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June 19, 2018

Reforestation Plan
Proposed Main Street Solar Project
AP. 4, Lot 25
Main Street (RI Route 3), Hopkinton, RI

Purpose:

The proposed development of a solar array on the subject property will involve establishment of access roads, sediment basins, electrical equipment, and the rows of ground-mounted solar panels on a 137.86 acre parcel in Hopkinton, RI. The developed area involves 67.54 acres of that parcel of land, which includes 57.91 acres of existing forestland to be cleared, and 9.63 acres of existing open meadow.

This Reforestation Plan addresses the future process and costs associated with the reforestation of the affected acres upon decommissioning of the solar project. The projected timeframe for this plan is 30 years from its installation, and the plan would be implemented upon completion of the removal of the solar arrays from the property. Therefore the reforestation practices are projected for the year 2050, with present costs calculated. Present costs can be amortized for the year 2050. There are options to renew contracts for energy production, depending on the technology and demand for this type of renewable energy at that time. Projected costs would need to be adjusted for any advanced timeframes at that time.

Scope of Project:

As designed by DiPrete Engineering, the solar array sites on the subject property encompass a total of 67.54 acres of land. Included within that acreage are access roads that should be retained for future use as woods roads. These access roads occupy approximately 3 acres of land, resulting in 64.5 acres of land that will be re-vegetated upon decommissioning of the solar project in 2050. There is a potential of re-establishing agricultural use of the existing open meadows, however this reforestation plan incorporates the planting of tree species on all of the disturbed areas, save the access roads mentioned above.

There are options for the establishment of forest vegetation on the site. They include:

- Bare-root planting of seedlings 3-5' tall;
- Bare-root shrubs;
- Direct seeding method of acorns and hickory nuts;
- Indirect seeding method of light seeds from pine species;
- Encouraging natural regeneration.

Environmental Factors Impacting Reforestation Efforts:

There are a number of factors that will influence the nature and success of reforestation efforts on this property. The existing soil types, the extent of grading to establish the solar project, soil compaction during the construction and future maintenance of the arrays, disturbance and compaction during the removal of the arrays, vegetation that becomes established during the 30 year period, including non-native invasive plants, the slope and aspect of the planting sites, and any effects that climate change will have on species selection, along with the deer population, will all have roles to play in determining what species to plant and the success of the reforestation efforts in 2050 or beyond.

This reforestation plan must take into consideration an impacted site as a worst-case scenario, with reforestation of the areas similar to that of mine reclamation efforts in the coal fields of Appalachia. Further discussion of these factors is provided following the details of the reforestation plan.

REFORESTATION PLAN

The following reforestation process is subject to review and revision prior to its implementation due to any of the factors that may influence the appropriateness of these recommendations in the year 2050 or beyond. Species selection is dependent on climatic conditions and the physical impacts to the soil conditions from installation and decommissioning activities.

Site Preparation:

Protection of existing vegetation between the rows of solar arrays will provide erosion control while the tree cover is being established.

Removal of solar arrays will provide rows of disturbed soils that will now facilitate planting of bare-root seedlings and also provide a mineral soil seedbed for natural seeding of the site.

Removal of the rows of solar panel mounting poles will provide rows of post holes approximately 10’ apart, separated by a 20’ wide grassy strip.

Upon removal of solar arrays, some site preparation may be necessary, to the extent needed to allow hand planting crews safe access to plant trees. Control of any non-native invasive plants that may have become established may be necessary to prevent the site from being dominated by shrubs such as multi-flora rose, Autumn-olive, and non-native trees such as Ailanthus (Tree-of-Heaven). Vines such as honeysuckle and bittersweet may also be present.

Tree & Shrub Species Selection:

Based upon the factors that influence the reforestation of the subject site, the following tree and shrub species are recommended for the various soil and slope conditions:

- Well-drained Upland sites with western aspect
  - White oak (*Quercus alba*); Pitch pine (*Pinus rigida*); Pignut hickory (*Carya glabra*); Lowbush blueberry

- Moderately well-drained Lower slope sites with western aspect
  - White pine (*Pinus strobus*); Black oak (*Quercus velutina*); Highbush blueberry; Witch hazel (*Hamamalis virginiana*); Maple-leaved viburnum (*Viburnum acerifolia*); Highbush cranberry (*Viburnum trilobum*)
- Poorly-drained, lower slope to level sites
  - Red maple (*Acer rubrum*); Black gum (*Nyssa sylvatica*); Shagbark hickory (*Carya ovata*); Spicebush; Highbush blueberry

The overall Landscape Plan's Sheet L-O has been marked up to indicate what areas of the proposed solar array sites are appropriate for the three planting scenarios provided above. See Attachment A.

Planting Methods & Practices:

Plant 200 bare-root pine and hardwood seedlings and 100 bare-root shrubs in a staggered fashion, utilizing the disturbed soil within the rows of post holes, to create a full stocking condition of mixed pine and hardwood species interspersed with native shrubs to provide habitat and water quality benefits.

Protect planted tree seedlings with tree tubes (fact sheet attached) that will allow seedlings to become established without being browsed by deer. Some girdling of seedlings by rodents will occur.

With the exposed mineral soil in the strips of removed panels, natural seed sources that surround the sites will contribute a variety of hardwood seeds to complete the reforestation process.

Provide supervision and inspection by a qualified forester and/or tree-planting technician to assure quality control of the planting.

Provide annual inspections for a period of five (5) years following the initial planting to determine seedling survival, natural seed establishment, and adequacy of the reforestation effort.

Excessive mortality must be remedied through additional plantings and additional protection measures.

Reforestation Cost Estimates*

The present costs of this reforestation plan covers the seedlings, shrubs, tree tubes, stakes, and ties, along with the labor, equipment costs, and overhead required for conducting the planting operation. These costs are subject to change depending on specific site conditions and final species selection and plant availability at the time of decommissioning.

Total Area for Planting = 64.5 acres

Number of plants (Tree and Shrub) per acre = 300

Total # of Plants Required = 19,350 @ $1.66 per plant = $32,121

Qu. 10,000 4” x 48”Tree Tubes, Stakes, & Ties @ $3.00 each = $30,000

Labor, Equipment, & Overhead Costs = $398 per acre = $25,671

(5 hours per acre time estimated for planting & tree tubes, plus supervision & equipment costs)

Total Reforestation Cost Estimate = $87,792

* From USDA Natural Resource Conservation Service Conservation Practice Scenario Costs, developed for EQIP program implementation: www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/?cid=nrcseprd1328426

Factors Affecting the Implementation of this Reforestation Plan:

- Soil conditions: According to the USDA Soil Survey, the existing soil conditions underlying the proposed solar array sites on the property vary from marginally hydric Freetown and Ridgebury series in the southwest portion of the property, to moderately well-drained Woodbridge and Sutton series in the central areas of the property, to well-drained upland Paxton and Canton/Charlton series in the eastern areas of the property, with a patch of well-drained Canton/Charlton in the northwest corner.

  Wetland delineations have more specifically delineated those areas that, from the Soil Survey, appear to be underlain with hydric soils in the southwest portion of the property.

  For the purposes of this reforestation plan, species selection will depend upon the proximity of wetlands to the areas to be planted, and the potential for seasonally high water tables that will impact tree growth and the particular species that will tolerate any high water tables.

  The USDA Soil Survey includes information on depth to bedrock, soil texture, seasonal water table influences, and suitability for certain tree species. These constraints are factored into the selection of tree species for this reforestation plan.

- Grading: The extent of topsoil disturbance and grading during site preparation, and the resulting depth of soil for rooting by trees will have an impact on the success of the reforestation efforts. Shallow topsoil conditions will limit root development, and lack of organic soil conditions, versus nutrient poor sub-soil, will impact seedling survival and limit the development of mature trees.

- Soil compaction: Access by heavy equipment during site preparation and solar array installation and maintenance phases of the project will lead to compacted soils, particularly between the rows of panels. Removal of the panels will also require access by some type of equipment. Disturbance of the soils at each panel location from their removal may help in loosening up compacted soils and create favorable planting conditions.

- On-site vegetation: Vegetation maintenance of the array sites, according the Operation & Maintenance Plan, will include mowing and weed-whacking 2 or 3 times a year to maintain a grassy condition.

  Pioneer seeding of tree seedlings and shrubs will likely occur during the 30-year time period, despite the regular mowing schedule. Root systems will develop with repeated cutting of the plant's stem, and these naturally-seeded trees and shrubs, including non-native invasive species, will then be in a position to respond to the removal of the solar arrays and cessation of mowing activities. This will be particularly true at the edges of the solar array sites, contributing to the screening provided in the Landscape Plan.

  Natural seeding from adjacent vegetation is routine and typical of abandoned fields and habitat clearings promoted by wildlife biologists for creating early-successional habitat. Natural seeding will eventually return this disturbed area to a forested condition, even if no efforts are made to reforest the site. The natural succession process takes time, and there is no control over which species become dominant. The subject site includes forested wetlands stocked with a mix of deciduous trees, with a small patch of White pine just north of the property, and only scattered White pines in the landscape. This source of pine seed is minimal, but certainly a significant component of the pioneer species would consist of pine species, including White and Pitch pines.

- Slope and Aspect: Species selected for reforestation must factor in the slope position and aspect of the specific locations for planting, as well as the soil types. South and west-facing upper slopes will require planting with drought-tolerant species, while lower slope sites and east-facing slopes can be planted with a wider variety of species that can take advantage of these more favorable sites.

  Most of the solar array sites are located on the upland ridge and west-facing slope of Diamond Hill, with only the western sites being located on relatively level terrain. Upper level slopes will require planting with more drought-tolerant species such as Pitch pine and White oak, with White pine and Northern red oak planted on the lower slope sites.

- Climate Change: Projections for more frequent drought events, warmer temperatures, and more severe precipitation events require that any reforestation efforts in 2050 or beyond take into consideration the impacts on tree species selection and planting success. Will planting of southern pine species in 2050 be required?

  The Northern Institute of Applied Climate Science have provided projections for the Southern and Coastal New England sub-area, where species such as White pine and Quaking aspen (poplar) are predicted to decline, while other species such as White oak, Black oak, and Pitch pine are likely to increase their presence in the landscape. (See enclosed Fact Sheet). Southern species, such as Virginia pine and Sweetgum, may be good choices for planting in 2050 and beyond.

New insect and disease problems will also occur between now and 2050 which will impact the final selection of tree species for this reforestation effort. Oaks are susceptible to Gypsy moth defoliations, which may occur with increased frequency as spring droughts become more common, and the Southern pine beetle has been found in Rhode Island. This beetle will feed on and kill Pitch pine.

- Animal damage: Browse impacts from deer, mice, and other species will have an impact on the survival and species composition of the re-forested site. Of particular concern will be the deer population at that time, and what efforts are provided to control its presence during the establishment of the new forest. Although the 6' fence around the site will limit the travel of deer through the site, taller fencing is needed to keep the stronger adult jumpers from getting in and feeding on established plant material. In the event de-commissioning includes removal of all fencing as well as the solar arrays, then other means of protecting planted trees will be required.

  Use of tree shelters will be needed to improve success rates, with subsequent maintenance needed to remove the shelters once trees have attained a suitable height to avoid browse damage.

Prepared By: Marc J. Tremblay, CF

MA Forester Lic #239, CT Certified Forester #F-517, RI Lic. Arborist #104

Certification: I hereby attest that the above Reforestation Plan prepared for the proposed Main Street Solar Project has been prepared according to the appropriate standards and information available, and the information provided is as accurate as current forestry practices allow.

Marc J. Tremblay, CF

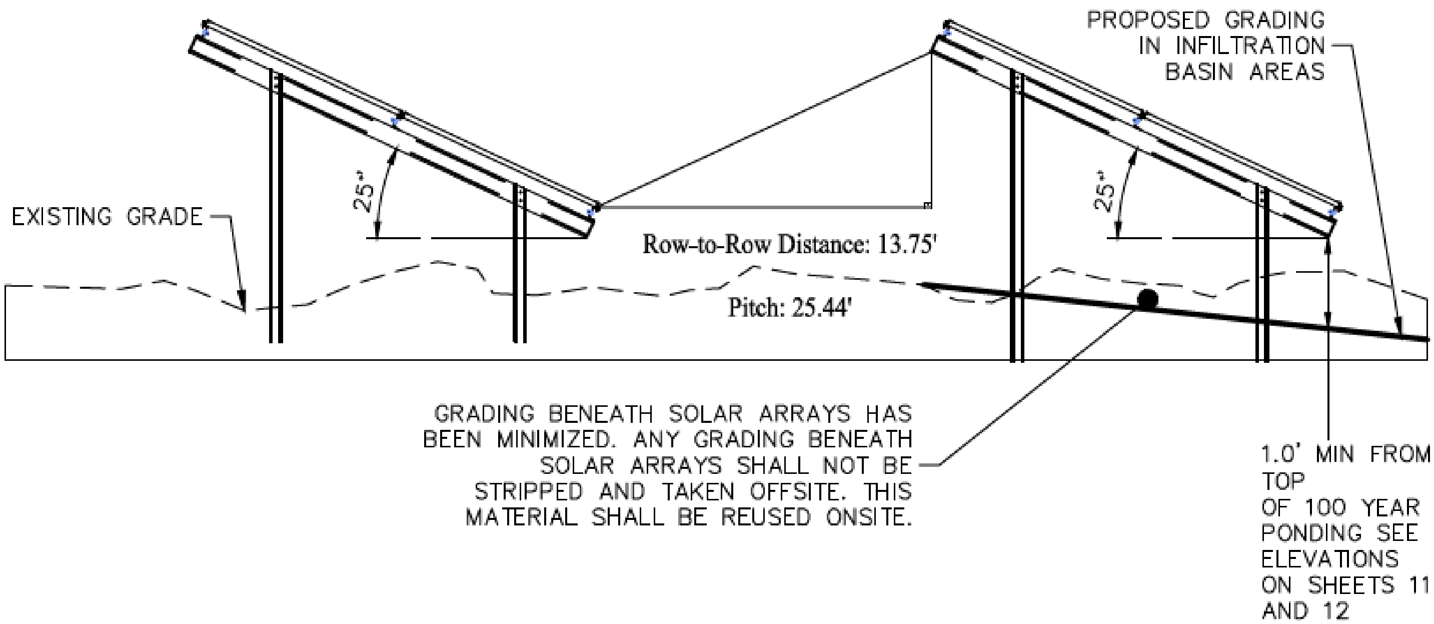
Attachments:

- Plan Detail Showing Distance Between Rows of Panels
- USDA Soil Survey Forestland Productivity Tables (4 pp)
- Climate Change Projections for Individual Tree Species, Southern and Coastal New England – Northern Institute of Applied Climate Science (2 pp)
- Schematic of Species to Plant by Soil and Slope
- Protex Pro/Gro Solid Tube Tree Protectors info sheet from Forestry Suppliers, Inc.
- Tree Planting Guidelines, from the USDA Natural Resources Conservation Service, Texas Forestry Technical Note, TX-FS-12-4 (9 pp)

DETAIL OF DETAIL SHEET 1, PG 18 OF 18

SHOWING DISTANCE BETWEEN ROWS OF PANELS

MAIN STREET SOLAR, HOPKINTON



Onsite Grading Material and PV Array

Distance Scheme - Tilt, Angle, and Shading Detail

NOT TO SCALE

The *volume of wood fiber*, a number, is the yield likely to be produced by the most important tree species. This number, expressed as cubic feet per acre per year and calculated at the age of culmination of the mean annual increment (CMAI), indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

Trees to manage are those that are preferred for planting, seeding, or natural regeneration and those that remain in the stand after thinning or partial harvest.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service, National Forestry Manual.

Report—Forestland Productivity

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
ChB—Canton and Charlton fine sandy loams, 0 to 8 percent slopes, very stony				
Canton, very stony	Eastern hemlock	—	—	Beech, Bitternut hickory, Black oak, Eastern hemlock, Eastern white pine, Gray birch, Mockernut hickory, Northern red oak, Pignut hickory, Red maple, Shagbark hickory, Sugar maple, White ash, White oak, Yellow birch
	Eastern white pine	58	100.00	
	Northern red oak	52	29.00	
	Red maple	55	29.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
Charlton, very stony	Eastern hemlock	—	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	65	114.00	
	Northern red oak	65	43.00	
	Red maple	55	29.00	
	Red pine	70	129.00	
	Red spruce	50	114.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
CkC—Canton and Charlton fine sandy loams, 3 to 15 percent slopes, extremely stony				
Canton, extremely stony	Eastern hemlock	—	—	Beech, Bitternut hickory, Black oak, Eastern hemlock, Eastern white pine, Gray birch, Mockernut hickory, Northern red oak, Pignut hickory, Red maple, Shagbark hickory, Sugar maple, White ash, White oak, Yellow birch
	Eastern white pine	58	100.00	
	Northern red oak	52	29.00	
	Red maple	55	29.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
Charlton, extremely stony	Eastern hemlock	—	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	65	114.00	
	Northern red oak	65	43.00	
	Red maple	55	29.00	
	Red pine	70	129.00	
	Red spruce	50	114.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
FeA—Freetown muck, 0 to 1 percent slopes				
Freetown	American elm	55	0.00	—
	Atlantic white cedar	60	0.00	
	Balsam fir	45	86.00	
	Eastern hemlock	55	0.00	
	Green ash	35	29.00	
	Red maple	50	29.00	
	Red spruce	50	114.00	
HkA—Hinckley loamy sand, 0 to 3 percent slopes				
Hinckley	Eastern white pine	61	100.00	Black oak, Eastern white pine, Pitch pine
	Northern red oak	49	29.00	
	Paper birch	60	54.00	
	Pitch pine	60	—	
	Red pine	54	92.00	
	Red spruce	39	86.00	
	Sugar maple	59	30.00	
	White spruce	52	114.00	

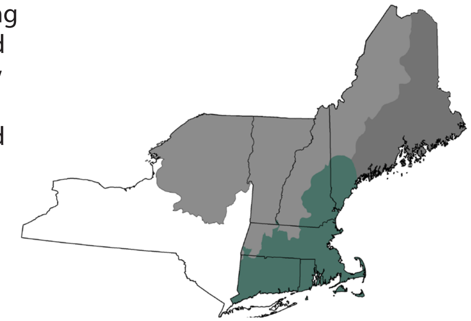
Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
PbB—Paxton fine sandy loam, 0 to 8 percent slopes, very stony				
Paxton, very stony	Black oak	67	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	66	114.00	
	European larch	80	—	
	Northern red oak	65	43.00	
	Red pine	67	114.00	
	Scarlet oak	67	—	
	Sugar maple	75	43.00	
	White ash	89	—	
	White oak	60	—	
Rf—Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony				
Ridgebury, extremely stony	Eastern white pine	63	114.00	American elm, Blackgum, Green ash, Pin oak, Red maple, Swamp white oak, Yellow birch
	Northern red oak	66	43.00	
	Red maple	62	—	
	Sugar maple	56	29.00	
	White ash	60	—	
Leicester, extremely stony	Eastern white pine	69	129.00	Green ash, Red maple, Tuliptree
	Northern red oak	56	43.00	
	Red maple	70	43.00	
	Yellow birch	—	—	
Whitman, extremely stony	Blackgum	52	—	—
	Eastern white pine	56	100.00	
	Northern red oak	70	—	
	Red maple	60	29.00	
	Red spruce	44	86.00	
	White oak	57	—	
SuB—Sutton very stony fine sandy loam, 0 to 8 percent slopes				
Sutton	Black cherry	72	43.00	Eastern white pine, European larch, Norway spruce, White spruce
	Eastern white pine	62	114.00	
	Northern red oak	62	43.00	
	Red spruce	50	114.00	
	Sugar maple	54	29.00	

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	**Potential productivity**			**Trees to manage**
	Common trees	**Site Index**	**Volume of wood fiber**	
			Cu ft/ac/yr	
W—Water				
Water	—	—	—	—
WoB—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony				
Woodbridge, very stony	Black oak	77	—	Ash, Northern red oak, Sugar maple, Tuliptree, White oak
	Eastern white pine	67	114.00	
	Northern red oak	72	57.00	
	Red pine	65	114.00	
	Red spruce	50	114.00	
	Sugar maple	65	43.00	
	Yellow poplar	84	—	

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

SOUTHERN AND COASTAL NEW ENGLAND

The region's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in New England and northern New York (Janowiak et al. in press). This report includes information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest types. This handout is summarized from the full assessment.



Remember that models are just tools, and they're not perfect. Model projections don't account for some factors that could be modified by climate change, like droughts, wildfire activity , and invasive species. If a species is rare or confined to a small area, Tree Atlas results may be less reliable. These factors, and others, could cause a particular species to perform better or worse than a model projects. Human choices will also continue to influence forest distribution, especially for tree species that are projected to increase. Planting programs may assist the movement of future-adapted species, but this will depend on management decisions.

TREE SPECIES INFORMATION:

This assessment uses two climate scenarios to "bracket" a range of possible futures. These future climate projections were used with two forest impact models (Tree Atlas and LANDIS) to provide information about how individual tree species may respond to a changing climate. More information on the climate and forest impact models can be found in the assessment. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Despite these limits, models provide useful information about future expectations. It's perhaps best to think of these projections as indicators of possibility and potential change. The model results presented here were combined with information from published reports and local management expertise to draw conclusions about potential risk and change in the region's forests.

SPECIES	ADDITIONAL CONSIDERATIONS
LIKELY TO DECREASE	
Balsam fir	Requires cold climate and susceptible to drought, fire, and insects
Eastern white pine	Good disperser, but susceptible to drought and insects
Paper birch	Early-sucessional colonizer, but susceptible to insects and drought
Quaking aspen	Early-sucessional colonizer, but susceptible to heat and drought
Red spruce	Needs a particular type of habitat, limited seedling establishment
Striped maple	Shade tolerant and easily established, but susceptible to drought
MAY DECREASE	
American beech	Affected by beech bark disease, extremely shade tolerant
Bigtooth aspen	Early-sucessional colonizer, but susceptible to drought
Eastern hemlock	Hemlock woolly adelgid causes mortality
Gray birch	Disperses easily, but susceptible to drought, fire, and insects
Red pine	Fire-adapted, but susceptiple to some insects
Yellow birch	Good disperser, but susceptible to fire, insects, and disease
NO CHANGE	
Black cherry	Susceptible to insects and fire, but tolerates some drought
White ash	Emerald ash borer causes mortality

SPECIES	ADDITIONAL CONSIDERATIONS
MAY INCREASE	
American elm	Affected by Dutch elm disease, grows across a variety of sites
Black oak	Drought-tolerant, but susceptible to insects and disease
Eastern hophornbeam	Grows across a variety of sites and tolerates shade
Eastern redcedar	Drought-tolerant, but susceptible to insects and fire
Pitch pine	Susceptible to some insect pests
Shagbark hickory	Susceptible to some insect pests
White oak	Fire-adapted and grows on a variety of sites
MIXED MODEL RESULTS	
Chestnut oak	Grows on a variety of sites, but susceptible to insects and disease
Northern red oak	Susceptible to some insect pests
Pignut hickory	Grows on a variety of sites, but susceptible to drought and insects
Red maple	Competitive colonizer tolerant of disturbance and diverse sites
Scarlet oak	Drought- and fire-adapted, but susceptible to insects and disease
Sugar maple	Grows across a variety of sites and tolerates shade
Sweet birch	Susceptible to drought, fire topkill, and insects

SOURCE: Janowiak et al. in review. New England and New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. ***www.forestadaptation.org/new-england/vulnerability-assessment***

NIACS
Northern Institute of Applied Climate Science

www.forestadaptation.org

FUTURE PROJECTIONS

Data for the end of the century are summarized for two forest impact models under two climate change scenarios. The Climate Change Tree Atlas (www.fs.fed.us/nrs/atlas) models future suitable habitat, while LANDIS models changes in forest growth over time (future tree density presented in this table; additional data are available in the assessment).

▲ **INCREASE**
Projected increase of >20% by 2100

● **NO CHANGE**
Little change (<20%) projected by 2100

▼ **DECREASE**
Projected decrease of >20% by 2100

★ **NEW HABITAT**
Tree Atlas projects new habitat for species not currently present

ADAPTABILITY

Factors not included in the models, such as the ability to respond favorably to disturbance, may make a species more or less able to adapt to future stressors.

+ high
Species may perform better than modeled

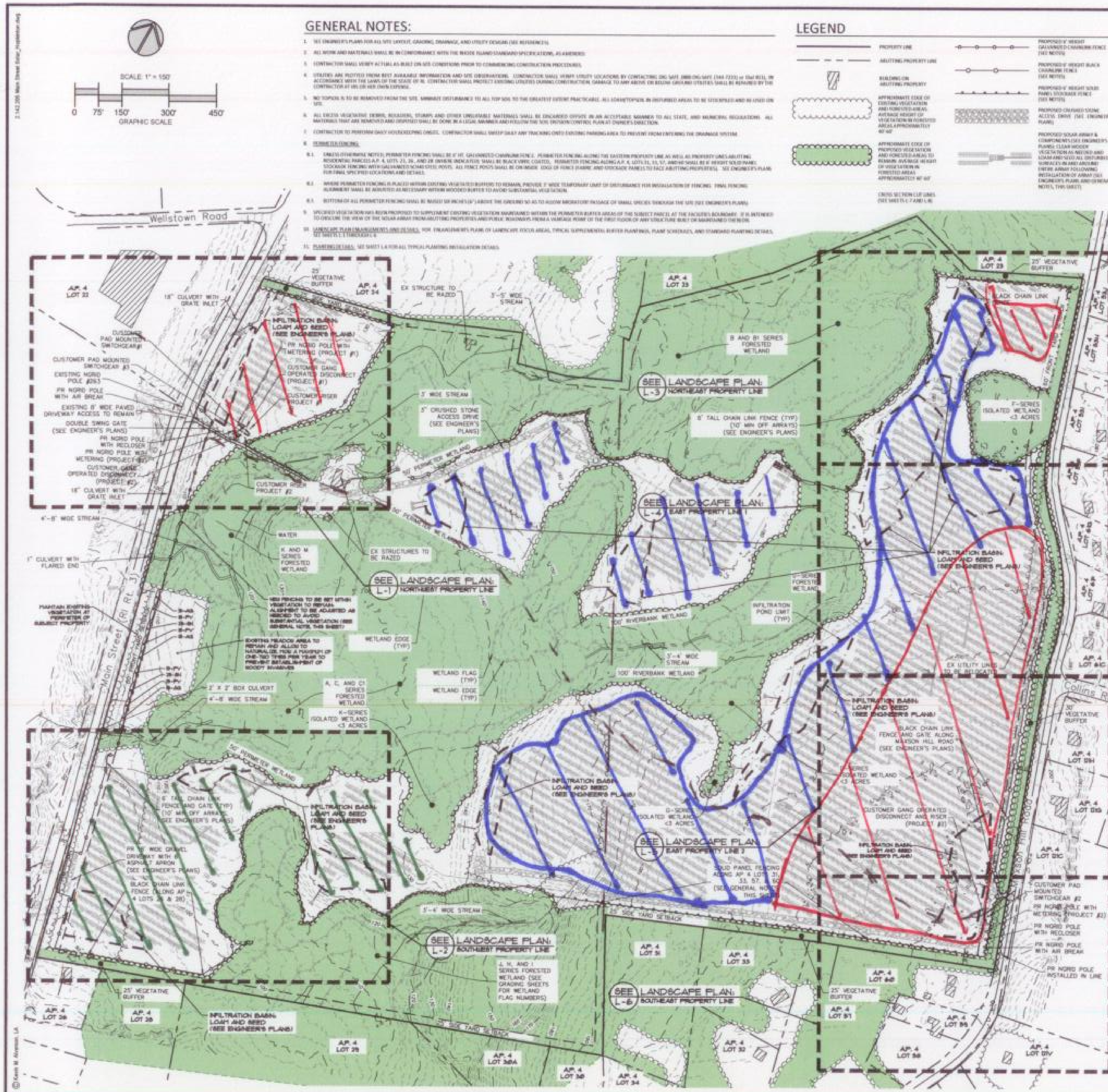
· medium

– low
Species may perform worse than modeled

	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		
SPECIES	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	ADAPT
American basswood	●		▲		·
American beech	●	●	▼	▼	·
American chestnut	●		●		·
American elm	▲		▲		·
American holly	●		▲		·
American hornbeam	●		▲		·
American mountain-ash	●		●		–
Bald cypress	★		★		·
Balsam fir	▼	▼	▼	▼	–
Balsam poplar	▼		▼		·
Bigtooth aspen	●		▼		·
Black ash	▼		▼		–
Black cherry	●	●	●	●	–
Black hickory			★		·
Black oak	▲	●	▲	●	·
Black spruce	▼	▼	▼	▼	·
Black walnut	★		★		·
Blackgum	▲		▲		+
Blackjack oak			★		+
Boxelder	●		●		+
Bur oak	●		▲		+
Cherrybark oak			★		·
Chestnut oak	▲	▲	▲	▼	+
Chinkapin oak			★		·
Common persimmon	★		★		+
Eastern hemlock	●	●	▼	▼	–
Eastern hophornbeam	●		▲		+
Eastern redbud	★		★		·
Eastern redcedar	▲		▲		·
Eastern white pine	▼	▼	▼	▼	·
Flowering dogwood	▲		▲		·
Gray birch	●		▼		·
Green ash	●		▲		·
Hackberry	●		▲		+
Loblolly pine	★		★		·
Mockernut hickory	▲		▲		+
Mountain maple	●		▼		+
Northern red oak	●	●	▼	●	+
Northern white-cedar	▼	▼	▼	▼	·
Overcup oak			★		–

	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		
SPECIES	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	ADAPT
Paper birch	▼		▼		·
Pignut hickory	▲	●	▲	▼	·
Pin cherry	●		●		·
Pin oak	▲		▲		–
Pitch pine	▲	●	●	●	·
Pond pine	★		★		–
Post oak	▲		▲		+
Quaking aspen	▼	▼	▼	▼	·
Red maple	●	●	▼	●	+
Red pine	●		▼		·
Red spruce	▼	▼	▼	▼	–
Sassafras	▲		▲		·
Scarlet oak	▲	●	▲	▼	·
Serviceberry	●		▼		·
Shagbark hickory	▲	●	▲	●	·
Shingle oak			★		·
Shortleaf pine	★		★		·
Silver maple	▲		▲		+
Slippery elm	●		▲		·
Sourwood	▲		▲		+
Southern red oak	★		★		+
Striped maple	▼		▼		·
Sugar maple	●	●	●	▼	+
Sugarberry			★		·
Swamp chestnut oak	●		▲		·
Swamp tupelo	★				–
Sweet birch	▲		▼		–
Sweetbay	★				·
Sweetgum	★		★		·
Sycamore	▲		▲		·
Tamarack (native)	▼		▼		–
Virginia pine	★	●	★	●	·
Water oak			★		·
White ash	●	●	●	●	–
White oak	▲	●	▲	●	+
White spruce	▼		▼		·
Willow oak			★		·
Winged elm	●		▲		·
Yellow birch	●	●	▼	▼	·
Yellow-poplar	▲	▲	▲	●	+

PLANTING SPECIES BY SOIL/SLOPE



LANDSCAPE NOTES:

KEY	Scientific Name / Common Name	QTY	Size / Comment	Spacing
AS	Andropogon gerardii / Big Blue Stem	45	#2 (2 Gal.) Container	36" O.C.
PV	Panicum virgatum / Switchgrass	80	#2 (2 Gal.) Container	36" O.C.
SN	Sorghastrum nutans / Indian Grass	50	#2 (2 Gal.) Container	24" O.C.

PLANT SCHEDULE: Main Street (RI Route 3) Meadow/Fencing Buffer

Notes:

1. The above quantities reflect the minimum quantity of each variety of plants illustrated on this drawing to be planted along the Western Property Line abutting existing meadow areas where no Solar Array or components are proposed.
2. All other Supplemental Buffer Plantings at the project Perimeter are illustrated and detailed on sheets L-1 through L-6 of this Plan Set.
3. Final Locations and Quantities of supplemental plantings shall be field adjusted to minimize any conflicts with existing wooded buffer vegetation to remain and to infill any potential gaps in existing vegetation to obscure the solar array and components from abutting properties.

LANDSCAPE REQUIREMENTS

(TOWN OF HOPKINTON, RI, TOWN ORDINANCE, CHAPTER 246: NON-RESIDENTIAL PHOTOVOLTAIC SOLAR ENERGY SYSTEMS (PSES))

(TOWN OF HOPKINTON, RI, ZONING ORDINANCE, AS AMENDED); ZONING: RFR-80

(TOWN OF HOPKINTON, RI, LAND DEVELOPMENT AND SUBDIVISION REGULATIONS, AS AMENDED); ZONING: RFR-80

REVISION HISTORY:

REFERENCES:

Main Street Solar

A.P. 4, Lot 25
Main Street (RI Route 3)
Hopkinton, RI

Applicant:
Maxson Hill LLC c/o Anthony DelVicario
43 Creston Way,
Warwick RI 02886

Kevin M. Alverson
LANDSCAPE ARCHITECTURE

Overall Landscape Plan

Project #: 2.142.205	Sheet 1 of 7
Scale: 1" = 150'	L-0
Drawn By: KMA	
Checked By: KMA	
Date: January 31, 2018	

UPLAND SPECIES = RED

LOWER SLOPE SPECIES = BLUE

LOWLAND SPECIES = GREEN

Share on:

Protex® Pro/Gro Solid Tube Tree Protectors

Acts as a miniature greenhouse.

★★★★★ 12 customer reviews

Availability: In Stock

Stock Number: 17141

Size: 48"H

Quantity	Price
1+	$2.95
200+	$2.75
400+	$2.55

Quantity: 1 Add To Cart

Add To My Equipment List

Description | Specifications | Reviews (12) | Q&A (3)

48" Protex Pro/Gro Solid Tube Tree Protectors
Each 4" diameter tube speeds photosynthesis by trapping moisture, thereby raising relative humidity and ambient temperature inside the tube. Also protects the tree from animals, wind desiccation, small rodents, and insects. Use optional cable ties to install optional bamboo stakes or wood guard stakes with each tube for support. Stakes and cable ties sold separately. Constructed of type 2 recyclable polyethylene.

Natural Resources Conservation Service

Natural Resources Conservation Service
Texas Forestry Technical Note, TX-FS-12-4

Tree planting is a widely used method to regenerate cutover sites and return cropland or pastures back to forested land. Planting trees allows one to adjust tree species and density on their acres while influencing wildlife habitat as well. Tree planting can also be used to create windbreaks and shelter belts providing a buffer from wind, snow, dust and noise.

Seedling Planting Guidelines

CAUTION – READ

1. Safety – the planting operation should be performed safely as the environment will have several hazards that can make walking difficult such as briars, down woody material, etc.
2. Seedling care – Seedlings should not be exposed to extreme temperatures, wind or contaminants (fuel or herbicides).
3. Seedling roots must not be exposed to excessive drying conditions – do not hold a handful of seedlings while you are planting or leave the bag or box of seedlings open.
4. Planting quality – Seedlings should be planted to the proper depth and firmly packed to ensure the highest likelihood of survival. One can tell if the seedlings are packed tight by grasping a few needles and pull upward – If the seedling moves it is not firmly packed, if the needles pull off then it is firmly packed.

Seedling handling: Handling involves seedling storage, transit and field handling.

Seedling Storage:

1. Avoid damaging seedling bags or boxes to minimize damage to seedlings, tape up any hole to prevent moisture loss and drying of the seedlings.
2. Keep seedlings and their containers out of direct sunlight.
3. Allow space for air circulation between seedling boxes/bags.
4. Don’t allow seedlings to freeze. (Don’t plant seedlings frozen for more than 2 days)
5. Plant seedlings within two weeks of lifting if possible.
6. Seedlings four weeks or older should be carefully checked for mildew, mold or decay.

Transit:

1. Prevent injury when lifting seedling bags or boxes by keeping your back straight and lifting with your legs.
2. Keep seedlings shaded and covered. A tarp will work if the vehicle is not covered (ie. van or truck with camper shell.
3. Drive at speeds allowed by law and road conditions.

4. Keep seedlings away from contamination commonly fuels or herbicides.
5. Keep the area with seedlings free from sharp objects.
6. Don't allow seedlings to freeze.
7. Don't stack seedlings more than 2 boxes/bags deep without spacers to provide support.

Handling seedlings before and during planting:

1. Keep seedlings moist – Dry roots kill seedlings.
2. Keep seedlings shaded and covered - High temperatures kill seedlings.
3. Don't prune the roots unless the laterals are long (5" or longer) – prune the laterals with a sharp machete to 3 to 4 inches in length. A good root system is essential to seedling growth and survival.
4. Don't beat seedlings against objects to remove clay slurry
5. Close boxes or bags and place out of direct sunlight
6. Remove only minimum number or seedlings that can be planted quickly to avoid exposing roots to wind and sun very long.
7. Discard cull seedlings – seedlings with a stem diameter smaller in diameter than a kitchen match, dry seedlings, or seedlings without a good root system.
8. Don't dump out the whole box or bag of seedlings to sort them before planting.

Hand Planting:

Hand planting allows areas to be planted not suitable for machinery due to debris, terrain, wet conditions and availability of suitable machines.

1. If area has duff, litter, etc., rake to bare mineral soil to ensure proper seedling depth and tightness.
2. Remove no more than 3 or 4 seedlings (drop any culls) from the planting bag.
3. Make the planting hole wide and deep enough to insert the root system so the seedling is straight and the roots are straight down in the planting hole. (It is highly undesirable to have the roots curled up in the planting hole).
4. Lift the seedling up in the hole until the root collar is slightly below the soil level for loblolly, slash and shortleaf pines and for longleaf pine plant the root collar at the soil level keeping the terminal bud above ground.
5. Pack the seedling firmly using your planting tool eliminating the air pockets. See diagram at the back of this document.
6. Plant when there is good soil moisture.
7. Don't plant when the ground is frozen.

Tools for hand planting include a dibble bar, hoe dad, or sharp shooter shovel. A planter bag worn around the waist makes the planting faster and more efficient keeping the seedlings moist and readily available. Seedlings properly planted by hand should have a high percentage of surviving trees.

Hand planting with bare-root seedlings usually occurs between late December and early April. The seedlings have to "harden off" or set buds at the end of the growing season and in southern nurseries this usually does not occur until late November or early December. This hardening off is a little easier to visualize with hardwood seedlings as the leaves fall off and one can easily see the buds. In planting loblolly, slash or shortleaf pines and the hardwood species, the seedlings should be planted at the root collar which is the location the seedling grew in the nursery (where the above ground and below ground portion of the seedling meet). Longleaf seedlings should be planted at a depth where the root collar is slightly above the soil line ensuring that the terminal bud stays above the ground.

The earlier one can plant their seedlings (Jan – Feb) the more time the seedling will have to establish their root systems. The better the roots get established, the better the seedlings can survive dry conditions that will occur during the summer months.

Containerized seedlings have a wider window for planting beginning in late October and going through April. Containerized seedlings are grown in tubes that help the seedling develop a dense root system that is fairly easy to plant. Containerized loblolly, slash and shortleaf pines can be planted with the entire root plug placed in the planting hole. The terminal bud is well away from the ground line. Containerized longleaf pines however are planted in the grass stage meaning that you have a root plug, a very short stem and a terminal bud surrounded by the needles. Plant containerized longleaf pine with a small portion of the plug above the planting hole to ensure the terminal bud is above the ground.

The photo shows an example of hand planting hardwood seedlings. Some positive things to notice is only one seedling out of the container, a wide planting bar, seedlings with their roots protected and moist in the bucket.

Some common hand planting errors include:

- Planting the seedling too shallow: The root collar and roots are exposed above the soil drying out the roots.
- Planting the seedling too deep: The hardwood seedlings root collar is 2” or more below the soil surface and loblolly/shortleaf/slash pines terminal bud is within 2” of the ground line while longleaf pines has the terminal bud below the soil line.

- J or U Roots: Roots form a J or U shape from the seedling being pushed into the planting hole resulting in the primary root to point to the side or back upward. This problem contributes to poor root development and seedling problems. (Avoid by making the planting hole a little wider before planting the seedling.
- Seedling too loose: A firm pull on the seedling should not move the plant. The seedling should be packed firmly in the soil.
- Seedling not erect: The tap root should not be planted at more than 30^{o} from perpendicular.

Machine Planting:

Machine planting can be accomplished on areas that have received good site preparation, have little debris remaining on the site; areas that have been windrowed or bedded; old fields or farmland being converted back to forests.

There are many safety concerns to consider during machine planting operations as a person is being pulled behind a tractor or dozer. Some items to consider for safety are how the planter communicates with the tractor operator, first aid kit, personal safety gear, fire extinguisher, etc.

1. Only open enough seedlings to fill the planting box. Keep the seedlings upright with the roots down out of the wind. A little water can be added to the planter box to keep the roots moist.
2. Do not cut or prune the roots.
3. Do not leave unplanted seedlings exposed to sun and wind.
4. Plant seedlings along the contour.
5. Do not plant the seedlings to deep or to shallow, when holding the seedlings and placing them in the planting rip do not release them until the packing wheels start to close the rip. Otherwise the seedlings will drop to deep covering the terminal bud. On the other side, do not pull the seedlings upward as the seedling will be planted to shallow exposing some roots.
6. Periodically check the planted seedlings for firmness or packing, planting depth and number of seedlings per acre.
7. Look for skips in planting as the planter may have difficulty in getting seedlings out of the holding tray.
8. The planting operation needs to occur at speeds where the proper number of seedlings are planted which takes coordination between the operator and planter.

Machine planting is an effective method of planting seedlings if the operator and planter work as a team. The operator has to be constantly aware of the safety hazards and protect the individual riding in the planter.

- With machine planting, make sure the seedling depth is satisfactory and that the seedlings are not leaning due to being dragged by the planter. The seedlings should be upright and firmly packed in the soil.

How many seedlings per acre:

Everyone has their reasons for a particular planting density and spacing. One might want to mow between the planted rows so the rows need to be wider than the available equipment. There are many options available (see Table 1). You can calculate the number of seedlings needed per acre by multiplying the spacing between seedlings, for example (10 X 10 = 100); dividing 43,560 sq ft per acre by the sq ft spacing provides the number of seedlings needed per acre. Our example: 43,560/100 = 436 seedlings per acre. Thus, you can substitute any spacing and determine the number of seedlings needed per acre.

Table 1: Various spacings and initial planting densities for tree seedlings

Spacing (feet)	Square Feet per	Number of Tree/Shrub Seedlings per Acre
5 x 5	25	1,742
6 x 6	36	1,210
6 x 8	48	907
8 x 8	64	680
8 x 10	80	544
10 x 10	100	436
10 x 14	140	311
12 x 12	144	302
12 x 16	192	227
14 x 14	196	222
10 x 20	200	218

Ideally, the planting operation should be checked out by personnel with the Texas Forest Service. However, in some instances the TFS may not be available so an approved Technical Service Provider may be used. Thirdly, NRCS personnel may be used to evaluate the planting operation. If this is the case, here are some tips on checking out a planting job.

How to quickly check behind a planting operation:

What needs to be checked? Proper planting of seedlings – depth and firmness; number of seedlings properly planted per acre.

How many seedlings per acre?

A quick way to determine the number of seedlings planted on an acre is to obtain a cane pole or an extending fishing pole at least 12 feet in length. Mark on either a point at 11'8" long. This distance is equivalent to a 1/100th acre plot radius. Holding the pole over a fixed point and then move the pole around making a circle and count each seedling that is contained in the 1/100th acre plot. Each seedling represents 100 seedlings per acre. For plantings with fewer than 600 trees per acre a 1/50th acre plot may be used (16.7' plot radius). Sample multiple plots and average the seedlings per acre.

For example: The goal is to hand plant 545 trees per acre (8 X 10) spacing. The planting check found:

Plot 1 = 5 seedlings; Plot 2 = 6 seedlings; Plot 3 = 5 seedlings; Plot 4 = 5 seedlings, you would have 525 seedlings planted per acre. That's the average number of seedlings tallied in the sampled plots. The field measurements are compared against the targeted seedlings per acre and should be within 10% for a satisfactory planting job. The 525 is within the 10% guide for number of seedlings per acre. The question is now how many of the seedlings were satisfactorily planted. From this example, 21 seedlings were located on our 1/100th acre plots so no more than 2 seedlings can be unsatisfactory, if 3 or more are unsatisfactory then the planting will fail.

The following provides a guide in determining number of plots needed per acre by tract acreage:

1 to 60 acres – 1 plot per acre
61 – 90 acres – 1 plot per 2 acres for hand plantings to 5 acres for machine plantings
91+ acres – 1 plot per 3 acres

Tract maps can be created with plots laid out on the proper spacing to fulfill the requirements provided above using newer versions of ArcGIS or other GIS mapping software.
Once at the tract, the inspector should orient their self and use their map to navigate to plot 1.

- Mark the center of the plot with a pin flag
- Using a plot radius tape or device, count and check all seedlings in the specified plot radius.
- Seedlings should be checked for proper planting depth, proper closure of the hole, and proper packing of the seedling in soil. To check that seedlings are properly packed, grab a seedling by 3 to 5 needles and gently pull on the seedling, if the seedling moves up or down then the seedling is not properly packed.
- Results should be documented on the seedling inspection form
- When between plots (i.e. traveling from one plot to the next) carefully dig up two seedlings and check for underground planting problems but properly replant seedlings to maximize survival. **(This is not required for container plantings)**
- Results should be documented on the seedling inspection form
- Continue to next four plots and repeat.
- After plot 5 the inspector will need to calculate the excavation factor. The excavation factor is the percentage of good seedlings being dug up and can be calculated by dividing the number of good trees that have been dug up by the total number of seedlings that have been dug up. (See example below)

Calculating Excavation Factor:
After 5 plots
10 total trees dug up
1 J-root for a total of 9 good out of the 10
Good trees divided by total = percentage or in this case 9 ÷ 10 = 0.90 or 90%

The excavation factor should be calculated after every 5th plot. If at any time during the inspection the percentage falls below 90% the inspector should begin digging up four trees rather than two. While digging up four seedlings, if the percentage rises back above 90% then the inspector may resume digging up only two seedlings.

Once the entire tract has been inspected the inspector should then determine the total trees per acre. The total trees per acre should be within 10% above or below the original planting prescription. Above ground problems should be documented for each plot and deducted from the plot total while below ground problems will be deducted from the total inspection number and both will be used to determine whether the tract passes or fails.

Above ground

1. Examine a planted seedling as it should be planted close to the root collar where it grew in the nursery. For longleaf pine, be sure the terminal bud is not buried and is above the soil line. For other pine species, the root collar can be planted below the soil line but do not cover the terminal bud, in fact it should be 2” or higher above the soil line.
2. For pine species, pull upward on a few needles. If the seedling is planted firmly, the needles should pull off in your hand. If the seedling starts lifting out of the ground, the seedling is not firmly planted. No seedling should be capable of moving up or down easily in a planting hole.
3. Seedlings not firmly planted will dry out in the planting hole and not survive.
4. The main root should be completely below the soil line.
5. For pine seedlings, the green side goes up.
6. For Hardwood seedlings, the root collar should not be more than 2” below the soil line.
7. Hardwood seedlings should be firmly packed in the soil and if pulled on they should not easily move in the planting hole.
8. Be observant in the field, you may find discarded seedlings, piles of roots that have been cut off of the seedlings, unplanted seedling boxes or bags exposed to full sunlight. These are practices that you do not want occurring on your planting site.
9. Spacing – improper spacing will cause either too many or too few seedling per acre.
10. Planting hole not closed up, additional holes created to close the planting hole should be stomped shut.
11. Excessive lean in seedlings.

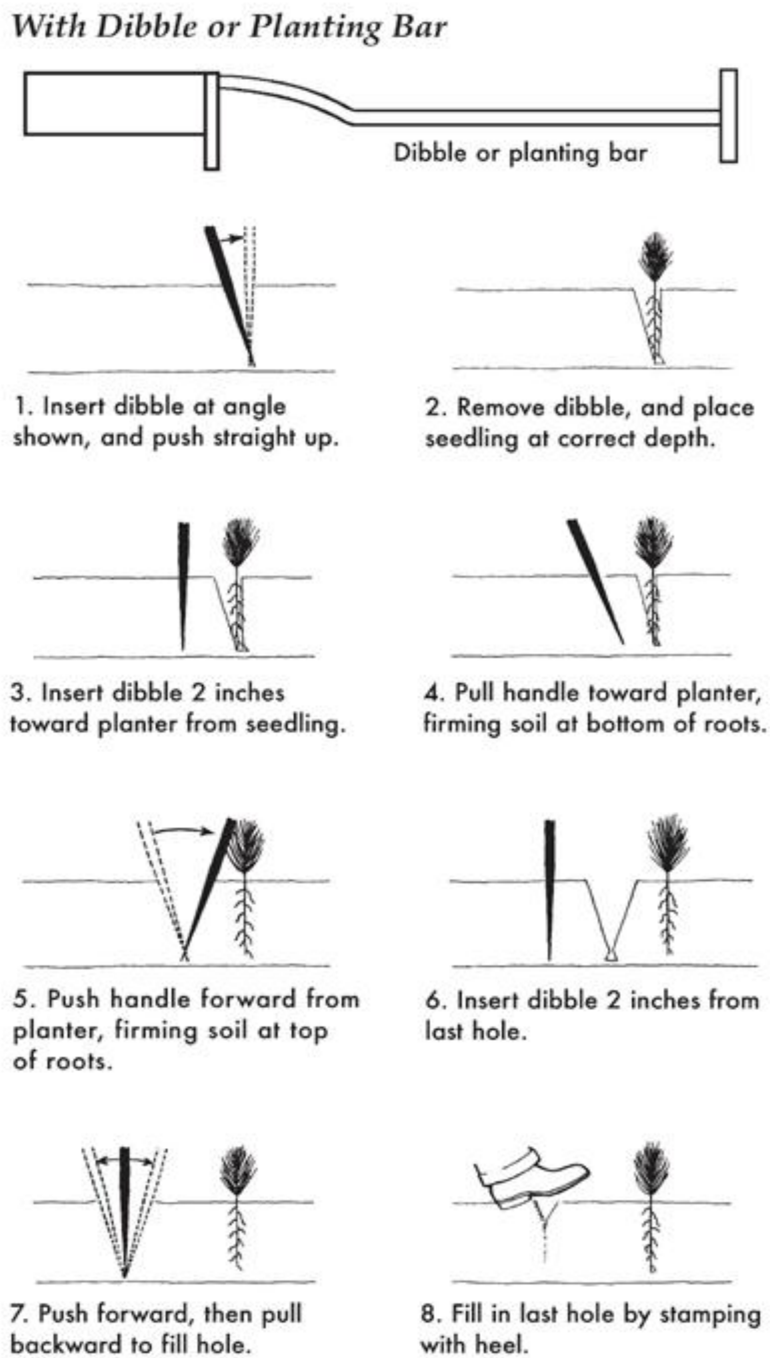
Below ground

12. A few seedlings will need to be dug up to examine for J, L or U roots by using a shovel. Carefully remove the soil and notice the shape of the roots. No more than 10% of all seedlings planted should have J, L or U roots (the primary tap root).
13. Tap root not 5 inches long, the tap root should be a minimum of 5 inches or be culled.
14. Cull seedlings less than $1/8^{th}$ inches in diameter.

A planting check-out form is available labeled “*planting check sheet*” that you can use to document the planting operation. Ninety percent of the planted seedlings should be satisfactory.

Written by: Williams, Richard, State Forester-Texas NRCS and Shane Harrington, Farm Bill Coordinator, Texas Forest Service.

The following illustration shows the proper hand planting technique:



Machine planting a cut-over site.

Machine planting pine seedlings. (note: the green side is up, nearly straight with the roots below the ground line, minimal soil disturbance)

Planting hardwood seedlings.

Hardwood seedling roots, note where the root was undercut in the nursery, new root growth