**REPORT FOR OBJ1.TASK 4b: DESIGN/SCHEMATIC LEVEL SPECIFICATIONS FOR SOILS, AND TREE PLANTING**

To: MPCA

From: The Kestrel Design Group Team (The Kestrel Design Group Inc, with Dwayne Stenlund – Minnesota Department of Transportation, James Urban – Urban Trees and Soils)

Date: October 30, 2013

Re: Contract CR5332

**SCOPE: note, this report addresses trees, please see separate report for soils**

Develop separate design specifications for tree quality, soil characteristics (quality and volume) for tree BMPs, and tree planting.[[1]](#footnote-1) Where appropriate the design specifications shall include but not be limited to considerations of BMP type (e.g. open, closed, or partially-open tree pits), soil properties, cold climate, water volume and pollutant (phosphorus and total suspended solids) removal, tree species, and groundwater constraints (e.g. seasonal high water table, karst settings). The specifications shall include illustrations and design drawings:

* 1. For each design specification (tree quality, soil characteristics, and tree planting), review state-of-the-art literature to identify existing design specifications, design drawings and illustrations for tree BMPs, considering different variations of tree BMPs.
	2. Review literature and identify special design considerations and incorporate these into design specifications for tree quality, soil characteristics, and tree planting. Examples of these specifications include but may not be limited to soil suitability, cold climate considerations, groundwater considerations, and need for stormwater pretreatment to remove pollutants.
	3. Prepare and submit a Technical memo that includes design specifications for tree quality, soil characteristics, and tree planting, including graphics. Include CAD drawings illustrating design specifications.
	4. Prepare and submit a final report that provides design specifications for tree quality, soil characteristics, and tree planting, including graphics. Include CAD drawings illustrating design specifications.

**REPORT FOR TREE MATERIAL AND PLANTING SPECIFICATIONS (SEE SEPARATE REPORT FOR SOILS)**

**Introduction**

Note: for definitions, see International Society of Arboriculture Dictionary at:

http://www.isa-arbor.com/education/onlineResources/dictionary.aspx

Trees can be purchased in many different forms. Gillman and Johnson (1999) describe some of the various forms as follows:

“1.Bare Root. Bare root plants are dug from nursery fields in the fall or spring. Soil is removed from the roots, and plants are held in humidity and temperature controlled storage over winter. They must be planted in early spring before growth begins. Because many roots are cut during field digging, bare root plants suffer severely from transplanting shock. Bare root stock is normally the least expensive, but if handled improperly, can have the highest mortality. When handling or transporting bare root stock, keep the roots moist and protected from sun and wind at all times.

2.Packaged. Packaged trees and shrubs are bare root plants with their roots packed in moist material such as peat moss or shingle tow. Plant them in early spring before growth starts. Keep packing materials moist, and the package cool and shaded until planted. These plants should be treated as bare root plants.

3.Field-Potted. Field-potted nursery stock are field-grown plants dug with a ball of field soil intact which is then placed as is, in a container. These plants should be sold and planted during the spring, as field soil will not provide good plant growth in a container. It is important that the root ball be disturbed as little as possible during the digging and planting process.

4.Containerized. Containerized trees and shrubs are dug from the nursery in the spring or fall as bare root stock, placed in a container with a special growing medium, and sold in the container. If containerized in early spring, most plants will be sufficiently established in the container and can be transplanted in late spring, summer, or fall. Roots must be established in the container and hold the media together before transplanting. Do not completely break up the root ball at planting time, but do cut any circling roots prior to planting. The tighter the root ball, the more the root system should be disturbed.

5.Container Grown. Container grown stock has been growing in a container throughout most of its production. Because the roots of these plants are not disturbed at the time of planting, container grown plants suffer little transplant shock and may be planted at any time during the growing season. Plants that have outgrown their containers may have deformed root systems, which can result in girdling roots. Large plants may be root bound in the container. The root ball of these plants must be torn or cut open [*or box cut*] to eliminate subsequent circling or girdling roots (Figure 3).

6.Balled and Burlapped (B & B). Balled and burlapped trees and shrubs are dug with a firm ball of soil around the roots, and held securely in place with burlap, twine, and sometimes a wire basket. A broken, damaged, or dry soil ball can result in serious damage to the roots. The stem should not wobble in the soil ball. Because of the weight of the soil ball, B & B trees can be difficult to transport and plant without special equipment. B & B stock is often the most expensive, but if handled and planted properly, is as reliable as container grown stock. Always lift B & B plants from beneath the ball, never by the stem. B & B stock can be planted in spring, summer, and fall.

7.Tree Spade. Larger plants are often moved with a tree spade—a machine that digs a mass of soil including the plant and some of its roots. The plant and root ball may stay in the machine until it is planted into a pre-dug matching hole, or it may be placed in a wire basket lined with burlap. The size of the root ball is critical and species dependent. An experienced machine operator can make the difference between success and failure. Matching soils from the digging site to the planting site is also important, as is compaction within the planting hole. Roughing up the sides of the hole can offset some of this compaction. Plants can be moved in most seasons with a spade, although plants dug in summer and early fall should have an oversized ball and receive special attention relative to species, condition, handling, and irrigation.” (Gillman and Johnson 1999, italics added).

8. Gravel Bed Method to market bare root trees

The Gravel Bed Method is a method of handling bare root nursery stock in which dormant plants are placed in an irrigated bed of gravel in the spring with their roots submerged in gravel. These trees are held for up to a year before planting bare root (in full leaf) in the landscape. It is a lower cost method to grow trees that extends the planting season of bare root stock. Root growth in gravel is very extensive and point fibrous and, unlike with bark mulch, sawdust or sand, few roots are damaged when plants are removed from the gravel. The gravel bed method also greatly minimizes the risk of girdling roots compared to containerized and B&B trees. For more information on gravel beds, see *All you need to Know about Community Gravel Beds* (Busiahn and Peterson 2013).

It is recommended that trees are inspected by the Owner or Project Landscape Architect prior to digging at the nursery where applicable.

Many tree material and planting specifications have already been developed by others. Many municipalities and jurisdictions, for example, have developed their own tree material and planting specifications. Many university extension services and tree organizations also provide tree planting guidelines. The tree material and planting guidelines below were developed based on experience and research by the contracted and technical teams for this project, combined with the resources listed in the references section. Additional guidance regarding tree planting is available in the references section below, as well as at the following 2 websites:

* <http://files.dnr.state.mn.us/assistance/backyard/treecare/howtoPlantTree.pdf>
* http://www.myminnesotawoods.umn.edu/category/urban-natural-resources/tree-planting/

**TREE MATERIAL AND PLANTING GUIDELINES**

Note: The following guidelines are written in a format similar to a specification, and can serve as a basis for a specification, however, they are NOT a finished specification. Any specification for construction must be developed specifically for that project by a person skilled in writing specifications and construction documents. Additional items are needed particularly in Part One – General. Terminology and requirements in the final specifications must be consistent with the terminology in other parts of the construction documents including plans and detail nomenclature.

Also see the attached Tree Planting Detail which supplements the tree planting guidelines. Additional drawings regarding tree planting are available in the references section below, as well as at the following 2 websites:

* <http://files.dnr.state.mn.us/assistance/backyard/treecare/howtoPlantTree.pdf>
* http://www.myminnesotawoods.umn.edu/category/urban-natural-resources/tree-planting/
1. GENERAL
	1. Definitions
		1. Container Grown Trees: Trees that have been grown in a container at any point in the production cycle without corrective pruning of roots at each point in the production cycle, or the use of root safe containers to eliminate stem girdling and kinked roots.
		2. Containerized trees: Field grown trees that are packaged into a container within 12 months of the growing season they are to be planted.
		3. Field Grown Trees: Trees growing in field soil at the time of harvest. Field grown tree shall have been root pruned after each transplant cycle to remove Stem Girding and Kinked Roots or which are grown in root safe container systems during earlier parts of the production cycle.
		4. Kinked Root: A root within the root package that bends 60 degrees or greater, around the trunk, or up, or down including roots deflected by the current or previous container.
		5. Plant Acceptance: The date at the end of the plant installation where the Owner accepts that all work in this section is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.
		6. Plant Final Acceptance: The date when the Owner accepts that the plants and work in this section meet all the requirements of the warranty.
		7. Reasonable and Reasonably: When used in this document relative to plant quality, it is intended to mean that the conditions cited will not affect the establishment or long term stability, health or growth of the plant. This document recognizes that it is not possible to produce plants free of all defects. This document also recognizes that some decisions cannot be totally based on measured findings and that profession judgment is required. In cases of differing opinion, the Owner’s expert shall determine when conditions within the plant are judged as reasonable.
		8. Root Ball: The mass of roots including any soil or potting mix that is shipped with the tree within the root ball package.
		9. Root Ball Package. The material that surrounds the root ball during shipping.
		10. Root Crown: The area where the majority of the main roots join the plant stem, usually at or near ground level (also known as the trunk flare). A single root emerging root perpendicular from the trunk ABOVE the Root Crown and / or the swelling of the trunk at the point of a previous graft should not be considered the root crown. For trees that develop two locations, one above the other, where three or more main roots emerge from the stem, the upper set shall be considered as the root crown.
		11. Spade Harvested And Transplanted: Field grown trees that are mechanically harvested and immediately transplanted to the final growing site without being removed from the digging machine.
		12. Stem: The trunk of the tree. The portion of the plant above the roots.
		13. Stem Girdling Root: Any root, 1/4 inch in diameter or greater, within the root package that crosses over the top of a structural root approximately tangential to the trunk circumference. Roots shall be considered as Stem Girdling that have or are likely to have root to trunk bark contact.
		14. Structural Root: Large woody root emerging from the root crown, approximately radial to the trunk and at approximately the same depth, with a diameter approximately 1/2 to 1/3 of the root crown diameter.
		15. Tree: Single and multi-stemmed plants with mature height approximately greater than 5 meters.
	2. SUBMITTALS
		1. Product Data: Submit manufacturer product data and literature describing all products required by this section to the Owner for approval.
		2. Plant Growers Certificates: Submit Plant Growers certificates for all plants indicating that each plant meets the requirements, including the requirements root system quality, to the Owner for approval.
		3. Samples: Submit samples of each product and material where required to the Owner for approval. Label samples to indicate product, characteristics, and locations in the Work. Samples will be reviewed for appearance only. Compliance with all other requirements is the exclusive responsibility of the contractor.
	3. QUALITY ASSURANCE
		1. Plant Acceptance:
			1. The Owner will inspect all work for Plant Acceptance upon written request of the Contractor.
			2. Plant Acceptance by the Owner shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
			3. Any plant that is deemed defective as defined under the warranty provisions below shall not be accepted.
			4. The Contractor is responsible for the condition and quality of work and materials during construction, and until Plant Acceptance. Contractor shall bear the total cost of replacing any and all plants until this time.
		2. Warranty:
			1. The contractor agrees to replace defective Work and plants as defined below.
			2. Plants warranty shall begin on the date of Plant Acceptance and continue for the following periods:

a. Trees – One Year.

* + - 1. All plants shall be warranted to be healthy, reasonably free of defects, in flourishing condition, and shall bear foliage of normal density, size, and color for the species at the end of the warranty period.
			2. Defective Plants: Plants shall be deemed defective that are dead, diseased, insect infested, or not in a vigorous, thriving condition, during or at the end of the warranty period. The following conditions shall be deemed as indicating a defective plant.
				1. Any plant that has a canopy or root system with 25% or more of its volume dead, diseased, insect infested, or not in a vigorous, thriving condition.
				2. Evidence of damage to plants, which diminishes the aesthetic character and form or structural integrity of the plant or group of plants. Plants that have had more than 25% of the canopy reduced by removed limbs that were not removed under the direction of the Owner.
				3. Plants that do not meet the requirements for stem girdling and kinked roots and proper depth of the root crown.
				4. Plants packaged with non-biodegradable fabrics or twine that have not been removed during the planting process.
				5. Any tree that has open wounds (not completely healed over) that penetrates the cambium into the wood on trunks or major limbs, the removal of which would result in the loss of 25% or more of the structure and form of the tree. Properly-made pruning wounds that are not yet fully healed over can be considered as satisfactory if callus tissue has formed around the entire circumference of the wound.
				6. The Owner shall make the final determination that plants are defective.
			3. Plants determined to be defective shall be replaced without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
			4. Any work required by this document or the Owner during the progress of the work, to remediate plant defects including the removal of roots or branches, or planting plants that have been bare rooted during installation to inspect for or correct root defect shall not be considered as grounds to void any conditions of the warranty. In the event that the contractor feels that such remediation work may compromise the future health of the plant, the plant or plants in question shall be rejected and replaced with plants that do not contain defects that require remediation.
			5. The Contractor is exempt from replacing plants, after Plant Acceptance and during the warranty period, that are removed by others, lost or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.
			6. The warranty of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended warranty period, the Owner may elect one more replacement items or credit for each item. These tertiary replacement items are not protected under a warranty period.
			7. During and by the end of the warranty period, remove all tree wrap, ties, and guying unless agreed to by the Owner to remain in place. All trees that have leaned shall be straightened.
		1. Plant Final Acceptance:
			1. At the end of the warranty period, the Owner shall inspect all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final inspection.
	1. SELECTION and inspection OF PLANTS
		1. Purchasing trees from the growing nursery is preferred over re-wholesale suppliers. When Re-wholesale suppliers are utilized, the contractor shall submit the name and location of the growing nursery from where the trees were obtained by the re-wholesale seller. The re-wholesale nursery shall be responsible for any required plant quality certifications.
		2. The contractor shall require the grower or re-wholesale supplier to permit the Owner to inspect the root system of all plants including random removal of soil around the base of the plant. Inspections may be as frequent and as extensive as needed to verify that the plants meet the requirements conform to the grower’s root quality certifications.
			1. For field grown plants, viewing of plants by the Owner may be at the growing nursery prior to the harvesting of the plant.
		3. The Owner may choose to attach their seal to each plant, or a representative sample. Viewing and/or sealing of plants by the Owner at the nursery does not preclude the Owner’s right to reject material while on site.
		4. Where requested by the Owner, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the Owner via photograph does not preclude the Owner's right to reject material while on site.
		5. Unless approved by the landscape architect, plants shall have been grown at a latitude not more than 325 km (200 miles) north or south of the latitude of the project unless the provenance of the plant can be documented to be compatible with the latitude and cold hardiness zone of the planting location. Many tree species are sensitive to the photoperiod of their native provenance. For example, red maple stock from native southern stock will not harden off in time for northern winters.
	2. PLANT SUBSTITUTIONS FOR PLANTS NOT AVAILABLE
		1. Submit all requests for substitutions of plant species, or size to the Owner, for approval, prior to purchasing the proposed substitution.
	3. SITE CONDITIONS
		1. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.
		2. Do not install plants into saturated or frozen soils. Do not install plants during inclement weather, such as heavy rain or snow or during extremely hot, cold or windy conditions.
	4. PLANTING AROUND UTILITIES
		1. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.
		2. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.
		3. Notification of *Local Utility Locator Service*, is required 72 prior to digging. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the *Local Utility Locator Service*.
1. PRODUCTS
	1. PLANTS: GENERAL
		1. Standards and measurement: Provide plants of quantity, size, genus, species, and variety or Cultivars as shown and scheduled in contract documents.
			1. Tree stock shall conform to Mn/DOT specification 3861.2, ANSI Z60.1 “American Standard for Nursery Stock”, and all state requirements for nursery stock except for where they are modified by this specification. Where there is a conflict between this specification and the above specifications, this specification will apply.
			2. Plants larger than specified may be used if acceptable to the Owner. Use of such plants shall not increase the contract price. If larger plants are accepted the root ball size shall be increased in proportion to the size of the plant. Larger plants may not be acceptable if the resulting root ball cannot be fit into the required planting space.
		2. Plant Quality:
			1. General: Provide healthy, vigorous stock, grown in a recognized nursery and reasonably free of disease, insects, eggs, bores, and larvae. At the time of planting all plants shall have root system, stem, and branch form that will not restrict normal growth, stability and vigor for the expected life of the plant.
			2. Plant quality above the soil line:
				1. Plants shall be of exceptional quality with the color, shape, size and distribution of trunk, stems, branches, buds and leaves normal to the plant type specified.
				2. There should be one dominant leader to the top of the tree with the largest branches spaced at least 6 inches apart. All trees are assumed to be single leader plants unless a different form is specified in the plant list or drawings.
				3. Tree shall have no significant branch unions with included bark between stems.
				4. Tree trunks shall be reasonably straight with lateral limbs reasonably symmetrical, free of large voids, and evenly distributed along the trunk. Clear trunk should be no more than 40% of tree height unless otherwise specified in the planting specifications.
				5. Branches should be less than ½ the trunk diameter at the attachment point unless otherwise approved by Project Landscape Architect or Arborist.
				6. Trees greater than 1.5 inches caliper should be able to stand erect without a supporting stake.
				7. The trunk and branches shall be reasonably free of knots, scrapes, broken or split wood, fresh limb cuts, sunscald, injuries, and abrasions. All graft unions, where applicable, shall be completely healed without visible sign of graft rejection. All grafts shall be visible above the soil line.
				8. Open trunk and branch wounds shall be less than 10% of the circumference at the wound and no more than 2 inches tall. Pruning shall not encroach on the branch collar. Properly made pruning cuts are not considered open trunk wounds. Pruning cuts in accordance with ANSI standards are considered properly made pruning cuts.
			3. Plant quality at or below the soil line:
				1. The roots shall be reasonably free of scrapes, broken or split wood.
				2. A minimum of three structural roots reasonably distributed around the trunk shall be found in each plant.
				3. Plants with structural roots on only one side of the trunk (J roots) shall be rejected.
				4. The root crown must not be more than 2 inches below the soil line.
				5. The root system shall be reasonably free of stem girdling roots above the root collar, vertical roots and or kinked roots from nursery production practices. Stem girdling roots, vertical and kinked roots include roots on the interior of the root ball. There shall be no roots greater than 1/10 the diameter of the trunk circling more than one-third the way around in the top half of the root ball. Roots larger than this may be cut provided they are smaller than one-third the trunk diameter. There shall be no kinked roots greater than 1/5 the trunk diameter. Roots larger than this can be cut provided they are less than one-third the trunk diameter.
				6. Trees may be rejected if the extent of root cutting required to remedy girdling, kinked, and vertical roots renders the tree unlikely to thrive by the end of the warranty period.
				7. The final plant grower shall be responsible to have determined that the plants have been root pruned at each step in the plant production process to remove stem girdling roots and kinked roots, or practices that produce a root system throughout the root ball that meets these requirements. Regardless of the work of previous growers, the plant’s root system shall be modified at the final production stage to produce the require plant root quality. The final grower shall certify in writing that all plants are reasonably free of stem girdling and kinked roots.
				8. Except for bare root trees, all trees should be rooted into the root ball so that soil or media remains intact and trunk and root ball move as one when lifted, but not root bound. The trunk should bend when gently pushed and should not be loose so it pivots at or below soil line.
		3. Submittals: Submit for approval the required plant quality certifications from the grower where plants are to be purchased, for each plant type. The certification must state that each plant meets all the above plant quality requirements. The grower’s certification of plant quality does not prohibit the Owner from inspecting any plant or rejecting the plant if it is found to not meet the requirements.
	2. ROOT BALL PACKAGE OPTIONS: The following root ball packages are permitted. Specific Root Ball Packages shall be required where indicated on the plant list or in this document. Any type of Root Ball Package that is not specifically defined in this document shall not be permitted.
		1. BALLED AND BURLAPPED PLANTS

### 1. All Balled and Burlapped Plants shall be field grown, and the root ball packaged in a burlapped and twine and or burlap and wire basket package.

### 2. Plants shall be harvested with the following modifications to standard nursery practices.

#### a. Prior to digging any tree, using hand tools or an air spade, carefully remove the soil from the top of the root ball of each plant to locate the root crown. Care must be exercised not to damage the surface of the root crown and the top of the structural roots.

b. Balled and burlapped trees shall be dug prior to leafing out (bud break) in the spring or during the fall planting period except for plants known to be considered as fall planting hazards. Plants that are fall planting hazards shall only be dug prior to leafing out in the spring. Plants to be shipped or installed when in leaf shall be pre-dug prior to bud break and stored appropriately protected storage yards with adequate water.

c. Twine and burlap used for wrapping the root ball package shall be natural, biodegradable material that has not been treated with preservatives to retard decomposition. If the burlap decomposes during the storage period the root ball shall be re-wrapped prior to shipping.

3. Trees greater than 5 inches in caliper shall be root-pruned a minimum of 12 months before transplanting. All root pruning shall be accomplished utilizing accepted horticultural practices for root pruning including staking and watering.

* + 1. SPADE HARVESTED AND TRANSPLANTED
			1. Spade Harvested and Transplanted Plants shall meet all the requirements for field grown trees. Root ball diameters shall be of similar size as the ANSI Z60.1 requirements for Balled and Burlapped plants.
			2. Trees shall be harvested prior to leafing out (bud break) in the spring or during the fall planting period except for plants know to be considered as fall planting hazards. Plants that are fall planting hazards shall only be harvested prior to leafing out in the spring.
			3. Trees shall be watered thoroughly before moving both to hydrate the tree and to keep root package together during transport.
			4. Trees shall be moved and planted within 48 hours of the initial harvesting and shall remain in the spade machine until planted.
		2. CONTAINER GROWN PLANTS
			1. Container grown plants may be permitted only when indicated on the drawing, this document or approved by the Owner.
			2. Provide plants established and well rooted in removable containers.
			3. Container class size shall conform to ANSI Z60.1 for container plants for each size and type of plant.
			4. Container-grown stock shall have been grown in a container long enough for the root system to have developed sufficiently to hold its potting medium together but not so long as to have developed Stem Girdling or matted, circling around the edge of the container. Plants that fail to meet this requirement may be modified to correct deficiencies as describe in Part 3 Execution if approved by the Owner.
		3. CONTAINERIZED PLANTS
			1. Containerized plants may be permitted only when indicated on the drawing, this document or approved by the Owner.
			2. Provide field grown plants in containers of similar size as the ANSI Z60.1 requirements for Balled and Burlapped plants.
			3. Place the field grown plant in the container at the correct depth of the root crown as defined in section Plants: General, sub paragraph Quality, above.
			4. Containerized plants shall not held in the container more than 12 months.
			5. Remove all stem girdling above the root collar or circling roots around the edge of the container prior to planting as describe in Part 3 Execution if approved by the Owner.
		4. BARE ROOT PLANTS
			1. Provide plants established and well-rooted field grown plants. Harvest bare root plant while the plant is dormant and a minimum of 4 weeks prior to leaf out (bud break).
			2. The root spread of the harvested plants shall conform to ANSI Z60.1 for nursery grown bare root plants for each size and type of plant.
			3. Bare root stock shall be protected from drying out at all times. Roots must be covered and packed in moist straw, sawdust, or other suitable moisture-holding packing material.
			4. Keep the trees in a cool dark space for storage and delivery. If daytime outside temperatures exceeds 70 degrees F, utilize a refrigerated storage area with temperature between 35 and 50 degrees.
			5. Where possible, plan time of planting to be before bud break. For trees to be planted after bud break, place the trees before bud break in an irrigated bed of 20% sand and 80% pea gravel.
				1. The pea gravel bed shall be 18 inches deep over a sheet of plastic.
				2. Space trees to allow the unbundled branches to grow without shading each other.
				3. Once stored in pea gravel, allow the trees sufficient time for the new root system to flush and spring growth of leaves to fully develop before planting.
				4. Pea gravel stored trees may be kept for up to one growing season.
				5. Pea gravel stored trees shall be dipped, packaged and shipped similar to the requirements for freshly dug bare root trees above.
		5. IN-GROUND FABRIC BAG-GROWN (GROW BAGS)
			1. In-ground fabric bag-grown (Grow Bags) plants may be permitted only when indicated on the drawing, this document or approved by the Owner.
			2. Provide plants established and well rooted, produced using Grow Bags.
			3. The Grow Bag size shall conform to ANSI Z60.1 for fabric bag-grown plants for each size and type of plant.
	1. MULCH
		1. Mulch shall be as specified in MNDOT 3882, Type 6, Shredded Hardwood Mulch.
		2. Submit manufacturers product data that product meets the requirements and one gallon sample for approval.
	2. ANTI-DESICCANT
		1. Anti-Desiccant shall be emulsion type, film-forming agent similar to Dowax by Dow Chemical Company, or Wilt-Pruf by Nursery Specialty Products, Inc., Croton Falls, New York, designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer’s fully identified containers and use in accordance with manufacturer’s instructions.
		2. Submit manufacturers product data for approval.
	3. TREE STAKING AND GUYING MATERIAL
		1. Tree guying to be flat woven polypropylene material, 3/4" wide, 900 lb break strength. Product to be ArborTie, manufactured by Deep Root Partners, L.P. (800) 458-7668, or approved equal.
		2. Stakes shall be 2”x2" hardwood stakes free of knots (or approved equal) and of lengths appropriate to the size plant required for to adequately support the plant.
		3. Dead men for Large Trees where required on the drawings shall be 4" x 4" x 4' long, wood (or approved equal). Wood shall NOT be treated to protect from rot.
		4. Submit manufacturer’s product data for approval.
	4. WATERING BAGS
		1. Watering bags shall be Treegator Irrigation Bags, sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc, Youngsville, NC 27596. Or approved equal.
		2. Submit manufacturers product data for approval.
	5. CHEMICAL or biological ADDITIVES
		1. Chemical or Biological Additives: Chemicals and biological materials designed to increase soil fertility. All material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.
			1. Fertilizer: Fertilizer for planting shall be organic fertilizer with a salt index of 25 or less. The majority of the nutrient elements are from organic sources. Fertilizer selections shall be based on the recommendations of the soil test.
			2. Submit manufacturers product data for approval.
1. EXECUTION
	1. SITE EXAMINATION
		1. Examine the surface grades and soil conditions to confirm that the soil and drainage modifications indicated on the Plans and Details have been completed. Notify the Owner in writing of any unsatisfactory conditions.
	2. DELIVERY, STORAGE AND HANDLING
		1. Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind, and extremes of heat and cold temperatures.
		2. Branches shall be tied with rope or twine only, in a manner that will not damage any part of the tree.
		3. If planting is delayed more than 24 hours after delivery, set plants in a location protected from sun and wind.
		4. Provide adequate water to the root ball package during the shipping and storage period. Using a soil moisture meter, periodically check the soil moisture in the root balls of all plants to assure that the plants are being adequately watered.
		5. Do not deliver more plants to the site than there is space with adequate storage conditions. Provide a suitable remote staging area for plants and other supplies.
		6. The Owner shall approve the duration, method and location of storage of plants.
		7. Protective covering is required over all plants during delivery.
		8. Before shipping, apply 1/8 inch thick, wax sealed, corrugated cardboard trunk protection, or approved equal, around the trunk of all trees from the top of the root ball package to the first branch or up to four feet high, whichever is lower. Secure the cardboard with plastic tape.
		9. If trees are moved when in full-leaf, spray with anti-desiccant per manufacturer’s recommendations at nursery no greater than 48 hours prior to digging, and again two weeks after transplanting. Spraying should take place in early morning hours with foliage at maximum turgidity.
	3. PLANTING SEASON
		1. Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified in accordance with locally accepted practice. Install plants during the planting time as described below unless otherwise approved in writing by the Owner. In the event that the contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty.
		2. Planting shall be completed within the following dates:
			* 1. Coniferous Trees and Shrubs: April 15 – July 15, September 1 – November 14
				2. Deciduous Trees and Shrubs – for all root package options except bare root

Quercus (Oaks): April 15 – May 15, during dormancy period prior to bud break

Populus (Poplar), Ostrya (Ironwood), Celtis (Hackberry), Malus (Crabapple), Acer (Maple), Prunus (Plum and Cherry), Sorbus (Mountain Ash), Betula (Birch), Salix (Willow), Tilia (Basswood), Cornus (Dogwood), Rhus (Sumac): April 15 – July 15

All other Deciduous Trees and Shrubs: April 15 – July 15, September 1 – November 14

* + - * 1. Deciduous Trees and Shrubs – bare root

Betula (Birch), Celtis (Hackberry), Quercus (Oak), Crataegus (Hawthorn), and Ostrya (Ironwood): planting dates: Mid-Late May due to sweating requirements.

All other BR Deciduous Trees and Shrubs: Plant only during Spring and Fall dormancy periods.

* 1. COORDINATION WITH PROJECT WORK
		1. Coordinate the relocation of any irrigation lines, heads or the conduits of other utility lines that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner of any conflicts encountered.
	2. LAYOUT AND PLANTING SEQUENCE
		1. When applicable, plant trees before other plants are installed.
	3. SOIL PROTECTION DURING plant DELIVERY and installation
		1. Protect soil from compaction during the delivery of plants to the planting locations, digging of planting holes and installing plants.
			1. Where possible deliver and plant tress to that require the use of heavy mechanized equipment prior to final soil preparation and tilling.
			2. Till and restore grades to all soil that has been driven over or compacted during the installation of plants.
	4. INSTALLATION OF plants: General
		1. Inspect each plant after delivery and prior to installation for damage of other characteristics that may cause rejection of the plant. Notify the Owner of any such condition observed.
		2. The root system of each plant, regardless or root ball package type, shall be inspected by the contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality in Part 2 Products: Plants General: Quality. The contractor shall undertake at the time of planting, all modifications to the root system required by the Owner to meet these quality standards.
		3. Container Root Ball Shaving: The outer surfaces of ALL plants in containers, including the top, sides and bottom of the root ball shall be shaved to remove all circling and matted roots. Shaving shall be performed using saws, knives, sharp shovels or other suitable equipment that is capable of making clean cuts on the roots. Shaving shall remove a minimum of one inch of root mat or deeper as required to remove all roots that are not growing reasonably radial to the trunk and all kinked and vertical roots. For trees where shaving could potentially harm the tree because the tree would not have sufficient roots left, shaving is not required if the specifier permits not shaving the root ball.
		4. Exposed Stem Tissue after Modification: The required root ball modifications may result in stem tissue that has not formed trunk bark being exposed above the soil line. If such condition occurs, wrap the exposed portion of the stem in a protective wrapping such as Dewitt Tree Wrap fabric. Secure the fabric with biodegradable tape such as “3M Scotch 234 or 232” masking tape or approved equal. DO NOT USE string, twine or any other material that may girdle the trunk if not removed.
		5. Using hand tools, back hoe or mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing.
			1. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
			2. Scarify sides and bottom of planting hole.
		6. For trees to be planted in prepared Planting Soil that is deeper than the root ball depth, compact the soil under the root ball using a mechanical tamper to assure a firm bedding for the root ball. If there is more than 12 inches of planting soil under the root ball excavate and tamp the planting soil in lifts not to exceed 12”.
		7. Set top outer edge of the root ball 1-3” above the average elevation of the proposed finish. Set the plant plumb. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.
		8. Brace root ball by tamping Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6") lifts. Lightly tamp each lift using hand tools to settle backfill and eliminate voids.
		9. Where indicated on the drawings, build a 3” high, level saucer of Planting Soil around the outside of the root ball to retain water. Tamp the saucer to reduce erosion of the saucer.
		10. Thoroughly water the Planting Soil and root ball immediately after planting
		11. Remove corrugated cardboard trunk protection after planting.
		12. Follow additional requirements for the permitted root ball packages.
	5. Permitted Root ball packages and Special planting requirements
		1. The following are permitted root ball packages and special planting requirements that shall be followed during the planting process in addition to the above General planting requirements.
		2. BALLED AND BURLAPPED PLANTS
			1. Remove burlap or cloth wrapping and wire baskets from full depth of root ball (remove all wire and burlap except burlap and wire under root ball). Completely remove all strings, nails, burlap, baskets, and wrappings from the root ball and trunk before backfilling. Dispose of properly.
		3. SPADE HARVESTED AND TRANSPLANTED PLANTS
			1. After installing the tree, loosen the soil along the seam between the root ball and the surrounding soil to a depth of 8-10 inches by hand digging to disturb the soil interface.
			2. Fill any gaps below this level with loose soil.
		4. CONTAINER GROWN PLANTS
			1. Start with the assumption that most container plants likely have significant stem girdling and circling roots, and that the root crown is likely too low in the root ball.
			2. Remove the container.
			3. Remove all roots and potting soil above the root crown and the main structural roots.
			4. Remove all potting soil at the bottom of the root ball that does not contain roots.
			5. Using a hose, power washer or air knife, wash out the potting mix from around the trunk and top of the remaining root ball and find and remove all stem girding roots within the root ball above the top of the structural roots.
			6. The resulting root ball may need additional staking and water after planting. The Owner may reject the plant if the root cutting process makes the tree unlikely to be vigorous at the end of the warranty period.
		5. CONTAINERIZED PLANTS
			1. Remove the container.
			2. Cut all circling roots on the perimeter of the root ball not removed in the required root shaving as noted in the paragraph, Container Root Ball Shaving, such that the roots are emerging out to remaining root system are oriented approximately radial to the trunk.
			3. Remove all roots, root mat and potting soil above the root crown and the main structural roots.
			4. Remove all potting soil at the bottom of the root ball that does not contain roots.
		6. BARE ROOT PLANTS
			1. Soak roots in water or mud slurry for at least one hour prior to planting.
			2. Dig the planting hole three times the diameter of the spread of the roots. Dig the planting hole in the center to the depth that maintains the root collar at the elevation of the surrounding finished grades.
			3. Spread the roots out radial to the trunk around the prepared hole.
			4. Maintain the trunk plumb while backfilling soil around the roots.
			5. Lightly tamp the soil around the roots to eliminate voids and reduce settlement.
		7. IN-GROUND FABRIC BAG-GROWN (GROW BAGS)
			1. Remove the fabric bag from the root ball. Cut roots at the edge of the bag as needed to extract the fabric from the roots. Make clean cuts with sharp tools, do not tear roots away from the fabric.
			2. Inspect the root system after the bag is removed to confirm that the root system meets the quality standards.
			3. Assure that the root crown is within 2 inches of the final soil line.
	6. TREE STAKING AND GUYING
		1. Stake or guy only if necessary for the tree to be stable in unusual circumstances, for example, in strong winds and if approved by Project Landscape Architect.
		2. The Owner shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.
		3. Poor-quality trees with cracked, wet, or loose root balls, poorly developed trunk-to-crown ratios, or undersized root balls shall be rejected if they require staking, unless written approval to permit staking or guying as a remedial treatment is obtained from the landscape architect. Trees that settle out of plumb due to inadequate soil compaction either under or adjacent to the root ball shall be excavated and reset. In no case shall trees that have settled out of plumb be pulled upright using guy wires.
		4. If tree needs to be staked, use a method that minimizes the chance of girdling the tree. Many such systems are available on the market. Allow for some trunk movement with whatever method is used. Do not use wires or cables to guy trees.
		5. Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the Owner.
	7. STRAIGHTENING PLANTS
		1. Maintain all plants in a plumb position throughout the warranty period. Straighten all trees that move out of plumb including those not staked. Plants to be straightened shall be excavated and the root ball moved to a plumb position, and then re-backfilled.
		2. Do not straighten plants by pulling the trunk with guys.
	8. INSTALLATION OF FERTILIZER AND OTHER CHEMICAL ADDITIVES
		1. Do not apply any fertilizer to plantings during the first year after transplanting unless soil test determines that fertilizer or other chemical additives is required. Apply chemical additives only upon the approval of the Owner.
		2. Fertilizers shall be applied according to the manufacturer’s instructions and standard horticultural practices.
	9. PRUNING OF TREES AND SHRUBS
		1. Trees need as many leaves as possible to recover from transplant shock, so prune as little as possible at the time of planting. Prune only broken or dead branches, if present, as well as co-dominant leaders, limbs that rub against each other, and poorly angled branches if these have not been pruned out by the nursery. To minimize oak wilt spread, never prune oaks in spring or early summer.
		2. Prune plants as directed by the Owner. In general, preserve the natural character of the plant and follow recommendations in “An Illustrated Guide to Pruning, Third Edition” (Gilman 2011).
		3. All pruning shall be performed by a person experienced in landscape pruning.
		4. Wherever possible and appropriate to the species, preserve or create a central leader.
		5. Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic man lift to gain access to the top of the tree. Do not climb in newly planted trees
		6. Remove and replace excessively pruned or malformed stock resulting from improper pruning.
		7. Pruning shall be done with clean, sharp tools.
		8. No tree paint or sealants shall be used.
	10. MULCHING OF PLANTS
		1. Apply 2-3 inch deep mulch ring around tree, minimum 8’ diameter or to extent indicated on plans.
		2. Do not install mulch on top of root ball.
	11. WATERING
		1. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Plant Acceptance. The contractor shall adjust the automatic irrigation system, if available and apply additional water, using hoses as required.
		2. Hand water root balls of all plants to assure that the root balls have adequate moisture. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.
		3. The Contractor shall install one set (two bags) of watering bags for each tree to be maintained and used for tree watering during the warranty period. Watering bags shall be removed between December 1 and March 1.
	12. CLEAN-UP
		1. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day.
		2. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The Owner seals are to remain on the trees and removed at the end of the warranty period.
	13. PROTECTION DURING CONSTRUCTION
		1. The Contractor shall protect landscape work and materials from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during installation until Plant Acceptance. Treat, repair or replace damaged planting work immediately.
		2. Damage done by the Contractor, or any of their sub contractors to plants, or any other parts of the work, shall be replaced by the Contractor at no expense to the Owner.
	14. PLANT MAINTENANCE PRIOR TO PLANT ACCEPTANCE
		1. During the project work period and prior to Plant Acceptance, the Contractor shall maintain all plants.
		2. Maintenance during the period prior to Plant Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of insects and disease, and in healthy growing condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures.
	15. MAINTENANCE DURING THE WARRANTY PERIOD

A. During the warranty period, provide all maintenance for all plantings to keep the plants in a healthy state and the planting areas clean and neat.

B. General requirements:

1. All chemical and fertilizer applications shall be made by licensed applicators for the type of chemicals to be used. All work and chemical use shall comply with all applicable local, provincial and federal requirements.

2. Meet with the Owner a minimum of three times a year to review the progress and discuss any changes that are needed in the maintenance program. At the end of the warranty period attend a hand over meeting to formally transfer the responsibilities of maintenance to the Owner.

C. Provide the following maintenance tasks:

1. Watering; provide all water required to keep soil within and around the root balls at optimum moisture content for plant growth.

a. Maintain all watering systems and equipment and keep them operational. Monitor soil moisture to provide sufficient water. Check soil moisture and root ball moisture with a soil moisture meter on a regular basis and record moisture readings. Do not over water.

2. Soil nutrient levels: apply fertilizers at rates recommended by the soil test.

3. Plant pruning: remove cross over branching, developing co dominant leaders, dead wood and winter-damaged branches. Do not over prune or shear plants.

4. Restore plants: reset any plants that have settled or are leaning as soon as the condition is noticed.

5. Guying: remove tree guys and staking after the first full growing season.

6. Weed control: keep all beds reasonably free of weeds. The Owner must approve in advance the use of all chemical herbicide applications.

8. Trash removal: remove all trash and debris from all planting beds and maintain the beds in a neat and tidy appearance.

9. Disease and insect control: pProvide Integrated plant management (IPM) program to maintain disease and insects at acceptable and manageable levels. Manageable levels shall be defined as minimum damage to plants. Use least invasive methods to control plant disease and insect outbreaks. The Owner must approve in advance the use of all chemical pesticide applications.

10. Plant replacement: replace all plants that are defective as defined in the warranty provisions, as soon as the plant decline is obvious and in suitable weather and season for planting.

12. Mulch: refresh mulch once a year to maintain complete coverage. Do not over mulch. Do not apply mulch against the trunks or stems of any plants. Replacement mulch shall meet the requirements of the original approved material.

**REFERENCES**

Busiahn, Jacob, and Sean Peterson. 2013.All you need to Know about Community Gravel Beds. University of Minnesota Department of Forest Resources.

Gillman, J.H. and G.R. Johnson. 1999. Planting and Transplanting Trees and Shrubs. University of Minnesota Extension WW-03825. Available August 2013 <http://www.extension.umn.edu/distribution/horticulture/dg3825.html>

Gilman, Edward F. 2013. Sample planting specifications for trees. Environmental Horticulture Department, University of Florida Gainesville. Downloaded August 2013 from <http://hort.ifas.ufl.edu/woody/abbreviated-planting-specs.shtml>

Gilman, Edward F. 2011. Specifications for Planting Trees and Shrubs in the Southeastern U.S. Document ENH856. Environmental Horticulture, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Downloaded August 2013 from <http://edis.ifas.ufl.edu/pdffiles/EP/EP11200.pdf>.

Gilman, E. No Publication Year Given. Sample nursery stock specification for shade trees.

 Available August 2013 at <http://hort.ufl.edu/woody/sample-specs.shtml>.

International Society of Arboriculture. No Publication Year Given. Guide for Developing Planting Specifications. Downloaded August 2013 from <http://www.isa-arbor.com/education/onlineResources/cad/resources/educ_CAD_DevelopingPlantingSpecifications.pdf>

Johnson, Jill; Gary Johnson; Maureen McDonough; Lisa Burban; and Janette Monear. 2008. Tree Owner's Manual for the Northeastern Midwestern United States. United States of Agriculture, Forest Service, Northeastern Area, State and Private Forestry, NA-FR-04-07. Downloaded August 2013 from http://na.fs.fed.us/pubs/uf/tom/090202\_tom\_lr.pdf

University of Minnesota Forest Resources Extension My Minnesota Woods website at <http://www.myminnesotawoods.umn.edu/>, available August 2013

Urban, J. 2012. Draft Tree Planting Specification, Prepared for 2012 International Society of Arboriculture Conference.

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1. Tree quality includes information specific to a tree, such as branch width, canopy extent and wound size. Soil characteristics include information pertaining to soil type and soil volume. Planting characteristics relate to information pertaining to the tree planting, such as information on the position of the root ball and use of mulch during planting. [↑](#footnote-ref-1)