor hereby certifies that _____:
(Engineer)

1. Is licensed or registered to perform professional engineering work in the state of _____;
(Location of Project)

2. Is qualified to design the _____
(Item)
specified in Section _____ of subject contract;

3. Has designed _____ before;
(Item)

4. Has prepared the design in full compliance with the applications and requirements of Section _____ of subject contract including all applicable laws, regulations, rules, and codes; and

5. The work has been signed and sealed pursuant to applicable state law.

FOR: _____
(Contractor)

BY: _____
(Signature)

_____
(Name and Title)

Dated: _____

SAMPLE RIPRAP SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. This Section covers riprap for slope protection, drainage swales and pipe ends, complete.

B. Grading and compaction of earth slopes and other slope preparation for the riprap are included under other sections of the specification.

1.02 RELATED WORK:

A. EARTHWORK. (Refer to BPWD Standard Specifications)

B. GEOTEXTILE FABRICS. (Refer to BPWD Standard Specifications)

1.03 REFERENCES:

A. The following standard forms a part of these specifications and indicates minimum standards required: Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. SLOPE PROTECTION:

Stone for slope protection shall be angular and shall be in accordance with MassDOT Specification Section M2.02.2, Dumped Riprap.

B. PIPE ENDS:

Stone for pipe ends shall be angular and shall be in accordance with MassDOT Specification Section M2.02.3, Stone for Pipe Ends.

C. DRAINAGE SWALES:

Stone for drainage swale ends shall conform to MassDOT Specification Section M2.02.3, and shall be not weigh less than 50 pounds or more than 125 pounds and least 75% of the volume shall consist of stones not less than 75 pounds each. The stones shall be so graded that when placed with larger stones, the entire mass will be compact.

D. GEOTEXTILE FABRIC:

Geotextile fabric shall be as specified in GEOTEXTILE FABRICS in the BPWD Standard Specifications.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Geotextile fabric shall be installed where shown on the drawings, prior to placing the riprap.

B. Riprap for slope protection and pipe ends shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids and a maximum void of 12-inches.

C. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers or by dumping into chutes or by other similar methods likely to cause segregation will not be permitted.

D. Riprap stones shall be placed and distributed such that there will be no large accumulation of either the larger or smaller stones in any given area.

E. It is the intent of these specifications to produce compact riprap protection in which all required sizes of stone are placed in the proper proportions. Hand placing or rearranging of individual stones by mechanical equipment shall be utilized to the extent necessary to secure the desired results.

END OF SAMPLE SECTION

SAMPLE SUPPORT OF EXCAVATION SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. This section covers wood and steel sheeting or soldier piles and lagging with internal bracing for support of excavations. The requirements of this section shall also apply, as appropriate, to any methods of excavation support and underpinning which the Contractor elects to use to complete the work.

B. The Contractor shall furnish and place timber or steel sheeting or soldier piles and lagging of the kinds and dimensions required, complying with these specifications, where required by regulation, indicated on the drawings or required by the Engineer.

C. Vibration monitoring shall be provided during installation and extraction of sheeting whenever the braced excavation is adjacent to existing structures, in critical areas as noted in the contract documents, or as requested by the Engineer.

D. Routine monitoring of the in-place excavation support system shall be provided.

1.02 RELATED WORK:

A. EARTHWORK (Refer to BPWD Standard Specifications)

B. DEWATERING (Refer to Special Provisions)

1.03 QUALITY ASSURANCE:

A. This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Safety and Department of Labor, Division of Occupational Safety “Excavation & Trench Safety Regulation (520 CMR 14.00)” and “Rules and Regulations for the Prevention of Accidents in Construction Operations (454 CMR 10.0 et seq.).” Contractors shall be familiar with the requirements of these regulations.

B. The Contractor is responsible for the adequacy of the excavation support system and shall retain the services of a Professional Engineer registered in the Commonwealth of Massachusetts to design the required excavation support systems. The Contractor's Professional Engineer shall practice in a discipline applicable to excavation work, shall have experience in the design of excavation support systems and shall design in conformance with OSHA requirements. The Contractor's Professional Engineer shall provide sufficient on-site inspection and supervision to assure that the excavation support system is installed and functions in accordance with his design. Criteria listed herein defining the responsibilities of the Contractor's Professional Engineer are minimum requirements.

C. The excavation support system shall be of sufficient strength and be provided with

adequate bracing to support all loads to which it will be subjected including earth pressures, unrelieved hydrostatic pressures, traffic loads, and any adjacent structure surcharge loads, utility loads, equipment and construction loads. The excavation support system shall be designed to prevent any movement of earth that would diminish the width of the excavation or damage or endanger adjacent structures, pavements, utilities, and other improvements or facilities adjacent to excavation.

1.04 REFERENCES:

The following standards form a part of this specification as referenced herein.

American Society for Testing and Materials (ASTM)

ASTM	A6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
ASTM	A328	Steel Sheet Piling

1.05 SUBMITTALS:

A. At least three weeks before starting installation of the excavation support system, the Contractor shall submit the attached Certificate of Design completed and signed by the Contractor and the Professional Engineer, identifying the Contractor's Professional Engineer who will be responsible for design of the excavation support system, and including, for record purposes only:

2. Qualification information for the support of excavation Installer and Professional Engineer.

3. An overall time schedule for construction of the braced excavation system.

4. A description of the anticipated sequence of construction.

5. Three (3) copies each of:

a. Complete details of support of excavation installation methods, equipment and sizes and lengths of materials proposed to be used.

b. A plan layout the system indicating wall types and clearance from existing and proposed utilities, structures, and other obstructions. Indicate dimensions, material properties, locations, spacing and penetration depths of all members, and the locations and various types of lateral support elements. Identify elements of the support that will not be left in place, as well as elements that will serve in a permanent capacity.

c. Details of the means and methods that will be used in monitoring the integrity of the support system during its entire period of use to insure the safety of the excavation.

d. Complete computations for the design of the excavation system bearing the seal of the responsible Professional Engineer duly registered and licensed to practice within a discipline applicable to excavation work, in the state where the project is located.

e. Any other pertinent data required for record purposes by the Engineer.

B. Receipt of the information by the Engineer will not relieve the Contractor of the sole responsibility for the adequacy of the braced excavation system, and for assuring that there will be no resulting damage to adjacent pavement, utilities or structures, and for providing safe conditions within the sheeted areas.

C. Further for the record, upon completion of the work of this section, the Contractor shall submit 3 copies of all records of survey, vibration monitoring and inspection of existing structures to the Owner's Engineer.

D. Within seven days of completing the initial installation of the earth support system, the Contractor shall submit a certification from their Professional Engineer, stating that the excavation support system as installed is in general compliance with the design or approved modifications thereto.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Timber sheeting shall be sound spruce, pine, or hemlock, and either tongue and grooved or splined. Timber sheeting shall not be less than nominal 2-inches thick.

B. Where steel sheet piling is indicated on the drawings or installation is ordered by the Engineer or required by OSHA standards, the material shall be of such size and strength as required by the excavation support design prepared and submitted by the Contractor's Professional Engineer. Steel sheet piling may be new or used material but shall not contain splices, cutouts, patches, or other alterations which would impair its integrity or strength. Steel sheeting shall conform to ASTM A6 and shall have an appropriate cross section and material properties for the intended use. Steel sheeting shall be free of rust, soil, contaminants, and debris of any kind.

C. Where soldier piles and lagging are used, the steel piles shall conform to ASTM A6, and the lagging shall meet the requirements for timber sheeting, as defined above.

D. Timber and steel used for bracing shall be of such size and strength as required in the excavation support design prepared and submitted by the Contractor's Professional Engineer. Timber or steel used for bracing shall be new or undamaged used material, which does not contain splices, cutouts, patches, or other alterations, which would impair its integrity or strength.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Work shall not be started until all materials and equipment necessary for construction are either on the site of the work or satisfactorily available for immediate use as required.

B. The sheeting/lagging shall be sufficiently tight to minimize any resulting lowering of the groundwater level outside the excavation, as required in DEWATERING.

C. The sheeting/piling shall be driven by approved means to the design elevation. No ends or edges of sheeting/piling shall be left exposed in a manner, which could create a possible hazard to safety of the public or a hindrance to traffic of any kind.

D. If boulders or very dense soils are encountered, making it impractical to drive a sheeting/piling section to the desired depth, the section shall be treated as directed by the Contractor's Engineer.

E. The sheeting/piling shall be left in place where indicated on the drawings or required by the Engineer in writing. At all other locations, the sheeting/piling may be left in place or salvaged at the option of the Contractor. Wood or steel sheeting/piling permanently left in place shall be cut off at a depth of not less than two feet below finish grade unless otherwise required.

F. All cut-off material is the property of the Contractor and shall be promptly removed by it from the site.

G. The satisfactory construction and maintenance of the excavation support system, complete in place, shall be the responsibility of the Contractor.

H. The Contractor shall be responsible for promptly repairing all damage to adjacent structures caused by the installation, performance, or removal of the excavation support system.

END OF SAMPLE SECTION

(SAMPLE Certificate of Design follows this page)

SAMPLE CERTIFICATE OF DESIGN

RE: Contract between
OWNER: _____ (Name)
and
CONTRACTOR: _____ (Name)
on
CONTRACT: _____ (Title)

_____ (Number) _____ (Date)

The undersigned hereby certify that the engineer listed below:

1. Is licensed or registered to perform professional engineering work in the state of _____; (Location of Project)

2. Is qualified by education and training to design the _____ _____

   specified in Section _____ of subject contract;

3. Has previously designed comparable excavation support systems;

4. Has prepared the design in full compliance with the requirements of subject contract, including all applicable laws, regulations, rules, and codes; and

5. Will inspect and supervise installation of the excavation support system and will monitor the in-place system to confirm that the system is installed and functions in accordance with the design.

CONTRACTOR	ENGINEER
By: _____ (Signature)	By: _____ (Signature)
_____ (Name)	_____ (Name)
_____ (Title)	_____ (Engineering Discipline)
_____ (Date)	_____ (Date)

SAMPLE COASTAL PROTECTION AND REPLICATION SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section consists of providing all plants, labor, equipment, materials, tools, and required professional services in connection with the protection, replication, and provision of specific mitigation measures to minimize and compensate for impacts to existing coast line areas.

1.02 QUALITY ASSURANCE:

A. This Contract requires construction adjacent to environmentally sensitive resource areas including flood plains and coast lines. The Wetlands Protection Act ("Act") G.L. Chapter 131 Sec. 40 governs work in these areas and the Contractor shall be required to comply with this and all other applicable Federal, State and local statutes, regulations, and ordinances, and with the Order of Conditions issued by the Conservation Commission.

B. The Contract Drawings show the extent of the Bordering Vegetated Coast Lines and Buffer Zone (BZ). Work within the BVW or BZ shall also comply with the requirements of this section.

PART 2 - PRODUCTS

2.01 BACKFILL:

Loam and Organic Mixture - This section describes the specification for preparing a loam and organic mixture to be used as suitable backfill within the wetlands restoration and enhancement areas.

1. Loam shall be a natural, fertile, friable soil, typical of productive soils in the vicinity. Loam shall be free of admixture of subsoil and foreign matter or objects (gravel, roots, debris) larger than 2-inches in diameter.

2. Loam shall be uncontaminated and free of toxic substances or any materials harmful to plant growth, regeneration or reproduction. The pH of the loam shall range between 6.0 and 8.0.

3. Peat (if used) shall be supplied from an authorized peat supplier or nursery. Peat shall have an organic content ranging from 75 to 100%. Peat shall be uncontaminated and free of toxic substances or any materials harmful to plant growth, regeneration or reproduction.

4. The loam and organic mixture shall be mixed onsite to achieve a 5% organic content. This will be determined through laboratory analysis or organic content by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F. The final pH of the loam-peat mixture shall range from 5.8 to 8.0.

2.02 FERTILIZER:

Fertilizer shall be 10-6-8 controlled release, commercial grade granular free flowing, and uniform in composition and shall conform to applicable state and federal regulations. Fertilizer shall be delivered in manufacturer's standard container printed within manufacturer's name, material, weight, and guaranteed analysis.

2.03 MOISTURE ENHANCER:

A suitable moisture enhancer containing at least 99% Copolymer Acrylamide Acrylate shall be obtained and used for each planted shrub and sapling. This moisture enhancer shall be SuperSorb-C, TerraSorb or approved equal.

2.04 MULCH:

A. Hay Mulch - Hay mulch shall consist of mowed and properly cured grass, clover and other acceptable plants. Hay mulch shall be free of weeds, twigs, debris or other deleterious material.

B. Straw Mulch - Straw mulch shall consist of stalks or stems of grain after threshing.

C. Wood Fiber Mulch - Wood fiber mulch shall consist of wood fiber produced from clean, whole, uncooked wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the project.

D. Erosion Control Blanket – Erosion Control Blankets shall consist of hay, straw, coconut, or plastic mulch interwoven with netting . Erosion Control Blankets shall be manufactured by North American Green or approved equal.

2.05 PROPAGULES:

A. The restoration and enhancement areas shall be vegetated with grasses and emergent species. Individual species to be planted are indicated on the final design plans.

B. Propagules shall be nursery or plantation stock and shall be supplied from a bonded source. Nursery stock shall conform to the requirements and recommendations of American National Standards Institute (ANSI) Z60.1.

C. Plants, propagules or cultivars other than those listed in this section will not be accepted unless specifically approved by the wetlands restoration specialist and accepted by the U.S. Environmental Protection Agency.

D. Propagules shall be dug and prepared for shipment in a manner that will not cause significant damage to branches, roots, shape and future growth and development after planting.

E. Plants shall have been grown under climactic conditions like those near the site. Plants budding into leaf or having soft growth shall be sprayed with an antidesiccant at the

nursery prior to delivery.

F. Emergent propagules shall be rootstock.

2.06 HYDROSEED:

A. Hydroseed shall be supplied by an authorized hydroseed contractor. The Hydroseed mixture shall include annual grasses and seed stock from *Juncus spp*. and *Carex spp*. The Engineer shall approve the final hydroseed mixture.

2.07 WATER:

Water shall not contain elements toxic to plant life.

PART 3 - EXECUTION

3.01 GENERAL:

A. Every effort shall be made to use existing coastal species. At the discretion of the Engineer, the Contractor may, at his option, dig up, store and maintain existing coastal plants from the excavation area for use in the replication area. All plants shall be vigorous and well-formed specimens.

C. American Association of Nurserymen, Inc., American Standard for Nursery Stock (latest edition) for each species. For hand dug plants, a suitable burlap or other wrap or container shall be provided to keep the rootball intact.

D. All plants dug for reuse shall be immediately moved to a protected storage area approved by the Engineer. Plants shall be set plumb on grade or in prepared holes and guyed as necessary. The area or holes shall be backfilled with suitable topsoil to cover rootballs entirely and mulched to prevent erosion. All stored vegetation shall be maintained in a damp condition by regular watering. Contractor shall utilize all cultural measures necessary for survival of collected plants.

E. When work has been completed, stockpiled plants shall be replanted in prepared pits in locations in the replication area designated on the Contract Drawings. Planting, backfilling, fertilizing, staking, mulching, watering and all other cultural methods, including season for planting, maintenance and warranties shall be as per BPWD Standard Specifications and Special Provisions.

F. Costs for digging, moving, storage, maintenance and transplanting shall be considered part of the costal replication item.

G. To protect the berms from siltation caused by excavation, a silt fence and a continuous line of staked hay bales or straw wattles shall be placed as detailed in the Contract Drawings. Hay bales and silt fence are specified in BPWD Standard Specifications.

H. The organic, top layer of coastal soils (generally, the top 12-inches) contains the rootstock

and seeds for many coastal plant species. As excavation in the coastal areas commences, the Contractor shall separate the top 12-inch layer of coastal soils (topsoil) within the delineated coastal areas (flagged coast line) from other soil types and stockpile the coastal soils within an upland area adjacent to the replication area. At no time will stockpiling of excavated soils within coastal areas be allowed. The coastal soil shall be carefully maintained in a wet condition by adequate watering and shall be protected by installing a siltation fence around the entire stockpiled area. Stockpiles shall be completely covered with a filter fabric and whenever possible, located in the shade.

I. Suitable soil which is excavated, not including the top layer referred to in the paragraph above, shall be carefully removed for use as subgrade material beneath coastal topsoil and if it is not immediately used, shall be stored in a designated stockpile area, to be reused. All soils to be reused shall be carefully stockpiled and protected with appropriate drainage and erosion control.

J. Once the replication area has been excavated, backfilling of the excavation with coastal soil can occur. Prior to the spreading of the coastal soil, the subsoil within the replication area shall be inspected and approved by the Engineer. The elevation and slope of the backfilled subgrade are critical elements in assuring proper replacement of coastal soils and the function of the coast line. When backfilled with the soil discussed in the paragraph above, elevation and slopes of backfilled areas shall be consistent with the Contract Drawings minus 1-foot to allow for replacement of coastal soils.

K. When Erosion Control Blanket is used, installation shall conform to the manufacturer's recommended installation methods.

3.02 COASTAL SOILS:

A. Coastal topsoil shall be deposited to a minimum depth of twelve (12) inches. coastal topsoil shall be deposited to minimize travel and subsequent compression of the underlying material and the replaced coastal topsoil. If the Contractor fails to remove and stockpile sufficient coastal topsoil to cover the replication area, or in the event sufficient coastal topsoil is not present, the Contractor shall provide, at no additional cost to the Owner, replacement coastal topsoil. Replacement coastal topsoil, if required, shall be provided by a licensed nursery and shall be similar in composition, texture, fertility, and as described in Section 2.01 BACKFILL. The final grading of the replacement coastal topsoil shall be completed to result in no discontinuities in elevation upon removal of any siltation barrier or erosion control materials.

B. Upon completion of final grading, the surface of the new coastal topsoil shall be shallowly harrowed (depth 3-inches), prior to planting.

C. Upon completion of grading, a final condition survey of the coastal restoration and enhancement areas shall be performed by a licensed surveyor. Elevations shall be checked in numerous random locations, and shall be within 0.1 feet of the final planned surface elevation. Areas that do not meet the 0.1 foot criteria shall be regraded.

3.03 PLANTING SCHEDULE:

A. Spring planting of saplings and shrubs shall occur between 30 April and 15 June. Fall planting shall occur as dormant planting between 15 September and 30 October for saplings, and 15 September and 15 November for shrubs. If special conditions warrant a variance from the above planting schedules or conditions, and if in concurrence with the coast lines restoration specialist, the above dates can be modified only if recommended by the nursery and if all warranties still apply.

B. Planting and hydroseeding shall not occur when the ground is frozen, snow covered or in an unsuitable condition for planting.

C. All saplings, shrubs and emergent propagules shall be planted in the coast lines restoration and enhancement areas in accordance with a planting plan and schedule as indicated on the Final Plans. All saplings and shrub mixtures (within the coast lines restoration and enhancement areas) shall be planted randomly as indicated on the Final Plans. Sapling and shrub mixtures shall be planted randomly under the direction of the coast lines restoration specialist, with all planting locations no closer than 10 feet on center. Saplings and shrubs shall not be planted within ponds or standing water areas. No machinery or vehicles shall be allowed within the existing adjacent coast lines. Soil disturbances shall be kept to the minimum necessary to accommodate planting. Any extra soil (from pits) shall be removed from the coast line.

D. All balled and burlapped and container grown plants shall be handled and moved only by the root ball or container.

E. Pits for planting shall be dug to produce vertical sides and flat bottoms. The depth of pits shall be 6-inches deeper than the root ball. The diameter of the pits shall allow a minimum distance between the ball and the sides of the hole of 6-inches for shrubs and 10-inches for saplings. The bottom 4-inches of the pit shall be loosened with a shovel prior to planting.

F. Balled and burlapped stock shall be backfilled with soil to approximately half the depth of the ball and watered. Burlap and tying materials shall be carefully removed or folded back at the recommendation of the nursery. Plastic wrap shall be completely removed before placement of backfill. The remainder of backfill shall be tamped and watered.

G. Emergent plantings shall be planted by hand in random locations under the direction of the coast lines restoration specialist in locations designated by the Final Plans. Plantings shall be planted no closer than 2 feet on center.

3.04 HYDROSEEDING:

Hydroseeding shall accomplish seeding, fertilizing and mulching. Hydroseeded areas shall be seeded at a rate of 400 pounds per acre. Hydroseed application shall be conducted between 15 April and 15 June or 15 September to 30 October, or as recommended by the hydroseed contractor.

3.06 MOISTURE ENHANCER:

The moisture enhancer specified in Section 2.03 of this specification shall be applied to each planted shrub and sapling at a rate of 8 ounces per propagule and shall be broadcast around the root ball 3- to 4-inches below the surface.

3.08 WATERING:

All plantings shall be watered by flooding the backfilled hole within the same working day of planting. Additional soil shall be added around each plant as required to compensate for settling.

3.09 PROTECTION:

Upon completion of construction activities within the coast lines restoration and enhancement areas, barricades or snow fencing shall be erected along upland areas adjacent to the coast line to prevent unauthorized access.

3.10 PLANTING OF COAST LINES VEGETATION:

A. In all coast lines, replication of the disturbed areas shall require replanting with indigenous coastal species. The Contractor shall have the option of digging, storing, and replanting existing trees, shrubs and groundcover and spreading stockpiled coast lines soil from the reservoir excavation area or, alternatively, providing and planting new coast line species at no additional cost to the Owner. The intent of this Section is to ensure that at least 75 percent of the surface area of all disturbed coast lines is reestablished with indigenous coastal plant species within two growing seasons of their planting in accordance with the Massachusetts DEP's Protection Act Regulations. The growing season for coastal revegetation areas shall be April 15 to October 15. Attention is called to the fact that wetlands to be replicated within the project site have been identified as shrub-scrub or shrub-sapling swamps. The coast line planting zones are schematically shown on the plans. If after 180 growing season days it is evident in the opinion of the Engineer that it is unlikely that the 75 percent reestablishment requirement will be achieved, the Contractor shall supplement the plantings as necessary to achieve the required coverage at no additional cost to the Owner. If at the end of two growing seasons, 75 percent reestablishment has not been achieved, the Contractor shall provide and plant additional new plant material to achieve 75 percent reestablishment at no additional cost to the Owner.

B. Coast line species are divided into planting groups (designated below) according to their moisture requirements during the growing season. Plantings are done at specified elevations based on the assumed mean water table. (These elevations to be adjusted by the Engineer based on the mean water table as determined during one growing season April 15 to October 15).

C. Coast line plantings shall be performed as designated on the Contract plans.

H. For each 100 square feet of replication area to be revegetated with replacement soil, provide and plant a total of 50 plants. New plants shall be a minimum size of 1-3/4-inch peat potted nursery stock, dormant rhizome, dormant tuber, dormant bulb, or bare root plant, as appropriate for the species and planting season. Plants shall be spaced

according to Contract Plans.

I. All planting shall be supervised by a licensed nurseryman, qualified to do this work. At least four weeks prior to any coastal planting, the Contractor shall submit details of proposed planting methods, plant layout, and personnel qualifications for approval by the Engineer.

J. Coast line planting materials, operations, maintenance, inspection, and preliminary acceptance shall be as specified. Warranty and final inspection of all plantings shall be a minimum of one year from the date of preliminary acceptance.

K. Maintenance shall be provided until final acceptance. Final acceptance shall be obtained as stipulated in the attached Order of Conditions.

3.11 EROSION CONTROL SEEDING FOR COAST LINESS:

A. After Coast line soil is spread, no further preparation for seeding is required or allowed. No fertilizer, limestone, superphosphate or other amendment shall be added to Coast line soils. Seed mixture and application rates for this work shall follow the contract plans.

B. A Coast line seed mixture containing a wide variety of seeds native to New England and which do not include any invasive plant species prohibited in the latest edition of the “Performance Guidelines and Supplemental Information on the Checklist for Review of Mitigation Plan”, published by the U.S. Army Corps of Engineers New England Division. Application rates shall be two pound per 5000 square feet.

C. Where required by the Engineer, for reasons of excessive soil moisture, the coast line seed mixture shall be modified by the addition of an approved portion by weight of seed to provide soil stabilization cover in the fall.

3.12 WORK IN THE COASTAL BUFFER ZONE (BZ):

A. When any work occurs in the Buffer Zone (BZ) within 100 feet of bordering vegetated coast, certain measures, as indicated on the Contract Drawings, shall be taken to protect the integrity of the coast lines.

B. A siltation barrier consisting of a continuous row of staked hay bales and a silt fence shall be placed between the and the work area to prevent soil materials from entering the from the BZ as shown on the Contract Drawings. This siltation barrier shall be inspected and maintained daily. Hay bales and silt fence are specified in BPWD Standard Specifications.

C. In general, storage of equipment or materials in or BZ areas shall not be permitted. Storage of oil products or the repairing of vehicles and/or maintenance operations shall not be permitted in the or BZ areas. Should the Engineer deem that the Contractor's activities are unnecessarily detrimental to the coast lines, the Engineer reserves the right to order the Contractor to immediately cease all activities on-site until the situation is resolved to the satisfaction of the Engineer.

END OF SAMPLE SECTION

SAMPLE SURFACE SEEDING OF COASTAL AREAS SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

This section covers labor, materials, and equipment necessary to restore cross country areas affected by the Contractor's operations.

1.02 RELATED WORK:

A. Restoring lawn areas is specified in LOAMING AND SEEDING. (Refer to BPWD Standard Specifications)

1.03 SYSTEM DESCRIPTION:

A. Cross country areas shall be restored as much as possible to their original condition. A vegetative cover shall be established as soon as possible to prevent erosion.

B. In areas within or adjacent to wetlands, the provisions of the Conservation Commission Order of Conditions shall be adhered to unless otherwise required by the Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS:

A. The following seed mixes shall consist of a certified mixture of the following seeds:

Select from the following mixes**:**

- Erosion control/Restoration – Switchgrass, Virginia Wild Rye, Creeping Red Fescue, Fox Sedge, Creeping Bentgrass, Silky Wild rye, Nodding Bur-marigold, Soft Rush, Grass-leaved Goldenrod, Sensitive Fern, Joe-Pye Weed, Boneset, Flat-top Aster, New York Aster and Blue Vervain.

- Conservation/Wildlife mix – Big Bluestem, Switchgrass, Little Bluestem, Canada Wild Rye, Fox Sedge, Partridge Pea, Fringed Bromegrass, Pennsylvania Smartweed, Common Milkweed, Nodding Bur-marigold, Showy Tick-Trefoil, Silky Smooth Aster, Flat-top Aster.

- New England Wildflower Mix - Creeping Red Fescue, Little Bluestem, Indian Grass, Partridge Pea, Wild Blue Lupine, Smooth Aster, Canada Wild Rye, Common Milkweed, Wild Senna, Heath Aster, Butterfly Milkweed, Early Goldenrod, Grey Goldenrod, New England Aster.

- Wet Meadow Seed Mix – Switchgrass, Creeping Red Fescue, Riverbank Wild Rye, Nodding Bur-marigold, Blue Vervain, Flat-top Aster, Spotted Joe-Pye Weed,

Boneset, Arrowwood, Silky Dogwood, Steeplebush.

- Erosion Control/Restoration Mix for Dry Sites – Creeping Red Fescue, Annual Rye-grass, Timothy, White Clover, Little Bluestem, Red Top, Side-oats Gramma-grass.

B. Weed seed shall be less than 1 percent.

C. Lime and fertilizer shall be as specified in LOAMING AND SEEDING (Refer to BPWD Standard Specifications)

- Erosion control/restoration mix – fertilization is not required unless the soils are particularly infertile.

- New England Wildflower Mix - fertilization is not required unless the soils are particularly infertile.

D. Mulch shall consist of weed-free straw.

PART 3 - EXECUTION

3.01 SEPARATION OF SURFACE MATERIALS:

Topsoil shall be carefully removed and separately stored to be used again as required.

3.02 SURFACE PREPARATION:

A. After approval of rough grading, the stockpiled topsoil shall be replaced in the areas affected by the Contractor's operations.

B. Seedbed shall be worked up a minimum of 3-inches deep. The topsoil shall then be raked until the surface is finely pulverized and smooth and shall be compacted with rollers weighing not over 100 pounds per linear foot of tread, to an even surface to the prescribed lines and grades.

3.03 SEEDING:

A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 30 or August 15 to October 1, unless otherwise approved.

Straw mulch shall be used for summer and fall seeding for the following seed mixes:

Erosion Control/Restoration Mix
New England Wildflower Mix
Wet Meadow Seed Mix

Straw mulch shall be used at all times that the Erosion Control/Restoration Mix for Dry Sites is applied.

B. Seed shall be sown at a rate applicable to the type of seed mix being applied. Application

rates shall be as follows:

Erosion Control/Restoration Mix – 35 lb/acre
Conservation/Wildlife Mix – 25 lb/acre
New England Wildflower Mix – 15 lb/acre
Wet Meadow Seed Mix – 35 lb/acre
Erosion Control/Restoration Mix for Dry Sites – 35 lb/acre

Mix may be applied by hydro seeding, mechanical spreader, or by hand on small sites.

C. One half the seed shall be sown in one direction and the other half at right angles. Seed shall be raked lightly into the soil to a depth of ¼-inch and rolled with a roller weighing not more than 100 pounds per linear foot of tread.

D. Wherever poor germination occurs in areas larger than 3 square feet, the Contractor shall reseed, roll, and water as necessary to obtain proper germination.

3.04 INSPECTION AND ACCEPTANCE:

A. At the beginning of the planting season following that in which the seed mix is sown, the seeded areas shall be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. If necessary, the Contractor shall furnish and apply soil conditioners and fertilizer to achieve acceptable growth.

B. The seeded areas shall be watered, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show dense, vigorous growth.

END OF SAMPLE SECTION

SAMPLE WARM SEASON GRASS/WILDFLOWER SEEDING SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. This Section includes furnishing all labor, materials, equipment, seed and incidental materials necessary to accomplish all seeding of native warm season grasses (NWSG) and wildflowers and related work, complete in place, maintained, and accepted, in accordance with the Contact Drawings and Specifications.

B. The Contractor shall bear the responsibility and cost of furnishing and applying water or any other substances, as necessary to ensure the sustainability of NWSG/wildflower seeded areas, as part of the work of this contract.

1.02 SUBMITTALS:

In accordance with requirements of general specifications, the Contractor shall submit the following to the Engineer for review and approval:

A. Six copies of information for seed mixes including the following:

1. Name and address of the seed supplier.

2. Point of genetic origin, source of seed lot, seed lot number, and dates of harvest for each of the various types of seed.

3. Certification of seed mix composition and proportion, indicating named varieties by percent, percent germination, purity, percent crop seed, percent inert matter, and percent weed seed content. Accuracy shall be to .01 percent.

4. Estimated number of seeds per pound of each type of seed in the mix.

B. Six copies of information detailing proposed fertilizers, limestone, insecticides, herbicides, fungicides, mulch materials, and slope protection material (if required) to be applied to seeded areas.

C. Six copies of watering, fertilizing, and maintenance schedule.

D. Six copies of marked up prints indicating the square footage of all proposed seeded areas with quantities of various soil additives and amendments, and quantities of seed for each area prior to beginning work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. LOAM BORROW:

Loam Borrow shall be as specified in LOAM BORROW. (Refer to BPWD Standard Specifications)

B. LIMESTONE:

1. Lime shall be an approved agricultural limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide). The material will be ground such that 50 percent of the material will pass through a No. 100 mesh sieve and 98 percent will pass a No. 2 mesh sieve. Lime shall be uniform in composition, dry and free-flowing and shall be delivered to the site in the original sealed containers, each bearing the manufacturer's guaranteed analysis.

C. FERTILIZER:

1. Fertilizer shall be a complete, standard commercial fertilizer, homogenous and uniform in composition, dry and free-flowing, and shall be delivered to the site in the manufacturer's original sealed containers, each bearing the manufacturer's guaranteed analysis and marketed in compliance with State and Federal Laws. All fertilizer shall be used in accordance with the manufacturer's recommendations.

2. For Fertilizers containing Nitrogen, at least 50 percent of nitrogenous elements shall be Urea-form or derived from organic sources and contain no less than 3 percent water soluble Nitrogen.

3. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, containing not less than 18 percent available phosphoric acid.

D. SEED:

1. Seed shall be of an approved perennial variety mixture, the previous year's crop, clean, and high in germinating value. Point of genetic origin shall not be greater than 300 miles north or 200 miles south of the site where seed is proposed to be sown. Parameters for acceptance shall account for the elevation of the point of seed origin such that every difference in elevation of 1000 feet shall be considered equivalent to 175 miles north.

2. Weed seed content shall be less than 0.5 percent by weight and include no noxious weeds. Seed shall be obtained from a reliable seed company and shall be accompanied by seed analysis reports certifying compliance relative to mixture purity and germinating value. Seed shall be furnished and delivered in new, clean, sealed and properly labeled containers. All seed shall comply with applicable State and Federal laws. Seed that has become wet, moldy or otherwise damaged shall not be accepted.

3. Native warm season grass (NWSG) seed mix shall conform to the following requirements:

Botanical and Common Names	Proportion by Pure Live Seed	Germination Rate Minimum	Purity Minimum
Andropogon gerardii 'Niagara' (Big Bluestem 'Niagara')	20%	95%	85%
Dicanthelium clanestinum 'Tioga' (Deertongue 'Tioga')	20%	70%	95%
Panicum virgatum 'Shelter' (Switchgrass 'Shelter')	10%	90%	99%
Phleum pratense (Timothygrass)	20%	90%	99%
Schizachyrium scoparium 'Camper' (Little Bluestem 'Camper')	10%	75%	75%
Sorghastrum nutans 'Nebraska-54' (Indiangrass 'Nebraska-54')	20%	90%	80%

NWSG seed mix shall be sown at the rate of 15 pure live seed pounds per acre.

4. Wildflower seed mix shall conform to the following requirements:

Botanical and Common Names	Proportion by Pure Live Seed	Germination Rate Minimum	Purity Minimum
Aster novi-belgii (New York Aster)	25%	70%	90%
Asclepias syriaca (Common Milkweed)	25%	90%	95%
Solidago canadensis Canadian Goldenrod)	50%	75%	70%

Wildflower seed mix shall be sown at 2 pure live seed pounds per acre and incorporated with the above to the NWSG seed mix.

5. Temporary cover crop shall conform to the following requirements:

Botanical and Common Names	Proportion by Pure Live Seed	Germination Rate Minimum	Purity Minimum

Annual Ryegrass (Lolium multiflorum)	100%	85%	%

Temporary cover crop for newly loamed areas shall be sown as a companion/erosion control crop at 10 pure live seed pounds per acre and incorporated with the NWSG and NWSG/wildflower mixtures.

E. MULCH:

1. Materials to be used in mulching seeded areas shall be free of weed seed and shall conform to the following requirements:

   a. Hay Mulch shall consist of mowed and properly cured grass, clover or other acceptable plants. No salt hay shall be used.

   b. Straw Mulch shall consist of stalks or stems of grain after threshing.

F. HYDROSEED MULCH, TACKIFIERS AND WATER RETENTION AGENTS:

1. Wood fiber mulch for Hydroseed application shall be a manufactured product of natural wood cellulose fibers with a non-toxic green marking dye incorporated to ensure uniform distribution. Mulch shall be packed in sealed original containers, clearly labeled with brand name and manufacturer. It shall have delivered moisture content less than 12 percent.

2. Hydroseed tackifier shall be a powdered starch-based product approved by the Engineer. Hydroseed tackifier shall be applied in conjunction with the hydroseed slurry in accordance with the manufacturer’s recommendations.

3. Moisture retention agent shall be a powdered starch-based product, approved by the Engineer, and shall be capable of retaining up to 400 times their weight in water. Moisture retaining agents shall be added to the hydroseed slurry in accordance with the manufacturer’s recommendations. Moisture retention agent shall be ‘Hydro-Gel’ as manufactured by Finn Corporation, Fairfield, OH, or approved equal

G. SLOPE EROSION PROTECTION:

1. Erosion control blanket shall be 100 percent biodegradable mesh with 100 percent biodegradable straw or straw/coconut fill. Fill shall be held together by biodegradable fastening. Weight shall be 0.50 pounds per square yard. Erosion control blankets shall be applied parallel to direction of water flow. The erosion control blankets shall be by North American Green, Evansville, IN, or approved equal. For slopes 2:1 or greater, erosion control blanket shall be composed of 70 percent straw 30 percent coconut fiber, Model SC150. For slopes less than 2:1, erosion control blanket shall be a high velocity straw matting, Model S150.

2. Six-inch wire staples shall be placed in accordance with the manufacturer's recommendations to anchor the mesh material. Staples shall be biodegradable.

H. WATER:

1. Water shall be furnished by the Contractor, unless otherwise specified, and shall be suitable for irrigation and free from ingredients harmful to plant growth and viability. The delivery and distribution equipment required for the application of water shall be the furnished by the Contractor, at no additional cost to the Owner.

I. INSECTICIDES:

1. No insecticides shall be used on-site without the Contractor notifying and obtaining prior approval of the Engineer.

2. Insecticides shall be EPA registered and approved for use in public open spaces. All insecticides shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.

3. Insecticide use shall be limited and selective, only to control specific insect infestations, as identified by the Contractor or the Owner's Representative, that may result in the disfigurement, decline, or death of plant materials.

4. Grub control insecticide shall be Proturf Insecticide III, as manufactured by A.M. Scotts & Sons, Inc.; Dursban Granules, as manufactured by Old Fox Chemical Corp., or ACMC; or approved equal.

J. HERBICIDES:

1. No herbicides shall be used on-site without the Contractor notifying and obtaining prior approval of the Engineer.

2. All herbicides shall be EPA registered and approved for use in public open spaces. All herbicides shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.

3. Herbicides for post-emergent application shall be impazapic, 'Plateau DG', as manufactured by American Cyanamid, Co.; glyphosate contact, 'Roundup', as manufactured by Monsanto, Inc.; and/or approved equal.

4. Herbicide use shall be limited and selective, only to control specific weed infestations that have been identified by the Contractor or the Owner's Representative.

K. FUNGICIDES:

1. No fungicides shall be used on-site without the Contractor notifying and obtaining prior approval of the Engineer.

2. Fungicides shall be EPA registered and approved for use in public open spaces. All

fungicides shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.

3. Fungicide use shall be limited and selective, only to control specific fungal pathogenic disease infestations, as identified by the Contractor or the Owner's Representative, that may result in the disfigurement, decline, or death of plant materials.

PART 3 - EXECUTION

3.01 GENERAL:

A. All work shall be performed by skilled workers with a minimum of 2 years of NWSG/wildflower seed establishment experience and under the full-time supervision of a qualified foreman.

B. Seeding operations shall not begin until at least 4 days have elapsed after the application of lime and fertilizer and seedbed areas are reviewed and approved by the Engineer.

C. Seeding shall be done when soil and weather conditions permit in spring, until June 15. Soil temperature shall be at least 50 degrees F. If it becomes necessary for seed to be sown after June 15, provisions shall be made for applying supplementary water and using a mulch cover over seeded areas.

D. If there is a delay in seeding, during which weeds grow, or soil from newly loamed areas is washed out, the Contractor shall eliminate the weeds or replace the soil before sowing the seed, without additional compensation.

E. Seed shall be sown at the approved rate, on a non-windy day by machine.

1. All newly loamed areas shall be shall be lightly raked and hydroseeded in accordance with these specifications and as approved by the Engineer.

2. The equipment used to seed NWSG and wildflowers in existing turf areas shall use no-till drill technology to provide a uniform distribution of seed, place seed at the proper depth, and provide for proper seed to soil contact.

F. The surface shall be kept moist by a fine spray until the seed shows uniform germination over the entire area. Wherever poor germination occurs in areas larger than 3 square feet, the Contractor shall reseed, roll, and water as necessary to obtain proper germination.

G. If there is insufficient time in the planting season to complete soil preparations, fertilizing, and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or on order of the Engineer. In that event, a temporary cover crop shall be sown. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized, and the permanent seed crop shall be sown as specified.

H. Protection of newly loamed and graded areas is required and shall be accomplished by whatever means necessary, such as straw applied with a tackifier, or by other means approved by the Engineer. The Contractor shall be responsible for the prevention of siltation in areas beyond the limit of work and for all means of protection during the maintenance period at no additional cost to the Owner.

3.02 SURFACE PREPARATION OF NEWLY LOAMED AREAS:

A. If approved by the Engineer, the entire site area to be seeded shall be treated with an approved herbicide suitable for pre-emergent use, in accordance with the manufacturer's instructions, not less than 7 days before the start of seeding operations.

B. If approved by the Engineer, grub control insecticide shall be spread on the surface of the seedbed, in accordance with the manufacturer's instructions, after the seedbed has been properly graded, not less than 24 hours before the start of seeding operations.

3.03 BROADCAST SEEDING:

A. Mechanical broad cast machinery shall be equipped with special seed boxes to accommodate the irregularly shaped and sized NWSG/wildflower seed. Seed boxes shall include auger-agitators, or the seed mix shall include a carrier, to ensure uniform flow and distribution of seed.

B. The seed mix to be broadcast shall be sown at the rate recommended by the seed supplier, or as required by the Engineer. Seed shall be divided into 2 equal amounts and uniformly distributed in 2 applications at right angles to each other. Seed shall then be raked lightly into the soil to a depth of l/4-inch.

C. If mulch is not necessary the seed shall be directly firmed into the soil with a roller that will apply pressure between 75 and 100 pounds per linear foot of width.

3.04 HYDROSEEDING:

A. The application of lime, fertilizer, seed and mulch may be accomplished in a single operation by the use of an approved hydroseeding machine. The materials shall be mixed with water in the machine and kept in an agitated state in order that the materials may be uniformly suspended in the water. The slurry shall be of such consistency that it can be sprayed from a hydroseed gun or through at least 200 feet of 1-½-inch diameter hose. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of lime, fertilizer, seed and mulch shall be equal to the specified quantities.

B. Prior to the start of hydroseeding, the Contractor shall furnish to the Engineer, in writing, the weights of limestone, fertilizer, NWSG/wildflower seed, tackifier (as required), moisture retention agent (as required), and mulch per 100 gallons of water to be used. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above. If the results of the hydroseeding operation are unsatisfactory, the Contractor will be required to abandon this method and to apply the

lime, fertilizer, seed, and mulch by other means.

C. Seed shall be incorporated into the mulching material to obtain a minimum sown coverage of 200 pounds of the specified seed per acre. Seed substitutions may require rate adjustments as recommended by the seed suppliers, if approved by the Engineer.

D. Wood fiber mulch shall be uniformly spread over certain selected seeded areas at the minimum rate of 1,400 pounds per acre unless otherwise required. Mulch shall be placed by spraying from an approved machine with pressure sufficient to cover the entire area in a single operation.

E. The Contractor shall immediately cleanup hydromulch oversprays from plant materials, pavements, furnishings, etc., to the satisfaction of the Engineer.

3.05 SURFACE PREPARATION OF EXISTING TURF AREAS:

A. Areas covered with existing vegetation shall be treated with an approved herbicide in accordance with the manufacturer's instructions, not less than 4 weeks before the start of seeding operations.

B. After the treated vegetation has died, the Contractor shall hay the area, mowing the area low to the ground to remove above-ground vegetative growth and accumulated plant litter. All cuttings shall be disposed of off-site.

C. The Contractor shall then sow seed according to the No-till Drill Seeding method described below.

3.06 NO-TILL DRILL SEEDING:

A. No-till drill seeding equipment shall be capable of operating at a consistent shallow depth. Drill seeding machinery shall be equipped with a fluffy seed box with an auger/agitator, suitable for use with NWSG, to ensure uniform flow without carriers. If the seeding machine does not provide adequate row packing after the seed has been placed, the site shall receive an additional packing operation to ensure good soil to seed contact. Grass seed drills shall be as manufactured by Truax Company, 4821 Xerxes Avenue North, Brooklyn Center, MN, or approved equal. Truax grass seed drills are available from Ernst Conservation Seeds, 9006 Mercer Pike, Meadville, PA 16355 (1-800-873-3321).

B. The Contractor shall ensure that seed is placed to the proper depths and shall perform all seeding operations in accordance with the seed drill manufacturer's recommendations.

3.07 PLACING MULCH AND SLOPE EROSION PROTECTION:

A. Hay or Straw Mulch shall be loosely spread to a uniform depth over all areas designated on the plans, at the rate of 4-1/2 tons per acre, or as otherwise directed. Mulch shall be firmed into the soil with a roller weighing between 75 and l00 pounds per linear foot of tread.

B. Hay or Straw Mulch may be applied by mechanical apparatus, if in the judgment of the

Engineer, the apparatus spreads the mulch uniformly and forms a suitable mat to control slope erosion. The apparatus shall be capable of spreading at least 80 percent of the hay or straw in lengths of 6-inches or more, otherwise it shall be spread by hand without additional compensation.

C. Slope erosion control blankets shall be placed as indicated on the plans or as required by the Engineer.

3.08 FIRST YEAR MAINTENANCE:

A. The Contractor shall maintain and protect the entire seeded area until final acceptance at the completion of the contract or for 60 days, whichever is longer. Maintenance shall include watering as specified, liming, fertilizing, control of weeds, insect pests and fungal pathogens, and mowing. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.

B. As part of a post-planting weed control regimen, the first mowing shall be done in July, when NWSG/wildflower seedlings have 2 – 3 leaves, or when weed growth is greater than 6-inches in height, to remove the upper growth of weed species only. The second mowing shall be done 6 weeks later in late August/early September. The third mowing shall be done after hard frost in late fall to remove crop residues.

C. For the first year, all mowing shall be accomplished with a sickle bar mower raised to a height of 6 inches. All cuttings shall be removed and disposed of off-site.

D. The Contractor shall be responsible to regularly water NWSG/wildflower seeded areas with the equivalent of 1-inch minimum of rainfall per week, or as necessary to develop and sustain dense, green growth.

E. NWSG/wildflower seeded areas shall be periodically inspected, beginning 4 – 6 weeks after planting. Inspections shall include monitoring for seedling vitality, insect pest populations, opportunistic weed growth, and disease. Corrective measures, including reseeding and applications of insecticide, herbicide, or fungicide as needed, shall be undertaken in accordance with assessment of growth stands and these specifications.

F. The Contractor shall be responsible for securing all NWSG/wildflower seeded areas from physical damage as necessary, including warning signs, barriers, temporary fencing, or other means of protection, through the guarantee period until final acceptance. All damaged areas shall be repaired to reestablish healthy vigorous growth of turf at no additional cost to the Owner. All temporary barriers shall remain the property of the Contractor and shall be removed by the Contractor upon final acceptance by the Engineer.

3.09 EXTENDED MAINTENANCE:

A. After the first year, NWSG/wildflower seeded areas shall not be cut shorter than 8-inches in height. Mowing shall be undertaken with a sickle bar mower twice yearly – very early in the spring, to clear vegetative matter away from emergent NWSG/wildflower plants, and after hard frost in the fall, after NWSG/wildflower seedheads have matured. Remove and dispose of all cuttings from the site.

B. Every 3 years test soils for pH and plant nutrient levels. Apply lime and fertilizer at rates recommended for native warm season grasses. Nitrogen may be applied as needed in the second year after seeding and there beyond. Nitrogen shall only be applied in mid to late May, when spring growth is between 3- to 4-inches in height.

C. Continue to monitor NWSG/wildflower seeded areas for vitality, insect pest populations, adventitious weed growth, and disease. Undertake corrective measures including reseeding and applications of insecticide, herbicide, or fungicide, as needed, in accordance with assessment of growth stands and these specifications.

3.10 GUARANTEE:

A. Seeded areas shall be guaranteed until final acceptance of the project, or, in the case of late summer or fall planting, the guarantee period shall extend through the following spring.

3.11 INSPECTION AND PRELIMINARY ACCEPTANCE:

A. At the beginning of the planting season following that in which the permanent crop is sown, NWSG/wildflower seeded areas will be inspected. Any section not showing dense, vigorous growth shall be promptly reseeded by the Contractor at no additional cost to the Owner. The seeded areas shall be watered, weeded, cut and otherwise maintained by the Contractor, as many times as necessary, in accordance with these specifications, until they are accepted.

B. The Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of inspection for preliminary acceptance. The Engineer shall recommend preliminary acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals, or replacements.

C. Inspection and acceptance of NWSG/wildflower seeded areas may be requested and granted in part, provided the areas for which acceptance is requested are relatively substantial in size, and with clearly definable boundaries. Acceptance and use of these areas by the Owner shall not waive any other provisions of this Contract.

3.12 GUARANTEE:

A. NWSG/wildflower seeded areas shall be guaranteed until final acceptance of the project, or, in the case of late summer or fall planting, the guarantee period shall extend through the following spring.

B. When the work is accepted in part, the guarantee period shall extend from each partial acceptance to the terminal date of the last guarantee period. All guarantee periods terminate at one time.

C. Guarantee shall not apply to the replacement of NWSG/wildflower seeded areas resulting from the removal, loss, or damage due to occupancy of the project in any part; vandalism or acts of neglect on the part of others; physical damage by animals, vehicles, etc.; and Acts of God, including but not limited to, catastrophic fire, hurricanes, riots, war, etc.

D. In the instance of curtailment of water by local water authorities (when supply was to be furnished by the Owner), the Contractor shall furnish all necessary water by water tanker, the cost of which will be approved and paid for by the Owner.

3.13 FINAL INSPECTION AND FINAL ACCEPTANCE:

A. At the end of the guarantee period, the Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of final inspection for final acceptance.

B. The Engineer shall recommend final acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.

END OF SAMPLE SECTION

SAMPLE VEGETATIVE SUPPORT LAYER / HYDROSEEDING SPECIFICATION

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. Furnish all labor, materials, equipment and incidentals required to place vegetative support layer, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as specified herein.

B. Contractor shall seed all areas disturbed by his operations. All areas disturbed or not having sufficient vegetation to prevent erosion shall be seeded.

1.02 SUBMITTALS:

A. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

B. The Contractor shall submit the proposed seed mix including the manufacturer's certificate of compliance to the Engineer for review prior to seeding.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Vegetative support layer shall be fertile, natural soil capable of sustaining vigorous plant growth, typical of the locality, free from stones greater than 3-inches, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth.

B. Fertilizer shall be a complete commercial fertilizer, 10-10-10 grade for grass areas. It shall be delivered to the site in the original unopened containers each showing the manufacturers guaranteed analysis. Fertilizer shall be stored so that when used it shall be dry and free flowing.

C. Lime shall be ground limestone containing not less than eighty-five percent (85%) calcium and magnesium carbonates.

D. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than ninety (90), a percentage of purity of not less than eighty-five (85) and shall have not more than one percent (1%) weed content. The seed mixture shall conform to the requirements of Slope Seed Mix or other seed mix approved by the Engineer.

E. The seed shall be furnished and delivered premixed in the proportions specified above. The manufacturer for each seed type shall submit a manufacturer’s certificate of compliance to the specified mix. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and data of shipment. No seed may be sown until the Contractor

has submitted the certificates.

F. Hay mulch shall be dry hay or straw mulch free of mold.

PART 3 - EXECUTION

3.01 APPLICATION:

A. Unless otherwise shown on the contract drawings, vegetative support layer shall be placed to a minimum thickness of 6-inches.

B. For all areas to be seeded:

1. Lime shall be applied uniformly over the area at the rate of twenty-five (25) pounds per 1,000 square feet minimum and one hundred (100) pounds per 1,000 square feet maximum.

2. Fertilizer (10-10-10) shall be applied uniformly over the area at the rate of thirty (30) pounds per 1,000 square feet.

3. Seed shall be applied uniformly over the area at the rate of three (3) pounds per 1,000 square feet.

4. Fiber mulch shall be applied uniformly over the area at the rate of seventy-five (75) pounds per 1,000 square feet minimum and one hundred fifty (150) pounds per 1,000 square feet maximum.

C. The application of fertilizer and lime shall be performed hydraulically in one operation with hydroseeding. The Contractor will be responsible for cleaning all structures and paved areas of unwanted deposits.

D. The application of hay mulch is to be by pneumatic blower.

3.02 INSTALLATION:

A. The subgrade of all areas to be covered with vegetative support layer and seeded shall be raked and all rubbish, sticks, roots and stones larger than 3-inches shall be removed. Subgrade surfaces in all areas shall be tracked immediately after fine grading and raking has been completed. Tracking is to be performed with bulldozers operating in the direction of water flow. The tracks of the bulldozers are to have grousers of sufficient height to leave visible depressions in the subgrade. The depressions are to be perpendicular to the direction of water flow to reduce erosion potential until vegetative support layer is placed. During the tracking, all depressions caused by settlement or tracking shall be filled with additional vegetative support layer and the surface shall be regraded and tracked until an even finished grade is created.

B. Subgrades shall be inspected and approved by the Engineer before vegetative support layer is placed. After vegetative support layer has been spread, and fine

graded, all large stiff clods, lumps, brush, roots, stumps, litter and other foreign material shall be removed from the area covered with vegetative support layer and disposed of by the Contractor. The entire area where vegetative support layer has been placed shall then be tracked as indicated in paragraph 3.02A above.

C. Application of fertilizer, lime, seed and mulch shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, and as approved by the Engineer. Seeding and fertilizing shall be conducted between April 1 and June 1 or between August 15 and October 15, or as required or permitted by the Engineer. The Contractor shall hydroseed and hay mulch only on a calm day.

D. Schedules for seeding and fertilizing must be submitted to the Engineer and Owner for approval prior to the work being performed.

E. Lime and fertilizer are to be spread hydraulically in one operation with the hydroseeding.

F. Seeding shall be done within ten (10) days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the lime, fertilizer and seed shall be equal in quantity to the specified rates. Prior to the start of work, the Engineer and Owner shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.

G. When protection of newly graded areas is necessary at a time, which is outside of the normal seeding season, the Contractor shall protect those areas by whatever means necessary (such as straw) or by other measures as approved by the Engineer and Owner.

H. No more than 5 acres of unprotected vegetative support layer will be allowed at any one time.

3.03 MAINTENANCE AND PROVISIONAL ACCEPTANCE:

A. The Contractor shall keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded, and shall maintain these areas in an approved condition until provisional acceptance.

B. On slopes, the Contractor shall protect against wash outs by an approved method. Any wash out which occurs shall be regraded and reseeded at the Contractor's expense until a good sod cover is established.

C. The Engineer or Owner will inspect all work for provisional acceptance at the end of the eight (8) week grass maintenance period, upon the written request of the Contractor, received at least ten (10) days before the anticipated date of inspection.

D. A satisfactory stand will be defined as a section of grass of 10,000 square feet or larger that has:

1. No bare spots larger than three (3) square feet.

2. No more than ten percent (10%) of total area with bare spots larger than one (1) square foot.

3. No more than fifteen percent (15%) of total area with bare spots larger than 6-inches square.

E. The Contractor shall furnish full and complete written instructions for maintenance of the seeded areas to the Owner at the time of provisional acceptance.

F. The inspection by the Engineer or Owner will determine whether maintenance shall continue in any area or manner.

G. After all necessary corrective work and cleanup has been completed, and maintenance instructions have been received by the Owner, the Engineer or Owner will acknowledge the provisional acceptance of the seeded areas. The Contractor's responsibility for maintenance of seeded areas, or parts of seeded areas shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE:

A. All seeded areas shall be guaranteed by the Contractor for not less than one (1) full year from the time of provisional acceptance.

B. At the end of the guarantee period, inspection will be made by the Engineer or Owner upon written request submitted by the Contractor at least ten (10) days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer or Owner, shall be renovated, reseeded, and maintained meeting all requirements as specified herein.

C. After all necessary corrective work has been completed, the Engineer or Owner shall acknowledge in writing the final acceptance of the seeded areas.

END OF SAMPLE SECTION

SAMPLE LANDSCAPING SPECIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. This Section covers general landscaping.

1.02 SYSTEM DESCRIPTION:

A. The Contractor shall furnish all plants as specified. No substitutes will be permitted. All plants shall be nursery grown in local nurseries.

B. No trees and woody shrubs shall be planted on barriers and within 20 ft from the toe of the barrier in either direction.

1.03 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

A. Six sets of manufacturer literature shall be submitted to the Engineer for review.

B. Six sets of tree and shrub schedule shall be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Plants shall be in accordance with the USA Standard for Nursery Stock of the American Association of Nurserymen.

B. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such conditions for at least two years.

C. All plants shall be moved with the root systems as solid units with balls of earth firmly wrapped with burlap. The diameter and depth of the balls of earth shall be sufficient to encompass the fibrous root feeding system necessary for the healthy development of the plant. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting or after the burlap, staves, ropes, or platform required in connection with its transplanting have been removed. The plants and balls shall remain intact during all operations. All plants that cannot be planted at once shall be heeled in by setting the ground and covering the balls with soil and then watering.

D. The plants shall be in a moist, vigorous condition free from dead wood, bruises, or other root or branch injuries.

E. Ground cover plants shall be of size, age, and/or condition listed above. Plants shall be healthy, free of insects, and diseases. Ground cover plants shall be potted or in sod.

F. Humus shall be ground or shredded peat which has been stockpiled for at least one year prior to its use.

G. Manure shall be well-rotted, unleached, stable manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings, or refuse of any kind and shall not contain over 25 percent straw. The Contractor shall furnish information as to the kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.

H. A composition of peat moss or peat humus to which has been added dehydrated manure (such as bovung) in the proportion of l00 pounds of dehydrated manure per cubic yard of peat may be substituted for manure as specified above.

I. Mulch materials shall be softwood shredded pine bark mulch or medium grade wood chips. Mulch shall be 98 percent organic matter with the pH range of 3.5 to 4.5. Moisture content of packaged material shall not exceed 35 percent.

J. Woodchips shall be obtained from sound, green wood, and shall be 1/8-inch nominal thickness with not less than 50 percent of the chips having an area of not less than one (1) square inch, nor more than six (6) square inches. The material shall be free from rot, leaves, twigs, shavings, debris, and material injurious to plant growth. The material may be checked by the Engineer for suitability. If the material is rejected, it shall be removed promptly from the site and replaced by suitable material at the Contractor's expense.

K. Fabric underlying wood chips shall be non-biodegradable, permeable landscaping fabric especially designed to inhibit weed growth and prevent mixing the wood chip cover with the underlying soil.

L. Wrapping material shall be first quality, heavy waterproof crepe paper manufactured for this purpose. Strips shall be 8- to l0-inches wide. Twine for tying shall be lightly medium or coarse sisal yarn.

PART 3 - EXECUTION

3.01 PLANTING:

A. The furnishing and planting of any plant material includes the digging of the holes, provision for fertilizer, loam, furnishing the plants of specified size with roots in the specified manner, the labor of planting and mulching and guying where called for.

B. Seasons for planting shall be as specified below:

1. Spring

Deciduous materials shall be planted between March 2l and May l. Evergreen materials shall be planted between April l5 and June l.

2. Fall

Deciduous materials shall be planted between October l and December l. Evergreen materials shall be planted between August l5 and October l5.

C. Location for all plants and outlines for planting areas shall be staked on the ground as shown on the drawings for approval by the Engineer. The Engineer may make minor adjustments. Maintain at all times during the planting operations one or more loam stockpiles of approved quality loam.

D. Loam for backfill shall have thoroughly incorporated with it well rotted manure in the proportion of l cubic yard of manure to 7 cubic yards of topsoil, or equivalent of dehydrated manure.

E. All plant roots and earth balls shall be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation, and on the ground until the final planting. The plants shall be planted in the center of the holes and at the same depth as they previously grew. Loam shall be backfilled in layers of not more than 9-inches and each layer watered sufficiently to settle before the next layer is put in place. Enough topsoil shall be used to bring the surface to finished grade when settled. A saucer shall be formed around each plant to a depth of 6-inches for trees and 4-inches for shrubs.

F. Plants shall be flooded with water twice within the first 24 hours of the time of planting.

G. A 2-inch thick (after settlement) layer of mulch shall be applied to the entire area of each saucer or planting bed.

H. No debris shall be left at the site. Excavated material shall be removed as required by the Engineer. Any damage to site or structures shall be repaired.

3.02 PLANT MAINTENANCE AND GUARANTEE:

A. Maintenance shall begin immediately after each plant is planted and shall continue for 30 days.

B. Maintenance shall include watering (equivalent to 1½-inches of rain twice a week for the first eight (8) weeks), weeding, cultivating, mulching, tightening and repairing guys, removal of dead material, resetting plants to proper grades or upright position, and maintaining the planting saucer.

C. After the 30-day maintenance period, the Contractor shall request the Engineer for an inspection to determine whether the plant material is acceptable. If the plant materials and workmanship are acceptable, written notice will be given by the Engineer to the Contractor stating that the guarantee period begins from the date of inspection.

D. Plants shall be guaranteed for a period of one year after inspection. At the end of the guarantee period, inspection will be made again. Any plant that is dead or unsatisfactory shall be removed from the site. These shall be replaced during the normal planting season

until the plants live through one year. A plant may be considered unsatisfactory if there is evidence of disease, or if the plant has dead leaves or limbs, and insufficient growth when compared to normal standards.

E. All replacements shall be plants of the same kind and size specified hereinbefore. The cost shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.

END OF SAMPLE SECTION