CITY OF MORDEN

POLICY & PROCEDURES MANUAL

Section	*Classification*
Parks and Urban Forestry	Procedure
Subject	*Pages*
Landscape Specification Standards	1
Authority	*Effective Date*
Council	
Approved (date and resolution number)	*Index Number*
	PUF 006

Purpose:

The purpose of this policy is to establish landscape standards applied to all City owned lands for parks purposes. This includes all lands acquired by the City for parks purposes, including through the land dedication process. By adopting this policy, the City ensures that lands acquired, improved, operated, and maintained by the City continue to meet the standards set forth in the "Landscape Specification Standards & Details", attached as Schedule 'A'

Procedures:

1. The City and Developer determine the approach and associated submission requirements to be followed for improvements to the dedicated lands.
2. The developer follows the Landscape Specification Document for all improvements.
3. Issuance of the Construction Completion Certificate by the City.
4. The developer adheres to the criteria set out for the maintenance and warranty period.
5. Issuance of the Final Acceptance Certificate by the City.
6. The City assumes all responsibility of ongoing maintenance of the lands.

COMMUNITY SERVICES DEPARTMENT

LANDSCAPE STANDARD SPECIFICATIONS & DETAILS

November 2020

1 INTENT & APPLICATION

1.1 Intent

1.1.1 All lands dedicated for parks purposes, or lands otherwise acquired by the City of Morden for parks purposes, shall meet the standards specified herein and shall be capable of sustaining vigorous plant growth

1.1.2 Once the amount, purpose, and location of dedicated lands for parks purposes have been determined, the City and the Developer will reach an agreement on which of the following approaches will be followed for improvements to the dedicated lands:

.1 lands to be improved by the City

.2 lands to be improved by the Developer, in accordance with an approved Landscape Plan, prepared by a registered Landscape Architect on behalf of the Developer or

.3 lands to be improved by the Developer, without an approved Landscape Plan

.1 Where approach 1.1.2.2 is agreed to, the Landscape Plan must be submitted to the City for review and approval prior to commencement of work, c/o Parks & Urban Forestry Manager per Schedule "D"

.2 Work is generally expected to proceed in the sequence specified below in order to protect pre-development site conditions and minimize damage as work proceeds. Deviations from the specified sequence are to be approved by the City per Schedule "D"

- Site preparation & rough grade
- Hard surface materials & footings
- Soils & finish grade
- Plant materials & turf

1.2 Application

1.2.1 Per 1.1.2,2, where lands are dedicated for parks purposes and are to be improved by the City, the Developer shall furnish the City with a Site Plan that specifies final grade, drainage, and topsoil composition prior to Final Acceptance Certification. With this approach, the City will be responsible for site improvements following certification, with improvements to be made in consideration of City budgeting and in accordance with annual Parks & Urban Forestry workplans

1.2.2 Per 1.1.2.3, where lands acquired by the City through land dedication for parks purposes or by other means and where said lands are to be improved by the Developer without an approved Landscape Plan, the standards specified herein are to be met

1.2.3 These standards are also to be met where existing City parks are to be improved by the City

2 SUBMISSION REQUIREMENTS & PROCEDURES

2.1 Submission Requirements

2.1.1 Where approach 1.1.2.2 is agreed to and following a preliminary meeting to review a conceptual Landscape Plan, the Landscape Architect shall submit to the Parks & Urban Forestry Manager the Landscape Plan, construction drawings, details, and specifications. The Landscape Plan and additional submission information shall be complete, accurate, and in accordance with the Morden Landscape Specifications as determined by the Parks & Urban Forestry Manager

.1 The Landscape Plan must include the following information

- Property lines
- Pcontours at maximum 1-metre intervals and details for sloped areas greater than 10% slope gradients
- All roads, sidewalks, and trails
- All drainage ditches, swales, berms, and catchbasins
- All wetlands, ponds, creeks, and bio-swales
- All existing plant material and plans for retention, relocation, and removal
- All proposed trees, shrubs, turf areas, and other plant materials
- Any proposed facilities/structures within the landscaped areas
- Area [in square metres] and materials for all surface treatments including but not limited to mulched planting beds, perennial areas, naturalized areas, seeded/sodded areas, total area of mown and non- mown turf surfaces, hard surface areas, and playgrounds

2.1.2 Where approach 1.1.2.1 or 1.1.2.3 is agreed to and following a preliminary meeting with the Developer and Contractor, the Developer shall submit to the Parks & Urban Forestry Manager the Site Plan that includes all information specified in 1.2.1 prior to commencing improvements

2.1.3 In addition to the information specified in 1.2.1, all proposed improvements shall be inspected and approved by the Parks & Urban Forestry Manager prior to installation. Where approach 1.1.2.3 is agreed to, the Developer shall notify the Manager at each of the stages identified below in order to arrange inspection prior to commencement:

.1 Finished grade and drainage
.2 Soil installation
.3 Turf seed and/or sod installation
.4 Tree and/or shrub installation
.5 Mulch installation
.6 Maintenance plan during warranty period

2.2 Submission Procedures

2.2.1 Where approach 1.1.2.2 or 1.1.2.3 is agreed to, the Parks & Urban Forestry Manager will review the Landscape Plan or Site Plan and additional submission information in accordance with these criteria:

.1 Public safety and security
.2 Fit with drainage patterns, vehicular and pedestrian circulation networks, land use and form, and public utilities
.3 Appropriate to the location, scale, and scope the park/open space area
.4 Attention to soil conditions, hydrology, slope stability, successive plant growth, and pedestrian/cyclist circulation
.5 Maintenance requirements
.6 Protection and conservation of the natural environment and enhancement of biodiversity
.7 Universal design
.8 All-season use

3 SITE PREPARATION & ROUGH GRADE

3.1 Site Protection

3.1.1 Fires

Fires and burning of rubbish on site are not permitted.

3.1.2 Waste Disposal

Burying of rubbish and waste materials on site is not permitted. Disposal of waste, or volatile materials such as minerals, spirits, oil or paint thinner, into waterways, storm or sanitary sewers is prohibited. Remove rubbish, waste products and debris in accordance with regulations of authorities having jurisdiction

3.1.3 Drainage

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from standing water

.2 Pumping of water containing silt in suspension into waterways, sewer or drainage systems is prohibited

.3 Dispose of water containing silt in suspension in accordance with requirements of jurisdictions having authority

.4 Take necessary precautions to prevent runoff erosion. Repair damage as required to return to original condition

3.1.4 Existing Plant Material

.1 Provide documentation to the Parks & Urban Forestry Manager indicating the location, type, and pre-construction condition of all retained existing plant material

.2 Use all means necessary to protect plant materials before start-up and during construction. Review working conditions on-site, prior to start of construction with the Parks & Urban Forestry Manager

.3 When existing tree retention is planned and or the legal boundaries of the construction site are within 6m of adjacent public trees, refer to the City of Morden Tree Protection Plan (Appendix C)

.4 For the retention of all existing plant material the following site changes may impact plant health and survival: grade changes, soil compaction, ponding water, storage of construction materials, vehicle or equipment travel and storage, excavation impacting the below ground root system, pruning of existing limbs, removal of surrounding trees or adding buildings thus changing the wind dynamic, and trunk damage

3.1.5 Existing Wetlands and Waterways

.1 For all existing wetlands and waterways, the property owner is required under the Water Rights Act and Water Rights Regulation to follow all provincial and legal requirements prior to site changes or alterations

3.1.6 Vehicle Circulation and Parking

.1 Determine interference of plant material and their root zones before moving equipment or supplies on site to avoid any damage

.2 For traffic, use only approved access routes and parking areas for vehicles

.3 Store equipment and materials in approved areas only, beyond the dripline of plant material

3.1.7 Archeology and Heritage

.1 Items of archaeological value include all artifacts of prehistoric or historic origin and all human and animal remains

.2 Relics and antiques may include such items as cornerstones of old buildings, contents of buildings, and similar objects found on site or in buildings to be demolished

.3 Items of suspected value shall remain the property of the City of Morden, and recovery shall be governed by federal, provincial, and municipal statutes

.4 Supply shoring, barricades, and all other equipment required for safe recovery of such items

.5 Suspend work immediately and notify the Parks & Urban Forestry Manager when items of archaeological value, antiques, or relics are discovered. Proceed with work only after assessment and remediation is complete

3.1.8 Pollution and Contamination

.1 Provide and maintain temporary erosion, sedimentation, and pollution control features installed until project turnover
.2 Prevent sandblasting, rip-rap infill material, and other extraneous materials from contaminating air and water beyond application area by providing temporary enclosures as required
.3 Cover or wet down materials to prevent blowing dust and debris. Provide dust control for temporary roads, if applicable

3.1.9 Pesticides

.1 A pesticide is defined as "a substance that is intended for use in preventing, destroying, repelling or mitigating any insect, nematode, rodent, predatory animal, parasite, bacteria, fungus, weed or other form of plant life or virus".
.2 Use only with approval of the Parks & Urban Forestry Manager and in strict accordance with applicable regulations and manufacturer's instructions.
.3 Base upon the City of Morden Pesticide Use Permit, in accordance with Manitoba Regulation 94/88R, per The Environment Act, the City reserves the right to make recommendations and changes to all pesticide use applications. Upon receipt of the application the City shall reply within 48 hours and communicate recommendations or changes.
.4 The Contractor intending to apply pesticide on City property, or property intended to become City property after Construction Completion and prior to Final Acceptance, shall notify the Parks & Urban Forestry Manager prior to proceeding with application. The treatment date, target, type of application (i.e. spot, boom, ground, aerial), product used, copy of the pesticide applicators license, and map indicating the treatment area must be included in the written notification

3.1.10 Wildlife and Species at Risk

.1 If vegetative clearing or disturbance occurs within the migratory bird nesting period, the City of Morden shall provide the survey for the notice of protection of any migratory bird or rare bird nest sites within or near area of work. The Contractor shall coordinate with the Parks & Urban Forestry Manager and adjust work schedule and extents as temporarily or permanently necessary
.2 The landowner shall adhere to the Endangered Species and Ecosystems Act. Wherein it is unlawful to: kill, injure, possess, disturb, or interfere with the species; destroy, disturb, or interfere with the habitat of the species; damage, destroy, obstruct, or remove a natural resource on which the species depends for its life and propagation; endangered or threatened ecosystems are protected

3.2 Rough Grading

3.2.1 General

.1 Lay out work and be responsible for accuracy. Verify locations and depth of bury for all underground services and lines, whether or not shown on drawings. Protect from damage all site features which are to remain. Make good any damage
.2 Keep excavations dry at all times. Provide necessary equipment including pumps, piping and temporary drains and trenches as required to prevent runoff accumulations

3.2.2 Preparation

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated
.2 Establish and identify all require lines, levels, and datum
.3 Maintain benchmarks, monuments, and other reference points. Re- establish if disturbed or destroyed
.4 Remove all debris and unsuitable material from the area to be graded
.5 Remove all weed growth from the area to be graded by cutting or other acceptable means
.6 Remove all organic material and topsoil from areas designated for regrading, paving or structures. Stockpile for re-use in landscape development
.7 Ensure existing plant material and other items to remain are adequately protected from damage during site grading operations

3.2.3 Grading

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated

.2 Prior to placing fill over existing ground, scarify surface to depth of 150mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding
.3 Excavate soft subgrade areas and replace with approved fill
.4 Place fill in maximum 150mm loose lifts. Compact filled and disturbed area to minimum 96% of standard Proctor density at optimum moisture content to current ASTM D698 or 98% of One Point Proctor Density with moisture content of +/-2% of optimum
.5 Landscaped areas shall be sloped as required to maintain positive drainage; minimum gradient shall not be less than 2% and maximum gradients shall be no more than 20% or 5:1 slope
.6 Deviations from these parameters are acceptable only with prior written approval from the Parks & Urban Forestry Manager

3.2.4 Fill Material
.1 Earth fill to be unfrozen, composed of fine grained soils, and free of stones larger than 75mm, concrete, sticks, roots, and other debris
.2 Protect fill material from contamination
.3 Materials found on site which are deemed unsuitable for fill, grading, or landscaping includes but are not limited to the following:
- Soil contaminated with toxic materials
- Asphaltic rubble
- Concrete and other waste building materials
- Spongy or yielding material
- Organic material
- Frozen materials
- Wet or saturated materials
- Alkaline material
- Other materials detrimental to plant growth

3.2.5 Erosion Protection
.1 Provide and maintain erosion and sediment control measures in accordance with the requirements of authorities having jurisdiction
.2 Provide silt fence as required to control erosion and sedimentation. Install to manufacturers specifications. Maintain in effective condition
.3 Stop work if incidents occur and notify the Parks & Urban Forestry Manager and authorities having jurisdiction immediately. Suspend operations until authorized to proceed

3.2.6 Clean-up
.1 Remove waste material, surplus material, and material unsuitable for fill, grading, or landscaping from site to municipally-approved location
.2 Clean adjacent walks and road surfaces at the end of each working days

3.3 Penalties

3.3.1 Abuse to any plant material, including unauthorized pruning or removal, in whole or in part of plant material, is not permitted
3.3.2 Contractor is responsible for monitoring all persons on site for plant material abuse. Restitution for all damages found will be solely upon the Contractor
3.3.3 A fine for not less than plant material repair, removal, or replacement costs plus loss of aesthetic or intrinsic value per individual plant, may be levied. Plant material value will be determined by the Parks & Urban Forestry Manager, as required
3.3.4 Fines and/or costs related to post-impact assessment and/or remedial work may be assigned
3.3.5 Unauthorized excavations, removal, relocation, or pruning in part or whole of existing plant material, at or adjacent to the work, is not allowed and will result in a fine or penalty assessed against the Contractor. Includes activity that causes damage to, or results in the removal of any existing tree or plant material, without prior approval
3.3.6 The Contractor is responsible for damages resulting from unauthorized work to any existing tree

3.3.7 The Contractor is responsible to monitor Sub-Contractors as restitution for damages will be found to be solely the responsibility of the Contractor

3.3.8 Restitution for damages to, or removal of, plant material will be assessed onthe value of plant material as determined using a formula described by the International Society of Arboriculture (ISA) Guide for Plant Appraisal, current edition

3.3.9 City of Morden to supply an ISA Certified Arborist to perform the assessment and evaluate damages. Damages may include the cost of repair, removal, and replacement as determined by the assessment

3.3.10 The Contractor is responsible for costs associated with the assessment

4 HARDSCAPES

4.1 General

All hard surfaces shall be constructed as per the most recent City of Morden Engineering Specifications from the Operations Department and under the supervision of the Operations Department. The following information is supplemental to the Engineering Specifications.

4.1.1 Test for quality, gradation and compaction densities of base materials

4.1.2 Where hard surface installation occurs the Director of Operations will be contacted. If varied from the details provided in this *section, Engineering specs and standards will supersede*

4.2 Subgrade and Granular-based Course

4.2.1 Granular Base

.1 Place granular base, in unfrozen condition, to minimum compacted thicknesses indicated on the drawings, within 150mm of design grade and cross-section and with maximum variation of 10mm in 3000mm

.2 Place in maximum 150mm loose lifts; compact each lift to minimum 98% of standard Proctor density at optimum moisture content, plus or minus 1%; add water or aerate as required

.3 Sound hard, durable crushed aggregate free from shale, clay, organic matter, and debris to meet the following gradation. Plasticity index: 0- 6%; CBR: minimum 65; fracture: minimum 50%

Sieve Designation	Percent Passing by Weight
25.0mm	100%
18.0mm	87-100%
12.5mm	72-93%
5.0mm	45-77%
2.0mm	26-56%
0.90mm	18-39%
0.40mm	13-26%
0.16mm	7-16%
0.071mm	6-11%

4.2.2 Subgrade Preparation

.1 Scarify and recompact top 150mm of completed subgrade tominimum 98% of standard Proctor density at optimum moisture content plus or minus 1%; add water or aerate as required for optimum moisture content

.2 Excavate soft subgrade areas and replace with approved fill

.3 Completed subgrade shall not vary more than 15mm from the design grades

.4 Proof roll subgrade surface with roller of approved mass and type

.5 Check for unstable areas. Check for areas requiring additional compaction

4.3 Cast-in-place Concrete

4.3.1 Quality Control

.1 Submit for concrete material before delivery to site:
- Name of suppliers
- Class and compressive strength
- Other information requested to verify product quality

4.3.2 Notification

.1 Notify Engineering when delivery of concrete is schedule

.2 Schedule delivery and placement of above ground concrete when outside temperature is above 2 degrees Celsius and rising, unless hoarding is specified

.3 Schedule delivery and placement of in-ground concrete when outside temperature is about 5 degrees Celsius and rising, unless approved by the Parks & Urban Forestry Manager; insulation is

work:
- Compressive Strength (3 cylinders)
- Slump
- Air content

4.3.4 Products

.1 Concrete
- Compressive strength: 32MPa at 28 days, per CSA A23.1- 14/A23.2-14
- When no preliminary strength test is made, the water-to- cement ration is not to exceed values per CSA A23.1-14/A23.2- 14
- Slump: 100mm max., min. 50mm
- Air Content: hardened concrete to conform to CSA A23.1- 14/A23.2-14
- High sulphate resistant hydraulic cement, type HS, per CSA A23.1-14/A23.2-14

.2 Water
- Water used for concrete shall be clean and free from harmful amounts of acid, oil, alkali, organic matter and other deleterious substances

.3 Formwork
- Forms shall be constructed to meet requirements of shape, dimensions and tolerances per drawings and specifications
- Formwork is required to be true to alignment and grade per drawings

.4 Curing Compound
- Chlorinated rubber to meet requirements of ASTM C309, Type 1
- Florseal by Sternson or approved equivalent

4.3.5 Execution

.1 Layout
- Establish and maintain line and grade controls using appropriate survey personnel and equipment
- Contractor is responsible for layout accuracy
- Contractor is required to stake layout of concrete work, construct formwork, and obtain approval before concrete placement

.2 Concrete Delivery and Installation
- Areas to receive concrete must be free of debris and ice
- Convey concrete from mixer to place of final deposits
- Equipment for chuting, pumping and pneumatically conveying concrete must be the appropriate size and style to ensure continuous flow of concrete to final position
- Re-tempered or concrete contaminated by foreign material is not allowed
- Place concrete in final position to avoid segregation due to re- handling or flowing
- Concrete placement rate to be plastic and flowing only
- No interruption of concrete placement per area is allowed between start and finish
- Protect concrete from hot weather or wind with windbreaks, sunshades, fog sprays, or other suitable devices as required
- Placement of concrete against frozen surfaces is not allowed
- Consolidate concrete thoroughly by mechanical vibration during placement
- Vibrator type and design to be suitable for the work
- Vibration application required at the point of deposit and in areas of freshly deposited concrete
- Vibrator is required to move continuously in and out of concrete and applied at points uniformly spaced for optimum visible effectiveness
- Vibration in one location cannot draw a pool of grout from the surrounding concrete
- Apply vibration to ensure distribution of surface concrete effectively, no contact or damage to forms is allowed
- Vibration directly to set concrete is not allowed
- Vibration to make concrete flow into forms over distances causing segregation is not allowed
- Spade areas inaccessible by vibrator to ensure smooth surfaces and dense concrete

.3 Concrete Footings
- Remove water from excavation before concrete placement
- Install support posts, anchor bolts, pipes, sleeves, frames, etc. as specified
- Support accessories during installation and curing to prevent movement
- Install plumb, level, and to design elevations

.4 Concrete Pad and Slab Construction
- Forms: wet or oily, including masonry filler units
- Reinforcement material: clean of dirt, loose ruse, mill scale and other coatings
- Screed and level per drawings and details

.5 Finishing
- Profile and cross-section of +/-6.0mm, no depressions exceeding 3mm as measures with 3000mm straight edge
- Trowel concrete surface per drawings and details
- Provide construction joints and saw cuts for concrete surfaces

4.4 Concrete Curbs

4.4.1 Refer to Operations

4.4.2 For Curb Specifications contact Director – Operations.

4.5 Asphalt Walks

4.5.1 Quality Control

.1 Submit before delivery to site:
- Name of supplier
- Mix design
- Other information requested to verify product quality

.2 Notify the Director – Operations when delivery of asphalt is scheduled

.3 Schedule delivery and placement of asphalt when outside temperature is above 4 degrees Celsius and rising

4.5.2 Inspection

.1 Notify the Director – Operations min. 24 hours in advance for review and approval of:
- Surface layout before placement of asphalt
- Granular base preparation
- Asphalt placement and finishing work

4.5.3 Testing

.1 Asphalt is subject to analysis by an approved testing laboratory and includes Marshall density and core samples to check design thickness tolerances

.2 Test results that do not meet specification will be averages with two additional core tests within two metres of the original core

4.5.4 Asphalt

.1 Asphalt Mix Type 2

.2 Slurry Seal; SS-1 emulsion and sand mixture with sand passing #16 sieve

.3 Bonding Glue; SS-1 emulsified prime coat or equivalent

4.5.5 Layout

.1 Establish and maintain line and grade controls using appropriate survey personnel and equipment

.2 Contractor is responsible for layout accuracy

.3 Establish layout of asphalt work as required per drawings

.4 Contractor is required to spray paint edge of asphalt surfacing and obtain approval, before start of work

4.5.6 Asphalt Delivery and Installation

.1 Transport asphalt to site using trucks with clean metal boxes
.2 Cover materials to maintain temperature and eliminate contamination
.3 Loss of temperature from plant to job site not to exceed 10 degrees Celsius
.4 Place hot asphalt after base course is compacted as specified and free from foreign matter
.5 Check surface and correct any irregularities before starting compaction
.6 Where hand-spreading is necessary, do simultaneously with machine- spreading or immediately
afterwards to ensure adequate bond and to receive maximum compaction
.7 Make joints straight, clean, vertical, and free of broken or loose materials
.8 Where joints occur between new courses and existing previously laid down courses, cut back the existing course sufficiently to provide a clean, vertical surface
.9 Paint vertical faces of joints with a thin, continuous coating of bonding glue to provide a tight, waterproof bond
.10 Compact each paving course with approved rolling equipment to produce a smooth dense pavement surface and density =/> 97% of Marshall
.11 Roll with suitable equipment as soon as possible after placing the mixture once surface can bear roller without checking or undue displacement:
- Each pass of the roller is to overlap pervious passes to ensure a smooth surface free of roller marks
- Keep roller wheels sufficiently moist to not pick up any material
- Carry out rolling in three close sequenced operations
- First rolling as close as possible to the paver, using steelwheel rollers. Do not operate roller at speeds exceeding 4.8km/hr
- Second rolling with pneumatic-tired compactors to follow the first rolling as soon as possible while the paving mix is still warm enough to result in the maximum specified density. Do not operate compactor at a speed exceeding 8km/hr
- Final rolling with tandem roller weighing not less than 8 tonnes, while paving mixture is still warm enough for added compaction and removal of roller marks
.12 Correct defective areas immediately to assure continuous bond appearance
.13 Hard tamper with hot tampers in areas not accessible to the rolling equipment to achieve a density equal to machine rollers

4.5.7 Finishing
.1 Finished pavement surface to meet profile and cross-section of +/- 6.0mm and be free from depressions or bumps exceeding 3mm as measure with a 3000mm straight edge
.2 Repair of excessive depressions by overlay feathered to existing surface is not acceptable
.3 Defective areas to be marked and saw-cut through full depth of asphalt. Remove material in defective areas, paint edges of saw-cut with thin continuous coating of bonding glue to provide a tight, waterproof bond with new asphalt placement
.4 Tamp edges directly adjacent to soft landscaping to provide clean finish. Traffic on finished surface is not permitted until pavement has cooled to atmospheric temperature
.5 Do not saw cut asphalt edges

4.6 Unit Pavers

4.6.1 Quality Control
.1 Provide samples of full-size unit pavers for each type and colour to the Parks & Urban Forestry Manager for review and approval prior to installation
.2 Submit product information sheet for each type of unit paver

4.6.2 Materials

.1 Unit Pavers

- Uniform in material, colour, and size and from one manufacturer.
- Size, shape, colour, and layout per drawings

Pre-cast concrete pavers to conform to CSA A231.1-14/A231.2-14.
Interlocking pre-cast concrete pavers to conform to CSA A231.1- 14/A231.2-14
Burned lay bricks to conform to CSA A82-14 and ASTM C902-15
Flagstone pavers to conform to CSA A231.1-14/A231.2-14. Size, shape, colour and layout per drawings

.2 Granular Base Course

-Place granular base, in unfrozen condition, to minimum compacted thicknesses indicated on the drawings, within 15mm of design grade and cross-section and with maximum variation of 10mm in 3000mm. Place in maximum 15mm loose lifts; compact each lift to minimum 98% of standard Proctor density at optimum moisture content, plus or minus 1%; add water or aerate as required.

.3 Leveling Course

- Hard, durable, crushed stone particles, free from clay lumps, cementation, organic material, frozen material, and other foreign materials

Sieve	Percent Passing by Weight
9.50mm	100%
4.75mm	80-100%
2.00mm	50-80%
0.425mm	10-50%
0.075mm	0-10%

.4 Filler Sand

- Polymeric Sand to conform with ASTM C144-11, hard and durable, angular particles, free from clay lumps, cementation, organic material, frozen material, and other foreign materials

Sieve	Percent Passing by Weight
4.75mm	95-100%
1.18mm	50-95%
0.60mm	25-50%
0.30mm	10-30%
0.75mm	0-10%

.5 Edging

- SnapEdge, PaveEdge, or equivalent

.6 Layout

- Establish and maintain line and grade controls using appropriate survey personnel and equipment
- Contractor is responsible for layout accuracy
- Establish the layout and depth of the unit paving required accurately per drawings or specifications

.7 Installation

- Leveling Course

Spread leveling course to depth per details
Correction to variations for leveling course material in subgrade or granular base is not permitted
Compact and adjust water content to meet the following requirements:
Density test results minimum 98% of Standard Proctor Density

Water contents within the range of optimum water content +/- 1%

- Unit Pavers

Ensure leveling course is dried to 4-8% moisture content prior to placement
Install unit paving
Saw cut units accurately without damaging edges. Cut unit dimension less than 1/3 of original dimension is notpermitted
Install pavers with butt joints as specified and not exceeding 3mm
Tamp down and level pavers are true to grade and free of movement. For vehicular traffic surfaces, tamp and level pavers with rubber-tired roller
Fill spaces between pavers by sweeping infill sand as per manufacturer's instructions
Pass mechanical plate vibrator on sand cushion over surface course to achieve compaction of sand in joints
Surface of finished pavement is required free from depressions exceeding 3mm as measured with 3000mm straight edge
Sweep surface clean

.8 Finishing

- Abut unit pavers flush with adjacent materials
- Foot or vehicular traffic on or adjacent to unit paver installation areais not permitted until final adjustments are complete

4.7 Granular Surfaces

4.7.1 Materials

.1 Crusher Dust

- Sound, hard, durable crushed aggregate free from shale, clay, organic fines, and debris. When tested according to ASTM Designation C135, Method for Sieve Analysis, the material shall meet the following gradation requirement. Submit sieve analysis, Proctor curve, and CBR for Parks & Urban Forestry Manager review

Sieve Designation	Percent Passing by Weight
5.0mm	100%
2.2mm	63-73%
0.90mm	40-50%
0.40mm	25-35%
0.16mm	13-21%
0.071mm	8-14%

.2 Installation

- Place crusher dust, blade smooth, and compact to a minimum 98% of standard Proctor density
- Water contents within the range of optimum water content plus or minus 1%
- Minimum compacted granular thickness: as noted on details. Place lifts not exceeding 100mm. Do not mix base course with underlying materials
- Add and mix water to obtain optimum water content, if required. Watering and rolling should be controlled to prevent pumping of fine material to surface
- Compact and shape the surface to the lines and grades specified
- Completed, compacted surface must be free of ruts, irregularities, and foreign material. 15mm max. variation from design grades and adjacent finish grades

4.8 Fences

4.8.1 Quality Control

.1 Parks & Urban Forestry Manager to approve chain link construction

.2 Chain link to conform to CAN/CGSB-138.3-96

4.8.2 Materials

.1 Posts and Rails: galvanized steel pipe, schedule 40

.2 Gate Frames: galvanized steel pipe, schedule 40
Size: 41mm outside diameter (1 5/8")
Joints: electric welded; galvanize after welding
Hardware: galvanized malleable iron hinges, latch and latch catch with provision for padlock attached and operated from either side of installed gate

.3 Chain Link Fence Fabric
New, galvanized, chain link fencing, woven in 50mm mesh. Min. 0.5kg zinc galvanize per square metre of surface. Knuckled top and bottom. Continuous vertical
Gauge: 9 gauge; Vertical backstop fencing 6 gauge

.4 Tension wire: single strange, galvanized steel wire, 6 gauge

.5 Tensioner to be comprised of:
6mm x 25mm galvanized steel "L" bracket (100mm x 40mm). 9mm (3/8") eye bolt, 100mm long, c/w two nuts

.6 Tension bar: 5mm x 20mm min. galvanized steel

.7 Tie wire fasteners: single strand aluminum wire, 5mm diameter

.8 Tension bands: 3mm x 20mm min. galvanized steel

.9 Fitting and hardware: galvanized steel, malleable, or ductile cast iron. Post caps to provide waterproof fit, fasten securely over posts and to carry top rail

4.8.3 Finishes

.1 Chain link fabric galvanizing: CAN/CGSB-138.1-96 Grade 2

4.8.4 Layout

.1 Establish and maintain line and grade controls using appropriate survey personnel and equipment

.2 Approval of layout is required before excavation of footings

4.8.5 Excavation

.1 Excavate to depths, see details

.2 Remove loose material in excavations and compact with equipment suitable for the work

4.8.6 Installation

.1 Concrete Footings
- Excavation: bulb bottom of holes for corner, end, gate and intermediate posts at every 60m along fence line
- Brace posts in plumb position, true to line and elevation until concrete is cured
- Do not install fence fabric until concrete has cured a min. of 5 days

.2 Posts
- End posts: install end posts at end of fence
- Line post spacing: 3m apart, measured parallel to ground surface
- Straining posts: required where the distance between two end posts or end posts and corner posts exceed 150m. Straining posts are required equally spaced to max. 150m
- Corner posts: install corner post where change in alignment exceed 20-degree angle
- Gate posts: install gate posts on both sides of gate openings

.3 Centre Braces
- Required at the following locations, placed in centre of panel, parallel to ground surface:

Between end posts and nearest line post
Between gate posts and nearest line post
On both sides of corner posts
On both sides of straining posts
Between posts on backstops

.4 Top Rails
- Install between posts
- Fasten securely to terminal posts and secure waterproof caps

.5 Chain Link Fabric
- Install on inside face of backstop and home run fence
- Stretch fabric tightly to tension recommended by manufacturer. Fasten to end, corner, gate, and straining posts with tensionbar
- Secure fabric to posts, rails and tension wire with tie wires at 450mm intervals. Twist min. two times

.6 Tension Bar
- Install tension bar at each corner post, end post, and gate post. Thread through wire mesh
- Attach tension bar parallel to post with tension bands at the following spacing:
  Backstop: max. 300mm o/c to a height of 1830mm and max. 450mm o/c from 1830mm height and above
  Other: max. 450mm o/c

.7 Finish Grading
- Provide a smooth uniform gradient between posts
- Provide clearance between bottom of fence and ground surface as follows:
  Fencing: 75mm
  Backstops and home run fences: 20mm
  Gates: 40mm. Gate clearances are not to exceed 50mm

5 SOIL & FINISH GRADE

5.1 Drainage

5.1.1 Notify the Parks & Urban Forestry Manager and Director – Operations for inspection of:

.1 French drain, weeping tile, and filter cloth installation, before placing aggregate

.2 Play area drainage subgrade filter cloth layer installation before placing aggregate

.3 Panel drainage system installation before placing aggregate

.4 French drain and play area drainage construction

5.1.2 French Drain

.1 French Drain Materials

- Filter cloth: Nilex Nonwoven Environmental Geotextile: Nilex 4506E or equivalent
- Weeping tile: Polytubes, drain tile c/w filter sock or equivalent
- Drainage pipe: PVC pipe tested to ASTM D2729-11

.2 French Drain Installation

- Ensure sub-grade is smooth and free of debris
- Install filter cloth subgrade layer in sections and ensure successive filter cloth sheet overlap in flow direction. Tape seams with red tuck tape
- Install weeping tile per drawings, detail, and manufacturer's specifications, true to line and grade with inverts, smooth and free of sags or high points
- Install drainage aggregate up to filter cloth top per details
- Install remainder of drainage aggregate to finish grade
- Damage to filter cloth during weeping tile and aggregate installation is unacceptable
- Connect weeping tile to existing/proposed drainage system (if applicable)

5.1.3 Play Area Drainage

.1 Play Area Drainage Materials

- Drainage pipe: PVC pipe tested to ASTM D2729-11
- Filter cloth: Nilex Nonwoven Environmental Geotextile: Nilex 4506E or equivalent

.2 Play Area Drainage Installation

- Ensure sub-grade is smooth and free of debris
- Install filter cloth sub-grade layer in sections and ensure successive filter cloth sheet overlap in flow direction. Tape seams with red tuck tape
- Ensure filter cloth edges to play edge have overlap to join filter cloth drainage aggregate later
- Install drainage aggregate
- Install filter cloth drainage aggregate layer in sections and ensure successive filter cloth sheet overlap in flow direction. Tape seams with red tuck tape
- Tape seams with red tuck tape
- Install play surfacing

5.1.4 Panel Drainage

.1 Panel Drain Materials

- Nilex Multi-Flow or equivalent
- Very coarse sand: consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material, and other foreign or deleterious materials
- Gradations: within limits specified when tested to ASTM C136/C136M-14 and ASTM C117-13. Sieve sizes to CAN/CGSB- 8.1

Sieve	Percent Passing by Weight
4.75mm	100%
2.36mm	95%
0.595mm	5%
0.300mm	1%

.2 Panel Drainage Installation
- Install panel drainage system per drawings, details, and manufacturer's specifications

5.1.5 Swale Drainage

.1 Swale Drainage Installation
- Ensure sub-grade is smooth and free of debris
- Install one layer of filter cloth
- Secure fabric per details or to timber with 75mm long deck screws and washers at 1800mm intervals.
- Tape seams with red tuck tape
- Lay and secure fabric in sections
- Install drainage aggregate
- Install second layer of filter cloth. Lay and secure cloth in sections. Tape seams with red tuck tape

5.1.6 Drainage Aggregate

.1 Washed Stone Aggregate requirements: 19mm washed, crushed, angular stone, hard, durable angular particles, free from clay lumps, cementation, organic material, frozen material, and other foreign materials

.2 Gradation within limits specified tested to ASTM C136. Sieve sizes to CAN/CGSB-8.1:

Sieve Size	Percent Passing by Weight
25mm	100%
19mm	91%
12.5mm	16%
9.5mm	5%
4.75mm	3.5%
2.36mm	3.5%
0.60mm	3.2%
0.075mm	1.4%

.3 Layout
- Establish and maintain line and grade controls using appropriate survey personnel and equipment
- Contractor is responsible for layout accuracy

.4 Excavation
- Excavate to lines, grade, and elevations per drawings
- Remove waste material from trench before installing filter cloth
- Establish smooth surface at the bottom of trench to permit close contact between filter cloth and prepared surface

5.2 Site Preparation

5.2.1 Eliminate uneven areas and low spots from areas that have been rough graded. Ensure positive drainage in accordance with grading plans. Notify the Parks & Urban Forestry Manager of grading problems before proceeding.
- Remove debris, roots, branches, stones in excess of 50mm diameter and other extraneous materials. Remove subsoil that has been contaminated with oil, gasoline, calcium chloride, or other undesirable chemicals.
- Dispose of removed materials off-site on a daily basis and at a location approved by local officials

5.2.2 Cultivate all areas, which are to receive topsoil, to a depth of 100mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted the

subgrade

5.2.3 Do not damage structures, membranes, fabrics, gravel or other materials adjacent to or below landscaped areas

5.3 Soil Tests & Materials

5.3.1 Soil Tests

.1 Conduct soil tests of topsoil and planting mix, including stripped topsoil intended for reuse on site, as required to determine recommended soil amendments and fertilizer compositions for seeding, sodding, and planting. Samples shall be taken in accordance with recommendations of approved testing laboratory. Testing regimen as follows:
- PSA-2 (Particle size analysis)
- C-TOT-ORG (organic carbon)
- SAL-DETAIL+TGR (Detailed salinity)
- Soil Analysis Package 1 (for NPKS – with recommendations)

.2 Soil test shall be paid for by the Contractor and shall be conducted by an approved testing laboratory

.3 Submit a hard copy of soil test results and fertilizer recommendations to the Parks & Urban Forestry Manager for review

5.3.2 Materials

.1 Topsoil
- Free from subsoil, roots, grass, weeds, toxic materials, stones and foreign objects and shall be subject to analysis by a testing laboratory before use
- Topsoil shall consist of black topsoil, a fertile, friable, natural loam, neither heavy clay nor very light sand; 5-20% organic matter by weight; acidity value ranging from pH 6.0 to 7.5. Amend as recommended by soil tests.
- Topsoil to be screened and in a moist, not wet, condition when incorporated into the work
- Submit a one litre sample to the Parks & Urban Forestry Manager for approval prior to incorporation into the work

.2 Manure
- Well decomposed cattle or sheep excrement, rich in organic matter and humus containing balanced proportions of nitrogen, phosphorus, and potash
- Reasonably free of living vegetation, weed seeds and couch grass or brome grass rhizomes
- In a pulverized, friable condition, not containing fresh or “green” manure, clay, silt, gravel, or foreign material

.3 Sand
- Homogeneous, sharp-grained; to approved sample

.4 Planting Mix
- 80% sandy loam topsoil, 20% compost or well-rotted manure; to approved sample

.5 Fertilizer
- Fertilizer type and formulation ratio: as recommended by soil tests

5.4 Installation

5.4.1 Do not spread topsoil until the Parks & Urban Forestry Manager has inspected subgrade

5.4.2 Spread topsoil with adequate moisture in uniform layers during dry weather over approved, dry, unfrozen subgrade, where seeding and planting is indicated

5.4.3 Bring topsoil to finish grade, taking mulching into account

5.4.4 Uniformly place topsoil or planting mix, as indicated, in maximum 150mm loose lifts to the following minimum compacted depths:

.1 100mm topsoil for seeded areas
.2 300mm planting mix for at grade planting beds
.3 Compact each lift to minimum 90% of standard Proctor density

5.5 Finish Grade

5.5.1 Remove stones, roots, grass, debris, and foreign non-organic objects from growing media

5.5.2 Manually spread topsoil around existing trees and at areas subject to damage by equipment

5.5.3 Find grade entire landscaped area to contours and elevations as indicated. Eliminate rough spots and
low areas to ensure positive drainage in accordance with the grading plants. Notify the Parks & Urban Forestry Manager of grading problems before proceeding

5.5.4 Find grade and loosen topsoil prior to seeding or sodding. Prepare loose friable bed by means of shallow disc or harrowing and subsequent raking. Roll lightly and rake wherever growing media is loose

5.5.5 Changes in existing grade around existing trees is not permitted. Notify the Parks & Urban Forestry Manager of any grade conflicts within the TPZ of an existing tree prior to proceeding with work.
Reference the City of Morden Tree Protection Policy (Appendix C)

5.5.6 Leave surface smooth and uniform, with a fine loose texture

6 PLANT MATERIALS

6.1 General

6.1.1 Comply with the current edition of the Canadian Nursery Landscape Association (CNLA) Canadian Standards for Nursery Stock. https://cnla.ca/training/standards-guides
References to this section include:
- Appendix B City of Morden Approved Species & Diversification Guidelines
- Appendix D ISA Nursery Tree Quality Specifications
- Appendix E ISA Strategies for Growing Container Nursery Stock

6.1.2 Quality Control

.1 Approval from the Parks & Urban Forestry Manager required for proposed plant material species and sizes

.2 Submit name of plant material, source and supplier, species and quantity before delivery of product to site

.3 Plant material must be rated with a plant hardiness of Zone 3b or hardier. Plant material that is not rated Zone 3b or hardier is not acceptable, unless agreed by the Parks & Urban Forestry Manager

.4 Provide to the Parks & Urban Forestry Manager, a Tree Watering Log from date of planting to date of project turnover

6.2 Plant Material

6.2.1 Requirements

.1 Plant material will be nursery grown in accordance with sound horticultural practices

.2 Plant material will conform to:
- Specified quantity, species, and variety
- Specified caliper or height
- Layout and spacing per drawings
- CNLA Standards for Nursery Stock

.3 Plant material will be free of or will not contain:
- Disease and/or insects; pre-existing damages resulting from diseases or insects is unacceptable
- Growth habits indicative of plant stress
- Loose, unstable, or disturbed root ball
- Invasive or unwanted species, including weeds
- Roots growing in a circular direction within the rootball (girdling)
- More than 25mm of soil on top of the main structural roots
- Physical damage, including sunscald, frost cracks, rodent damage, or other mechanical damage
- Die-back or tip-kill adversely affecting tree structure
- Included bark
- Sparse or under-developed foliage
- Indicators of nutrient deficiencies
- Excessive pruning or shearing that adversely affects the mature form
- Excessive scarring from previous physical damage, including damage from poor pruning practices
- Co-dominant, forked or damaged central leader

.4 Plants dug from native stands, woodlots, Christmas tree lots, orchards, or neglected nurseries and have not received proper maintenance are unacceptable unless inspected and approved prior to deliver to site

6.2.2 Substitutions

.1 Plant material species and/or size (smaller or larger) substitutions is prohibited unless written approval is obtained by Contractor prior to installation. Plant substitutions

must be of similar species and of equal size to those originally specified

6.2.3 Replacements

.1 During the construction, maintenance, and warranty period the project site is not to contain rejected plant material at any time. Remove and replace rejected plant material in a timely manner

6.2.4 Inspections

.1 Notify the Parks & Urban Forestry Manager 24 hours in advance for inspection and approval of plant material before planting and installation methods before and during planting procedures

.2 The Parks & Urban Forestry Manager reserves the right to conduct inspections of plant material at any time before, during or after planting and during the warranty and maintenance period

.3 Inspection and approval at any point does not preclude rejection later

6.2.5 Delivery & Storage

.1 During transport, protect plant material to prevent damage, including from frost, excessive heat, sun, and wind

.2 Damaged trunks, branches, and leaders are unacceptable. Damaged plant material will be rejected

.3 Keep plant material damp until planted

.4 Coordinate shipping of plants and site preparation to ensure minimum time lapse between transport and planting. If plant material cannot be planted within 4 hours of arrival on site, provide necessary protection to keep plants at optimum health

.5 Keep roots moist and protected from sun, wind, and mechanical damage

.6 Protect root balls against sudden temperature changes and exposure to excess moisture

.7 Any action that may damage the integrity of the root ball (e.g. such as dropping, dragging at any time during handling) is not acceptable

.8 If plants cannot be planted the same day of arrival to site, store plants in an area protected from construction, sun and wind. Closely monitor plants watering needs

6.2.6 Wood Mulch

.1 Wood Mulch Material

- Mulch material shall meet or exceed the following criteria:
  Shall be clean and free from deleterious material
  Cannot be treated
  Shall be well-shredded to approved sample

.2 Wood Chip Mulch Installation

- Wood mulch is required to be installed after planting for planting beds and individual trees and shrubs
- 100mm minimum mulch depth, including uniform compaction
- Install mulch immediately after planting, away from tree trunk/ main stems per details
- Compact mulch by spraying gently with water

.3 Wood Mulch Approval

- Approval from the Parks & Urban Forestry Manager is required for proposed mulch
- Submit name of mulch material source and supplier before delivery to site
- Submit, if requested, a 1 litre sample of mulch for review and comment/approval before delivery to site

6.2.7 Water

.1 Potable and free of minerals detrimental to plant growth

6.2.8 Tree Watering Bag

.1 Plastic tree watering bags with a slow drip hole(s) water release system, specifically

designed to water establishing trees. Water should release over several days, not within a few hours

.2 Shall be the appropriate size and model for the size and type of plant, based on manufacturer's specifications

6.2.9 Tree Support (Container Stock Only)

.1 Pressure-Treated Wooden Post, 50mm diameter, 1800 to 2400mm long, clean, straight

.2 Tie material is to be flat woven polypropylene (Arbortie by Deeproot Green Infrastructure)

.3 Locate tree support upwind of prevailing wind or up-slope for trees on slopes

.4 Install tree support per detail

.5 Remove plant supports following one growing season

6.3 Plant Execution

6.3.1 Utilities & Setbacks

.1 Locate and clearly flag or mark underground utilities and irrigation mainline within 5 metres of proposed planting sites

.2 Unless otherwise approved by the Parks & Urban Forestry Manager, trees shall be set back the following minimum distances from the centre of the tree:
- 1.0m-1.5m: walkways
- 2.0m: roadways, street curbs
- 3.0m: fire hydrants, manholes, stop sign face.
- 4.0m: light standards
- 4.5m: entrances of driveways, walkways and alleyways
- 6.0m: hydro poles, overhead lines
- 10.0m: roadways intersections

.3 Set shrubs back a minimum distance equal to one half of shrub spacing at shrub bed perimeters

6.3.2 Excavation

.1 B&B Tree Material: Excavate planting hole using tree auger with a tapered bit, appropriate dimension for root ball size, and planting requirements per details

.2 Container Grown Stock: Excavate planting hole using appropriate equipment for container size and planting requirements per details. Auger excavation is not permitted

.3 Tree Spade Material: Dig tree hole with same mechanical equipment as used to transplant tree spade plant material

.4 Scarify wall of planting holes to 150mm before installing plant material. Remove excess soil and water from planting hole before placing tree

.5 Excavations left unattended by the Contractor or that are further than 5 metres away from where the Contractor is presently working, are required to be covered and marked

.6 Excavation and planting procedures are not permitted during extreme weather conditions including high moisture, high temperatures, high winds, sub-zero temperatures

6.3.3 Planting

.1 Install plant material in centre of planting hole, plumb, per drawings
- Consider existing subgrade soil conditions and further settlement of newly planted material at this stage ofplanting
- Water each plant thoroughly to ensure entire root ball is saturated immediately after planting

.2 Balled and Burlapped (B&B) plant material

- Examine root ball and, if necessary, remove excess soil from top of structural root
- Place top of structural root at finished grade (tolerance: +/- 25mm), allowing for future settlement
- If tree location is in heavy clay soil, install main structural root 50mm above finished grade (tolerance: +/-25mm)
- Install root ball on undisturbed/compacted subgrade. Place topsoil at edges of excavation to support root ball
- Place planting soil around root system in layers of 150mm, eliminating air voids
- When planting soil is installed up to half the root ball height, cut ties, cut and remove the top 1/3 of burlap and wire basket, ensure 2 lacing loops are left intact and folded down
- When 2/3 of planting soil has been placed, fill hole with water, allowing the water to settle the soil into all air voids
- Do not complete backfill until water has completely penetrated soil. Complete backfilling
- Do not cover top of root ball with soil
- Fill tree watering bag immediately after planting, if applicable. Water sufficiently to ensure entire root ball is saturated immediately after planting

.3 Container Grown Stock plant material
- Remove container
- Remove any soil on top of the main structural root
- Do not plant if girdling roots are apparent
- Prune and/or straighten girdling roots before planting
- Install root ball on undisturbed/compacted subgrade, ensure root-ball is installed on centre in tree well.
- Place topsoil at edges of excavation to support root ball
- Position top of main structural root flush with finished grade
- Place planting soil and compact firmly around plant. Do not cover top of root ball with soil
- Fill tree watering bag, immediately after planting, if applicable. Water sufficiently to ensure entire root ball is saturated immediately after planting

.4 Tree Spade plant material
- Using hydraulic tree spade, dig plant material with a firm root system in diameter and depth to ensure successful relocation of the plants
- Dig tree hole with same mechanical equipment and size used to dig plant material
- Scarify top half of planting hole to 150mm depth
- Install tree plumb and per drawings
- Backfill crevices with planting soil, water immediately withto ensure saturation of backfilled soil
- Repeat until soil is flush with finished grade; water thoroughly

6.3.4 Pruning

.1 Postpone pruning of trees, where heavy bleeding may occur, until in full leaf. Do not prune Elm trees during the annual pruning ban from April 1 to July 31

.2 Prune dead, diseased, damaged, and rubbing branches

.3 Remove projecting stubs back to branch collar

.4 Prune suckers from the base and trunk of trees

.5 Avoid flush cuts, locate the bark ridge and branch collar

6.3.5 Plant Bed Edging

.1 Edging is required for planting beds

.2 Trim planting bed edge with sharp, flat spade or edging tool

.3 Cut continuous shape per drawings

.4 Remove excess material before placing mulch

6.3.6 Identification Materials

.1 Remove other nursery identification materials at time of planting

.2 Remove plant identification tags at project turn-over

6.4 Notification of Tree Planting Completion

6.4.1 The Parks and Urban Forestry Manager maintains a Tree Inventory for all trees located on City property. Therefore, notification by the contractor to the City shall be given upon completion of tree installation

6.5 Warranty

6.5.1 The Contractor warrants plant material will remain acceptable until Final Acceptance Certification is received

6.5.2 The Parks & Urban Forestry Manager reserves the right to extend the Contractor's warranty responsibilities for an additional period of time if, at the end of the initial warranty period, leaf development and growth are questionable or the plant shows signs of stress. The length of the additional warranty period will be determined by the Parks & Urban Forestry Manager

6.5.3 The Contractor warrants invasive or unwanted plant species will not be imported into the site with the plant material

7 TURF

7.1 Fertilizer

7.1.1 Apply fertilizer at least 6 days before seeding or sodding

7.1.2 For Seed, spread fertilizer uniformly with mechanical spreaders over entire area of topsoil at rate determined on basis of soil tests

7.1.3 For sod, apply approved fertilizer to topsoil areas at rate of 100kg per hectare or as recommended in soil test analysis results

7.1.4 Incorporate fertilizer thoroughly into upper 50mm of growing media

7.2 Seed Mix

7.2.1 All seed supplied by the contractor shall be Canada Certified No. 1 or Canada Certified No. 2 and meet the quality standards. The seed supplied shall be free of disease and mixed by percentage (%) of weight to meet the following blends or mixtures:

.1 Turf Areas:
- 40% Creeping Red Fescue
- 40% Kentucky Bluegrass
- 20% Turf-Type Perennial Ryegrass

.2 Sports Fields:
- 85% Kentucky Bluegrass
- 15% Turf-Type Perennial Ryegrass

.3 Natural Areas: Refer to Section 8.3 Native Grass and Seed mixes

.4 Wetland Areas: Refer to Section 8.3 Native Grass and Seed mixes

.5 Seed rate (broadcast): 4lbs/1000sq.ft. or 1.0 kilogram per 100 square metres

.6 Variations in seed mix design to be submitted to the Parks & Urban Forestry Manager prior to application for review and approval

7.3 Seeding

7.3.1 Preparation

.1 Remove debris, roots, branches, and stones in excess of 50mm diameter and other extraneous materials. Remove contaminated subsoil. Dispose of removed materials off-site at municipally-approved location

.2 Fine grade areas to be seeded. Eliminate uneven areas and low spots. Ensure positive drainage

.3 Prepare loose, friable seed bed by means of shallow disc orharrowing and subsequent raking

.4 Leave surface smooth and uniform with a fine loose texture

7.3.2 Seeding

.1 All areas to be seeded shall be harrowed once with a landscape harrow to a maximum depth of 50mm or hand scarified in small scale areas

.2 Fertilize: Apply fertilizer, if required, at least 6 days before seeding. Spread fertilizer uniformly with mechanical spreaders over entire area to be seeded at rate determined on basis of soil tests. Incorporate fertilizer thoroughly into upper 50mm of soil surface

.3 Seed shall be evenly applied with an approved mechanical seeder. Seeding shall be done in two operations at right angles to one another. Contractor to confirm method of seeding (broadcast or direct) with the Parks & Urban Forestry Manager prior to commencement of work

.4 Sow during calm weather (winds less than 10 km/h), using equipment suitable for area involved. Sow half of required amount of seed in one direction and remainder at right angles. Incorporate seed into soil to a maximum depth of 13mm simultaneously or within one hour after seeding operation. Mix carefully with light chain harrow or

wire rakes

.5 Apply enough water to ensure penetration of minimum 50mm

.6 Protect seeded areas against damage. Maintain protection until acceptance of seeded areas

.7 Reseed at 2 week intervals where germination has failed

7.3.3 Maintenance

.1 Keep soil moist during germination period and adequately water seeded areas until accepted by the Parks & Urban Forestry Manager

.2 Apply water to ensure moisture penetration of 50 to 100mm. Control watering to prevent wash-outs

.3 Cut grass when it reaches height of 100mm, and cut to a height of 65mm. Evenly distribute (do not remove) clippings which exceed 10mm in depth

.4 Maintain grassed areas free of weeds and disease

.5 Provide snow fence to protect seeded area if necessary

7.3.4 Acceptance

.1 Seeded areas will be accepted provided that:

- Seeded areas are properly established for the intended purpose and to the satisfaction of the Parks & Urban Forestry Manager and true to grade
- Turf is free of eroded or dead spots and reasonably free of weeds
- Seeded areas have been cut at least twice, the last cut being carried out within 24 hours of acceptance

.2 Areas seeded in fall will be accepted in the following spring, one month after start of growing season provided acceptance conditions are fulfilled

7.4 Sod

7.4.1 Standards

.1 Bluegrass and Fescue grass sod seeded and cultivated in a nursery field as turf grass crop. Containing max. 2% of other grass species or clover and max. of two broad leaf weeds within a $40m^2$ area

.2 20mm min. thickness, 25mm max. thickness of sod portion

.3 Sod with soil visible when mowed to 63mm (2.5") height is prohibited

.4 Composition:

- Min. 40% Kentucky Bluegrass
- Min. 30% Creeping Red Fescue
- Max. 5% Perennial Ryegrass

7.4.2 Delivery & Storage

.1 Schedule delivery to minimize site storage and sod placement delays

- Deliver sod to site within 24 hours of being lifted
- Transport, unload and store rolled sod on pallets only
- Do not unload small, irregular or broken pieces of sod

.2 Store and protect sod as required to preserve quality and health

- In wet weather allow sod to dry sufficiently to prevent tearing during installation
- In hot weather prevent sod from drying out
- Water sod as required to prevent loss of soil during installation
- Dried out sod will be rejected

7.4.3 Preparation

.1 Fine grade and loosen topsoil to achieve loose, friable bed

.2 Eliminate rough spots and low areas to ensure positive drainage

.3 Consolidate topsoil in sodded areas leaving surface smooth, uniform, firm and with fine, loosed texture

.4 Finish grade for paths crossing wales require grades 25mm below adjacent path,

downstream side

.5 Re-grade areas damaged during construction and remove weeds, stones, debris, and other foreign material in excess of 25mm diameter before sod placement

7.4.4 Installation

.1 Lay sod within 24 hours of being lifted

.2 Do not lay sod under freezing temperatures or on frozen or excessively wet soil

.3 Minimize trimming and waste

.4 Begin laying sod along the straightest edge

.5 Stagger joints

.6 Trim excess sod along perimeter of area with sharp edging tool

.7 Short pieces along edges are unacceptable

.8 Knit sod edges closely together

.9 Install sod on slopes in rows perpendicular to slopes

.10 Slopes of 1.75:1 to 5:1: Secure bottom three rows of sod at every third row following with wooden stakes

.11 Slopes steeper than 5:1: Secure each row of sod with wooden stakes. Use chicken wire if necessary

.12 Place wood stakes close enough to prevent sod from shifting, at intervals not exceeding 600mm

.13 Drive stakes flush with soil surface of sod

.14 Roll sodded areas lightly to provide contact between sod and soil

.15 Heavy rolling to correct irregularities in grade is unacceptable

.16 Tamp edges smooth and flush with surface of adjoining areas

.17 Water sod areas immediately after installation using irrigation system or other method, ensuring that erosion and compaction are not caused during watering

7.4.5 Protection

.1 Protect sod areas against damage and traffic using approved materials and methods.

.2 Remove protection after turf areas have been accepted by the Parks & Urban Forestry Manager

7.5 Hydro Mulching

7.5.1 The slurry mixture shall be mixed as per manufacturers recommendations and applied evenly over the prepared surface

7.5.2 Apply approved mixture of hydromulch and tackifier/binder with water and hydroseeder immediately following seeding operation

7.5.3 Water with fine spray, avoiding washing out of seed or hydromulch

8 CONSTRUCTED WETLANDS

8.1 General

8.1.1 A naturalization plan prepared by a Certified Agronomist (native grass area) and wetland biologist (wetland area) specializing in naturalized storm water retention basin design and installation is required

8.1.2 Naturalization work shall not commence until the Parks & Urban Forestry Manager has approved the naturalization plan

8.1.3 Naturalization plan shall contain the following:

.1 All physical features, existing and proposed, including vegetation, berm, contours, walls, fences, surface utilities, and paving

.2 All existing shrubs and trees, labelled by their common name, botanical name, and size

.3 The Contractor's proposed restoration approach for wetland, within the water (with a mix of wetland plants), and tall grass prairie and transition zones from water level (with a mix of grasses and forbs)

.4 Proposed site preparation and grading procedures for both wetland and native grass areas to ensure successful establishment of plant material

.5 Seed source(s) and seed analysis

.6 Wetland plant and seed source(s) and wetland plant and seed analysis

.7 Weed control management procedures

.8 Maintenance and protection procedures

8.1.3 Native tall grass seed mix design

.1 Planting plan to be based on local availability of seed, species establishment requirements, site range capabilities, seed germination properties, as well as the seedling characteristics, growth habit of individual native species and maintenance requirements

.2 Parks & Urban Forestry Manager to review and approve site drawings and site-specific information

8.2 Wetland Plants

8.2.1 Wetland plants will be endemic to the prairie wetland ecosystem and will have originated from areas of similar ecology to the project location

8.2.2 Design with a high level of diversity using seed as well as plant material. Select only donor location void of the presence of noxious weeds or invasivespecies

8.2.3 The wetland planting zone should include three separate zones with the following potential species:

.1 Wet Meadows / Low Prairie Zone

- Wild Mint / *Mentha arvensis*
- Water Horehound / *Lycopus Americana*
- Joe-Pye Weed / *Eupatorium purpureum*
- Marsh Aster / *Aster borealis*
- Wheat sedge / *Carex atherodes*
- Prairie cordgrass / *Spartina pectinate*

.2 Shallow Marsh Zone

- Baltic Rush / *Juncus balticus*
- Spike Rush / *Eleocharis spp.*
- River Bulrush / *Schoenoplectus fluviatilis*
- Water Sedge / *Carex aquatilis*
- Whitetop / *Scolochloa festucacea*
- Mannagrass / *Glyceria spp.*
- Water Plantain / *Alisma plantagoaquatica*
- Arumleaf Arrowhead / *Sagittaria cunceata*

- Water Smartweed / *Polygonum spp.*
- Gian Bur-reed / *Sparganium eurycarpum*

.3 Deep Marsh Zone
- Broad-leaf Cattail / *Typhalatifolia*
- Softstem Bulrush / *Schoenoplectus tabernaemontani*
- Hardstem Bulrush / *Schoenoplectus acutus*

8.3 Native Grass Seed

8.3.1 Seed sourced will be endemic to the tallgrass prairie ecosystem and will have originated from areas of similar ecology to the project location

8.3.2 Provide Certificate of Seed Analysis for each seed lot to confirm germination tests reported on the certificate indicate Pure Live Seed content. That meets or exceed Canadian Certified Seed Standards

.1 Ensure weed contamination meets acceptable levels and allow zero tolerance for undesirable, highly invasive, and/or noxious weed species. This includes, but is not limited to:
- Downy Brome
- Japanese Brome
- Smooth Brome
- Quack Grass
- Canada Thistle

.2 Weed seed counts shown in the seed certificate should be reported at the 0.01 present level

8.3.3 Native Tall Grass Seed Mix Design

.1 Species to be selected based on site and local availability of seed:
- Western Wheatgrass
- Northern Wheatgrass
- Green Needlegrass
- Awned Wheatgrass
- Slender Wheatgrass
- Big Bluestem
- Little Bluestem
- Switchgrass
- Sideoat Grama
- Purple Prairie Clover

8.3.4 Wet Meadow Grass Seed Mix Design

.1 Species to be selected based on site and local availability of seed:
- Northern Wheatgrass
- Western Wheatgrass
- Canada Wild Rye
- Slender Wheatgrass
- Awned Wheatgrass Ticklegrass
- Tufted Hairgrass
- Switchgrass
- Prairie Cordgrass
- Fowl Bluegrass
- American Sloughgrass
- Tall Managrass

8.4 Execution

8.4.1 Site Preparation

.1 Remove debris, roots, branches, stones in excess of 50mm diameter and other extraneous materials. Remove contaminated subsoil. Dispose of removed materials off-site at municipally approved location

.2 Fine grade areas to be seeded. Eliminate uneven areas and low spots. Ensure positive drainage

.3 In wetland areas, use extensive bathymetric contouring to provide a wide range of water depths for wetland plants to becomeestablished

.4 Deliver and place "A" Horizon growth medium for grassland areas and wetland buffer strip

.5 Deliver and place "B" Horizon growth medium for wetland planting areas

.6 Deliver and place topsoil blended with peat amendment

.7 Monitor in-situ topsoil for weed species and, if required, utilize a variety of weed management strategies (i.e. herbicide application, mechanical control, cover crop seeding) to prepare the site for seeding

8.4.2 Seeding

.1 Seed areas with method and at rate as recommended by supplier for each seed type

.2 Protect seeded areas against damage. Maintain protection until acceptance of seeded areas

.3 Reseed at 2-week intervals where germination has failed

.4 Provide cover crop seeding to bind topsoil in areas where erosion control is required

8.4.3 Maintenance

.1 Establishment Period

- Native Grass Areas: min. two growing seasons
- Wetland Areas: min. one growing season
- Keep soil moist during germination period and adequately water seeded areas until established
- Apply water to ensure moisture penetration of 50 to 100mm. Control watering to prevent wash-outs

.2 Native Grass Areas

- Integrated weed management programs should be developed and coordinated by a Certified Agronomist
- Provide targeted weed control on difficult to control broadleaf and grassy perennials using plant ecology for decision making to ensure good efficacy
- Conduct regular monitoring and evaluation with Certified Agronomist throughout the growing season to identify weak planting population and weeds
- Use evaluations to determine areas that require weed control and reinforcement with over seeding
- Reinforce plantings as required in the spring
- Conduct monitoring after the grasses have gone through min. one winter

.3 Wetland Areas

- Integrated weed management program should be developed and coordinated by a wetland biologist specializing in naturalized storm water retention basin design
- Remove emergent or standing vegetation and weeds from the ponds. Emergent vegetation are species such as cattail (*Typha sp.)*, bulrush (*Schoenoplectus sp.*), and bur-reed (*Sparganium sp.*)
- Visual inspection of pond should be done once per year to identify and disturbances (i.e. dying vegetation, abnormal flooding, etc.)
- Assess plants during peak productivity, typically from mid-July to early-August
- Monitor intervals of stormwater to confirm that increased levels are present following extreme rain events or during abnormally wet years
- Water levels should not remain above normal water level for periods longer than 30

days

.3 Water Levels

- Managed drawdowns are sometimes used to expose mudflats and shoreline, which allows the seeds of wetland plants to begin to germinate or existing vegetation to be cultivated. If a managed drawdown is required to improve a pond's state, it generally begins in early-June with some water returned by late summer if plants are responding well
- Some signs that may indicate the pond is not functioning properly include:
  - Water loss/drying
  - High rate of infilling with sediments
  - Subsidence/compression of wetland bottom
  - Elevated salinity
  - Toxicity
  - Lack of vegetation
  - Low plant diversity
  - Presence of harmful algae communities

.4 Algae

- Algae are an important and naturally occurring component of a healthy wetland ecosystem and they play a critical role in the exchange and balance of nutrients between the water column and the rest of the wetland vegetation
- Natural algal communities assist in the proper functioning of the system; when the ratio of nitrogen to phosphorus required for algal growth shifts out of balance, the ecosystem may instead become occupied by potentially toxic blue-green algae
- Algal growth reaches its maximum during the warm summer months. If large amounts of algae persist beyond these warm summer months it can be an indication that nutrient levels within the wetland are unbalanced and inquiries into the cause should be made.

9 MAINTENANCE & CONSTRUCTION COMPLETION / FINAL ACCEPTANCE CERTIFICATION

9.1 Landscape Maintenance & Warranty

9.1.1 Plant materials, turf, and other improvements are to be maintained and nurtured by the Developer and Contractor until Final Acceptance Certification by the Parks & Urban Forestry Manager. Acceptance will normally occur as a result of inspection following the second full growing season.

.1 plant materials and turf installation from May 1st through to June 30th will constitute the first growing season.

.2 plant materials and turf installation from July 1st through to September 30th will not qualify as the first growing season. Therefore, the subsequent growing season following a July 1st to September 30th installation will become the first growing season.

.3 the second growing season will be the subsequent next year following the first growing season. Completion of the second growing season will be defined as September 30th in the calendar year following the first growing season.

9.1.2 Where native vegetation is to be used for decorative landscaping purposes or as a component of a drainage system, acceptance by the Parks & Urban Forestry Manager [and City Engineer for drainage system components] will be in accordance with the Naturalization Plan as approved by the Parks & Urban Forestry Manager.

9.2 Construction Completion Certificate Procedures

9.3.1 Where approach 1.1.2.2 is agreed to, the Landscape Architect shall contact the Parks & Urban Forestry Manager to schedule the construction completion inspection. The Landscape Architect shall furnish the Manager with the approved Landscape Plan and shall identify any changes thereto.

9.3.2 The Parks & Urban Forestry Manager shall inspect the plant materials, turf, and other improvements. Should the Manager be satisfied as to materials and conditions, s/he shall issue the Construction Completion Certificate—which will start the warranty period.

9.3.3 Where approach 1.1.2.3 is agreed to, the Developer shall contact the Parks & Urban Forestry Manager to schedule the construction completion inspection. The Developer shall furnish the Manager with the approved Site Plan and shall identify any changes thereto.

9.3.4 The Parks & Urban Forestry Manager shall inspect the plant materials, turf, and other improvements. Should the Manager be satisfied as to materials and conditions, s/he shall issue the Construction Completion Certificate—which will start the warranty period.

9.4 Final Acceptance Certificate Procedures

9.4.1 Where approach 1.1.2.2 is agreed to, the Landscape Architect shall contact the Parks & Urban Forestry Manager to schedule the final acceptance inspection. The Landscape Architect shall furnish the Manager with the approved Landscape Plan and shall identify any changes thereto.

9.4.2 Where approach 1.1.2.3 is agreed to, the Developer shall contact the Parks & Urban Forestry Manager to schedule the final acceptance inspection. The Developer shall furnish the Manager with the approved Site Plan and shall identify any changes thereto.

9.4.3 The Parks & Urban Forestry Manager shall inspect the plant materials, turf, and other improvements. Should the Manager be satisfied as to materials and conditions, s/he shall issue the Final Acceptance Certificate.

9.4.4 The Parks & Urban Forestry Manager may extend the warranty period an additional growing season as a result of the conditions identified upon inspection and as specified below:

.1 for trees planted, the warranty period will be extended if one or more of the following occur:

- decline or dieback of lateral branches and/or loss of leaf area exceeds 50%;
- mortality rate exceeds 10% of the total number of trees planted;

- rootball requires disturbance [i.e. lift, raise, straighten] in more than 10% of the total number of trees planted;
- caliper size exceeds the maximum.

.2 For shrubs planted, the warranty period will be extended if one or more of the following occur:

- 50% or more of shrub plantings have not established rooting in planting areas;
- 50% or more of shrub foliage has been lost on more than 10% of the total number of shrubs planted.

.3 For turf, the warranty period will be extended if one or more of the following occur:

- unacceptable turf species [e.g. quack grass, fox tail] or groundcover exceeds 25% or more of the total area;
- unestablished turf area exceeds 25% of the total area;
- broadleaf weed composition is more than 25% of the total turf area.

Appendix A -

Detailed Drawings

CM1002-1 Coniferous Tree Planting

CM1002-2 Deciduous Tree Planting

CM1002-3 Spaded Tree Planting

CM1002-4 Ball and Burlap Planting

CM1002-5 Slope Tree Planting

CM1002-5 Shrub Planting

CM1003-1 Asphalt Path

CM1003-2 Concrete Path

CM1003 -3 Crusher Dust Path

CM1003-4 Crusher Dust Path w Curb

CM1003-5 Bench Bay Layout

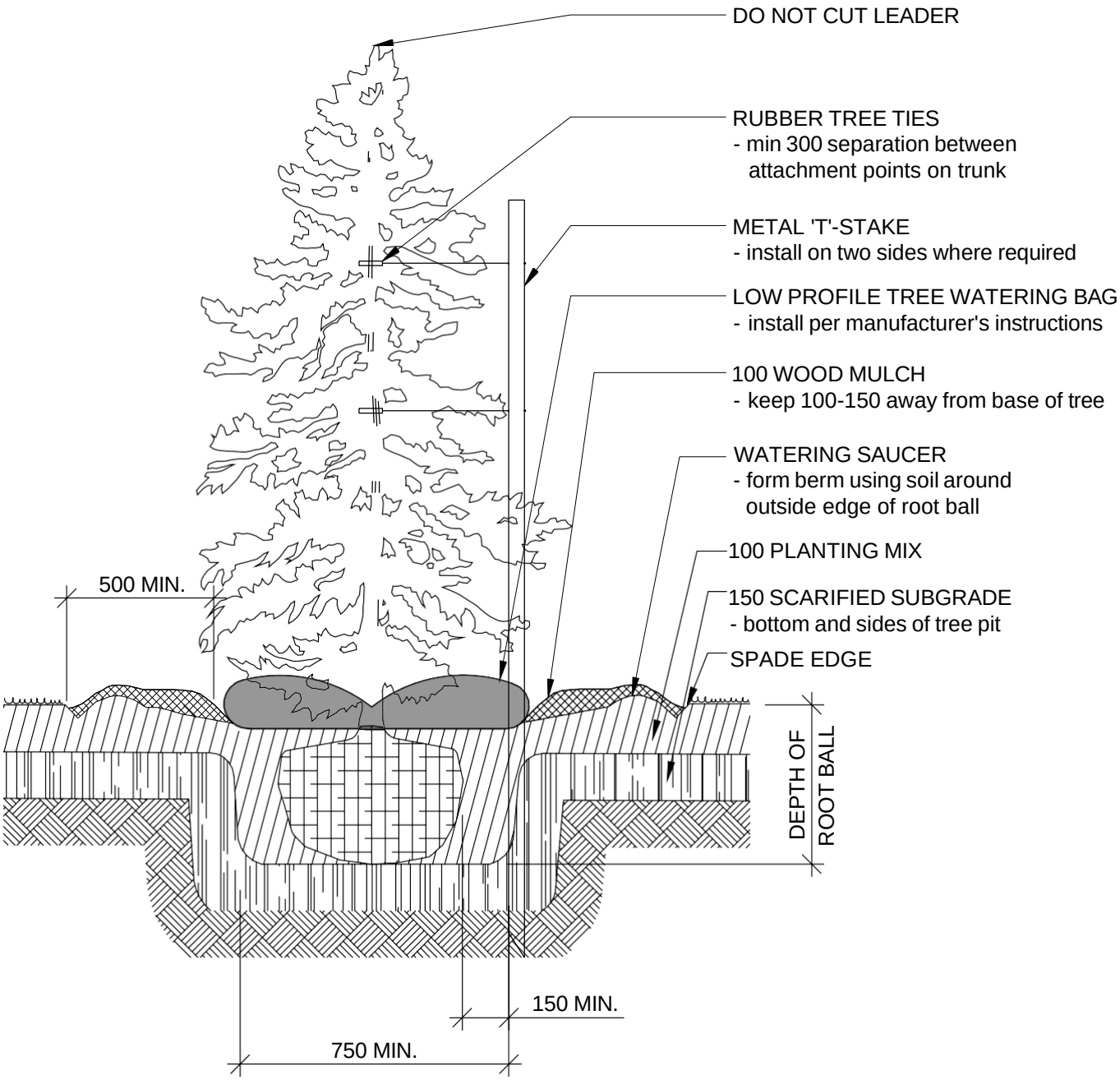
CM1003-6 Boulder Planting

CM1004-1 Timber Play Edge

CM1004-2 Concrete Play Edge

CM1004-3 Chain Link Fence

CM1004-4 Guard Rail End Post



The City of Morden

CONIFEROUS TREE PLANTING

CM1002-1

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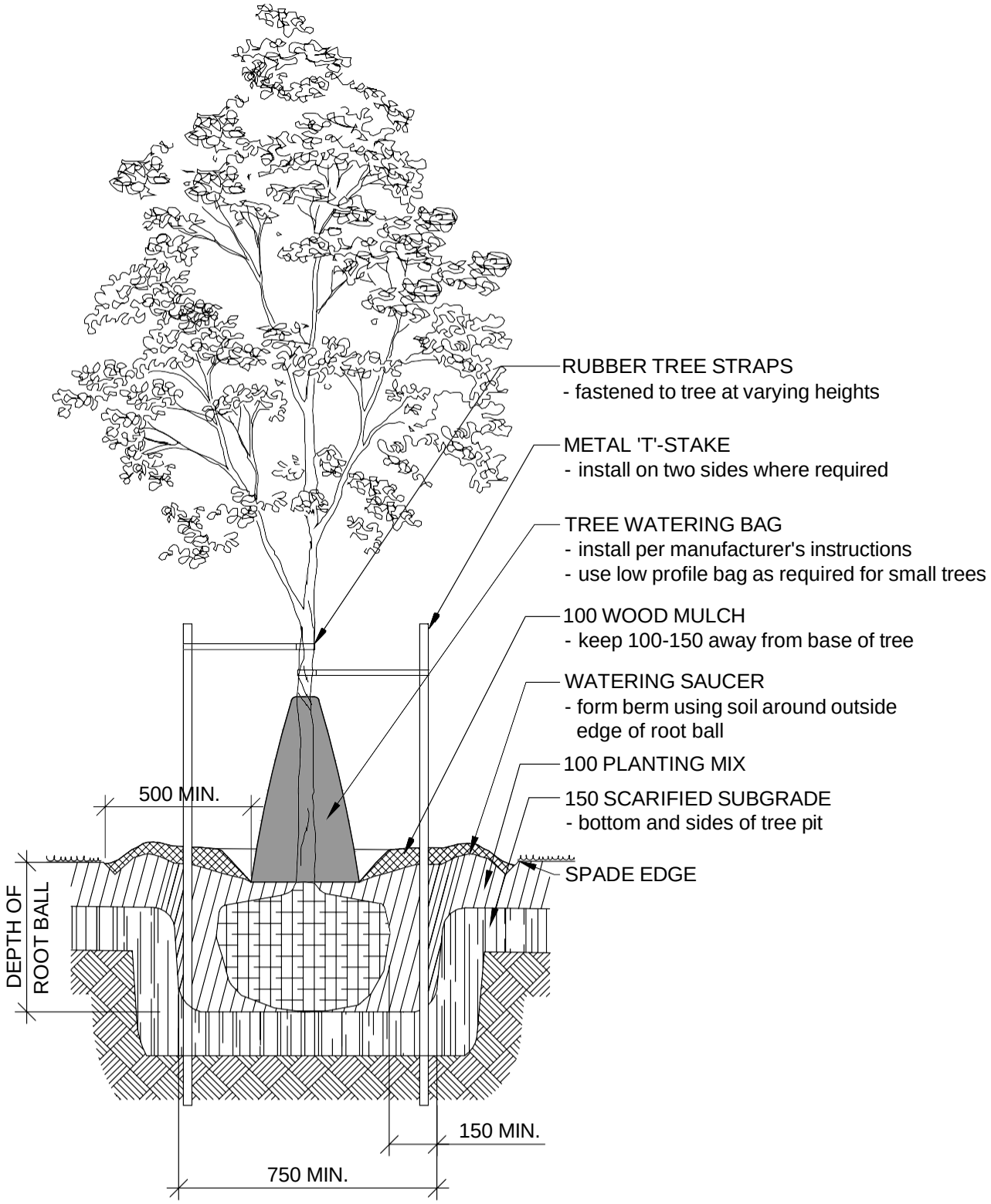

The City of Morden

DECIDUOUS TREE PLANTING

CM1002-2

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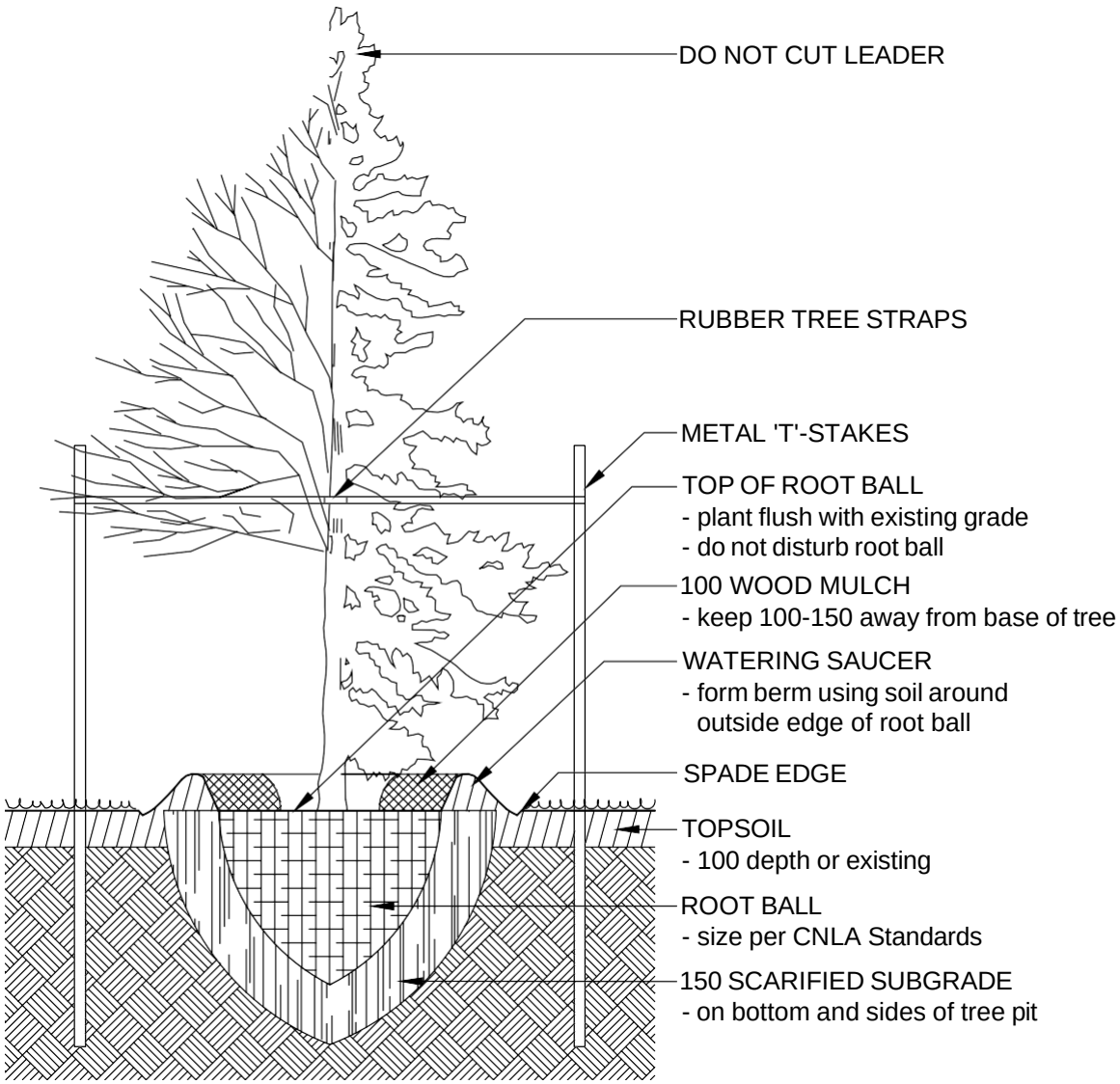

The City of Morden

CON./DEC. SPADED TREE PLANTING

DRAWING TITLE

CM1002-3

DRAWING NO.

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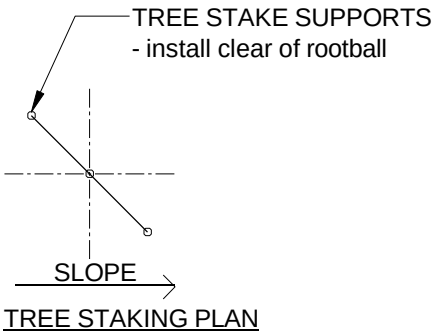
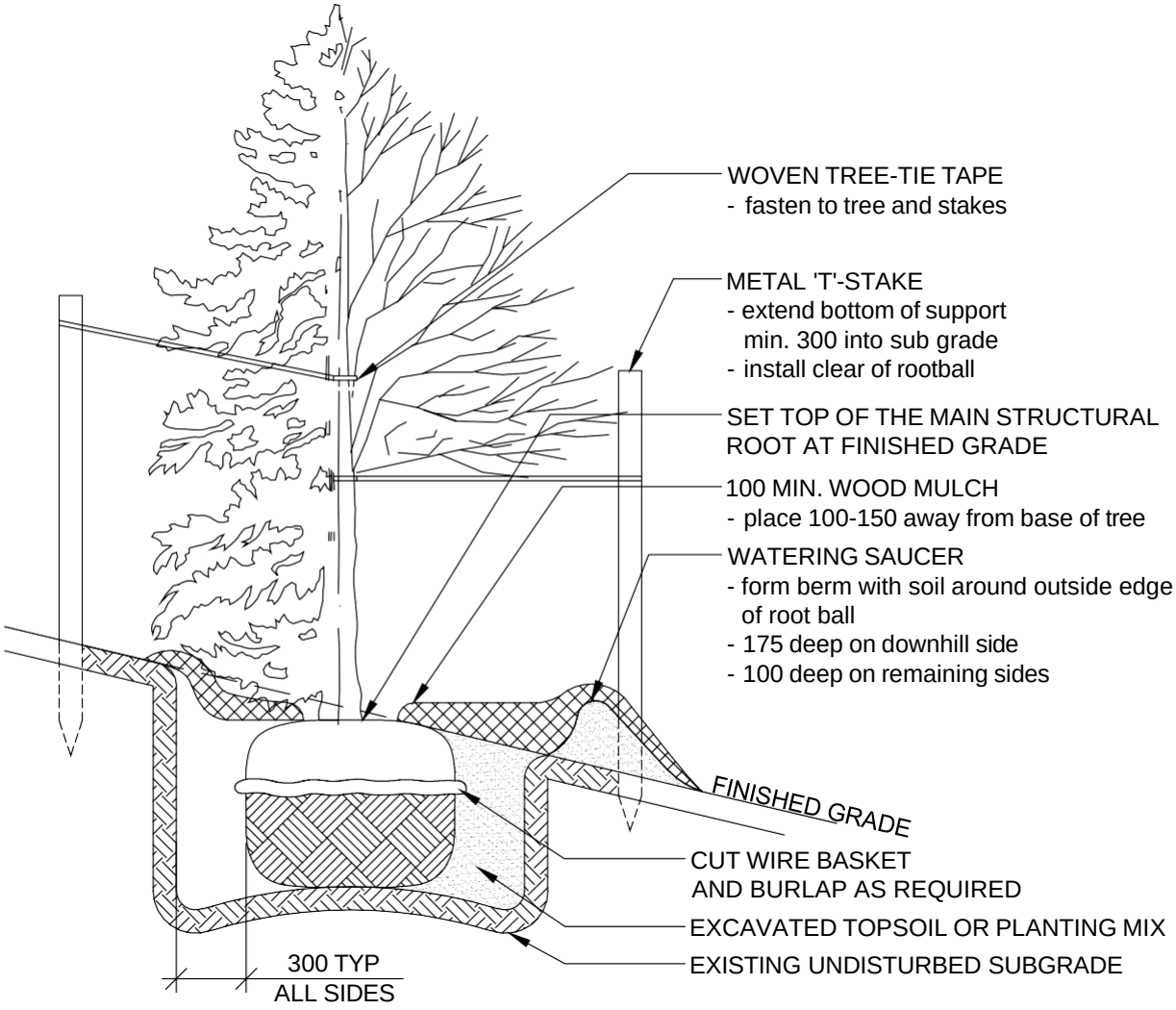


TREE STAKING PLAN



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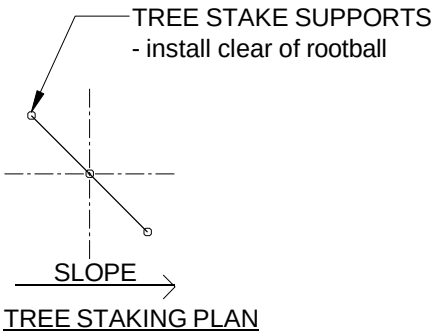
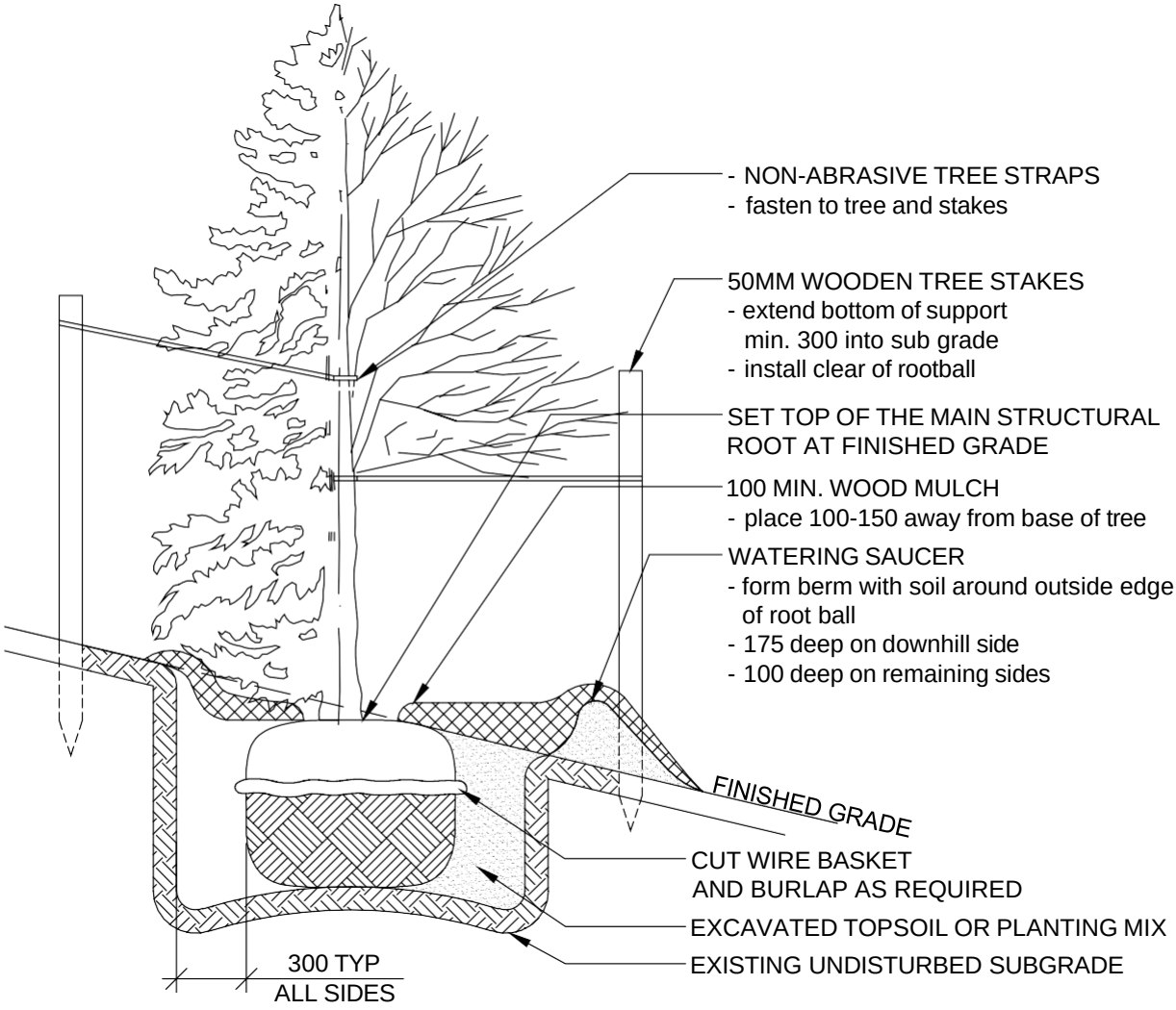


TREE STAKING PLAN



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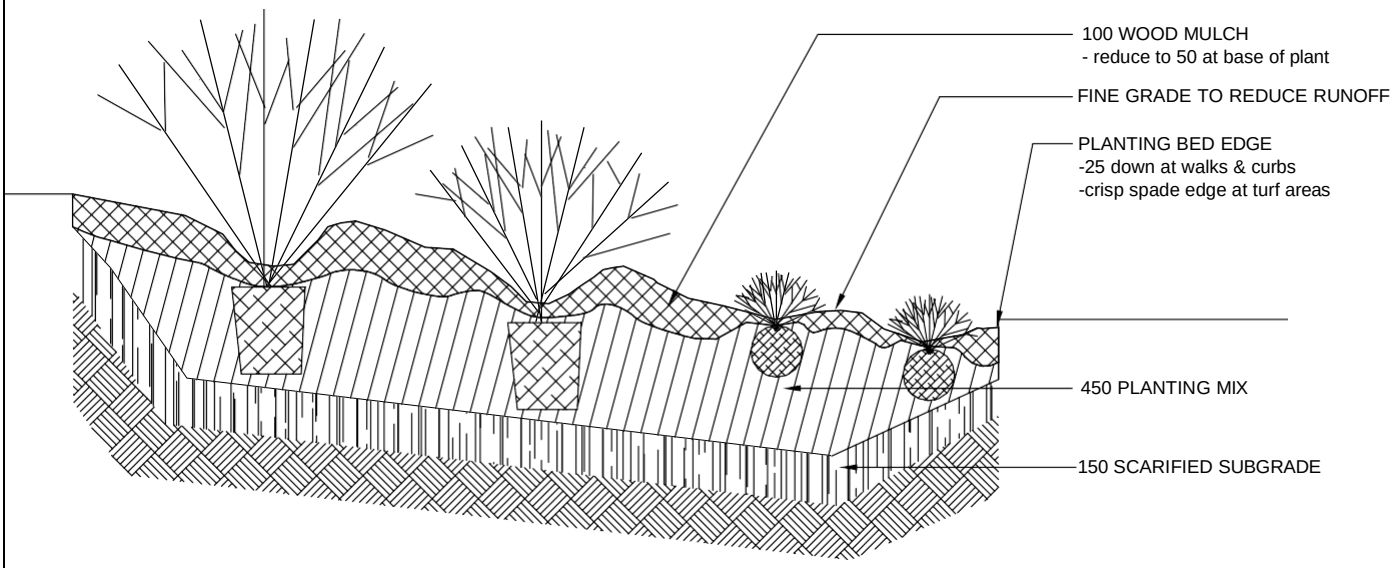

The City of Morden

SHRUB PLANTING

DRAWING TITLE

CM1002-6

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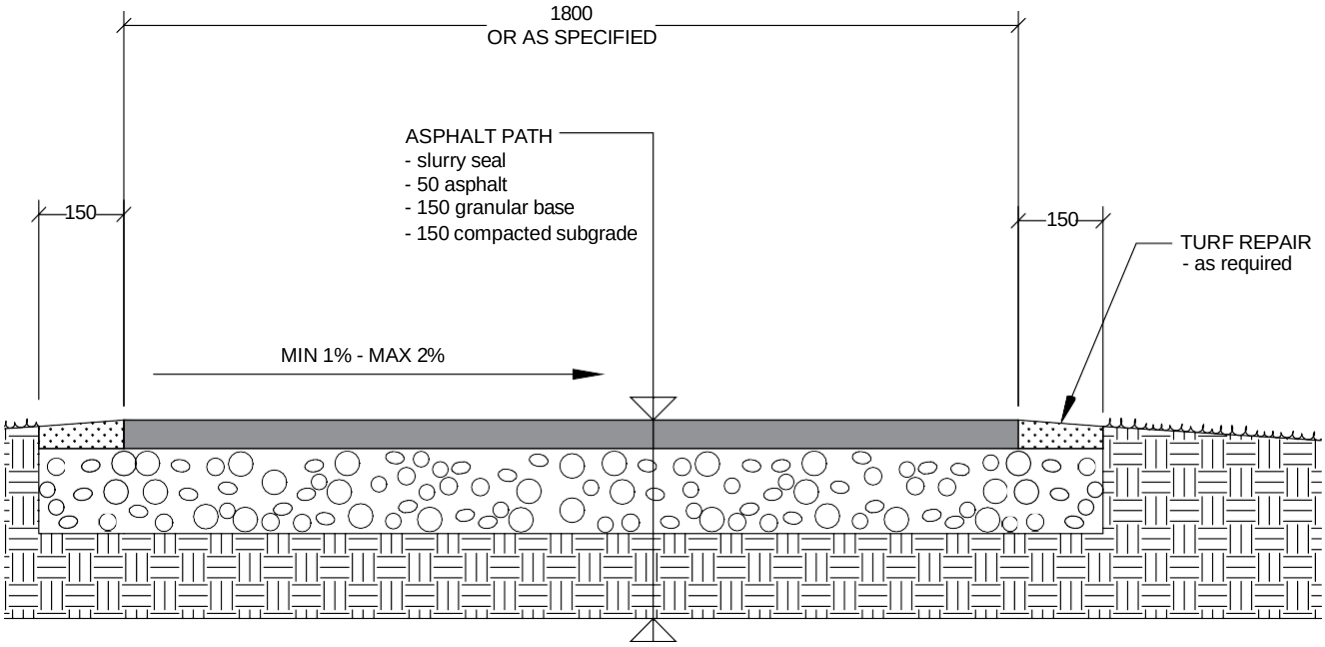

The City of Morden

ASPHALT PATH

DRAWING TITLE

CM1003-1

DRAWING NO.

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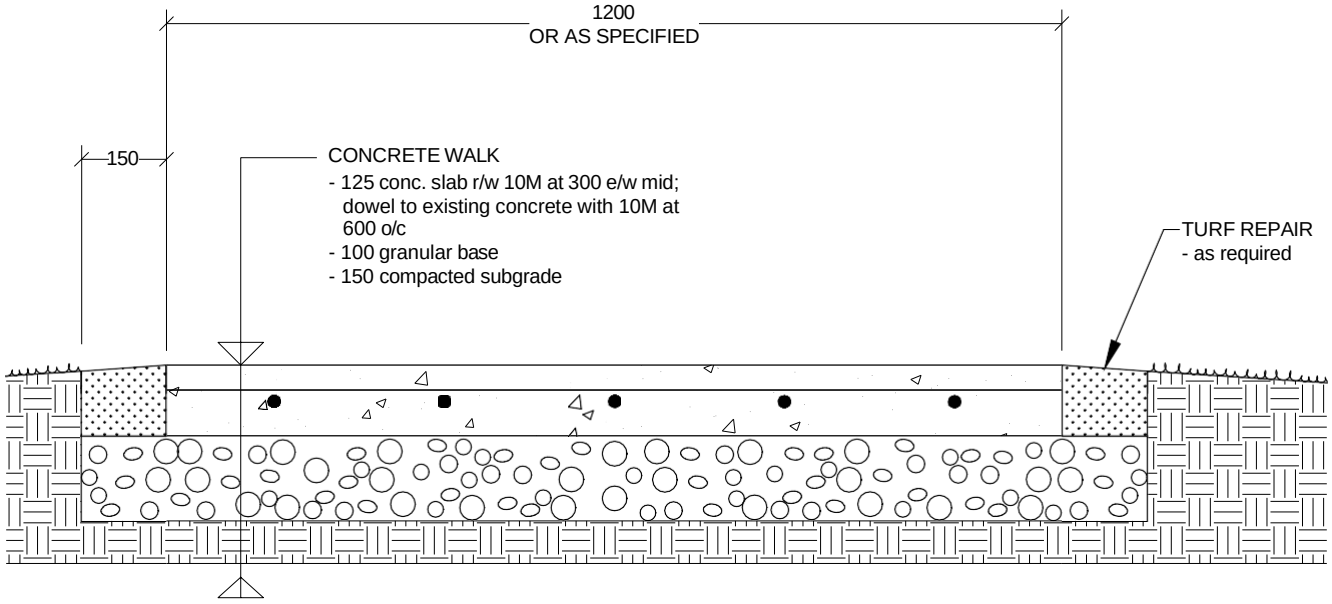

The City of Morden

CONCRETE WALK

DRAWING TITLE

CM1003-2

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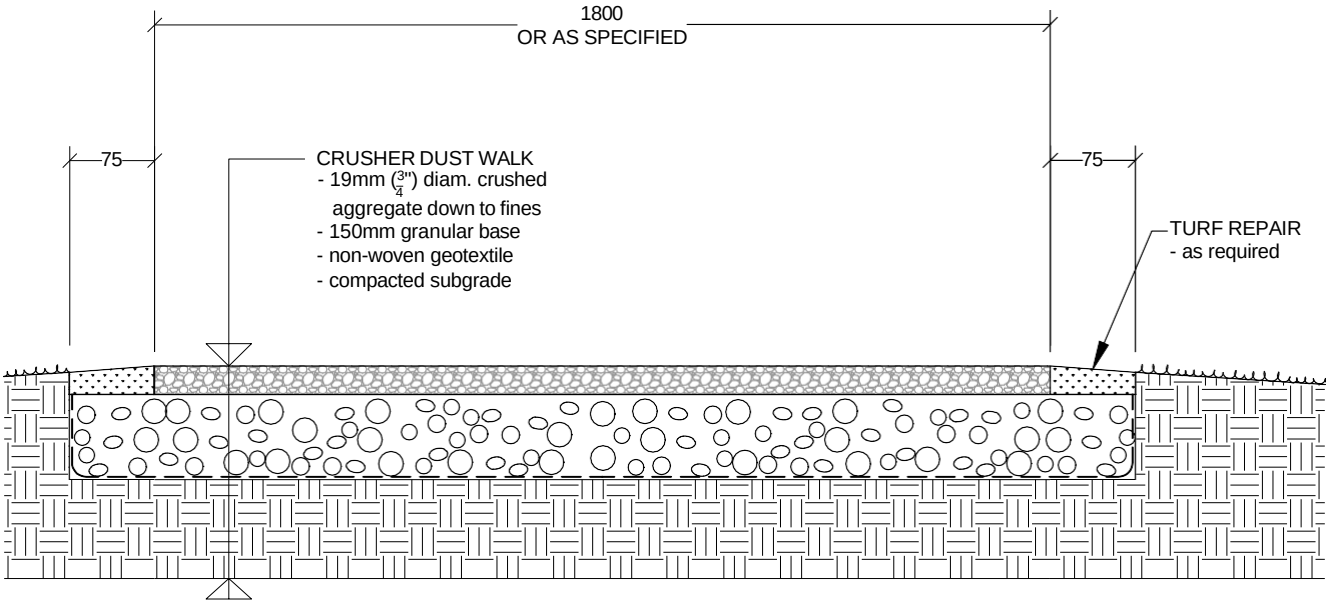

The City of Morden	CRUSHER DUST PATH				CM1003-3
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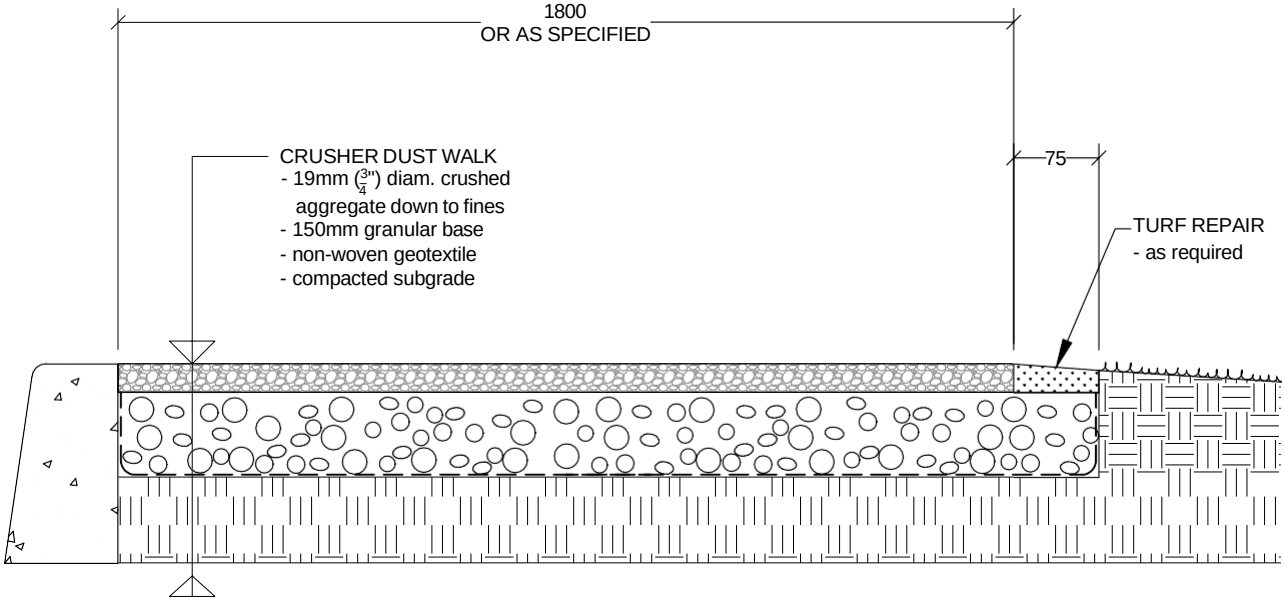

The City of Morden

CRUSHER DUST PATH WITH CURB

DRAWING TITLE

CM1003-4

DRAWING NO.

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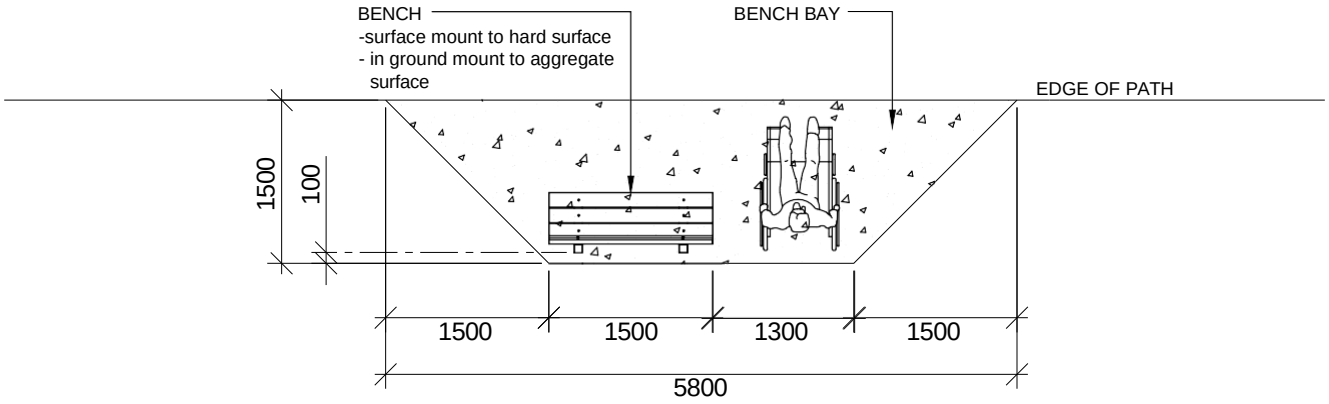

The City of Morden

BENCH BAY LAYOUT

CM1003-5

DRAWING TITLE

D R A W

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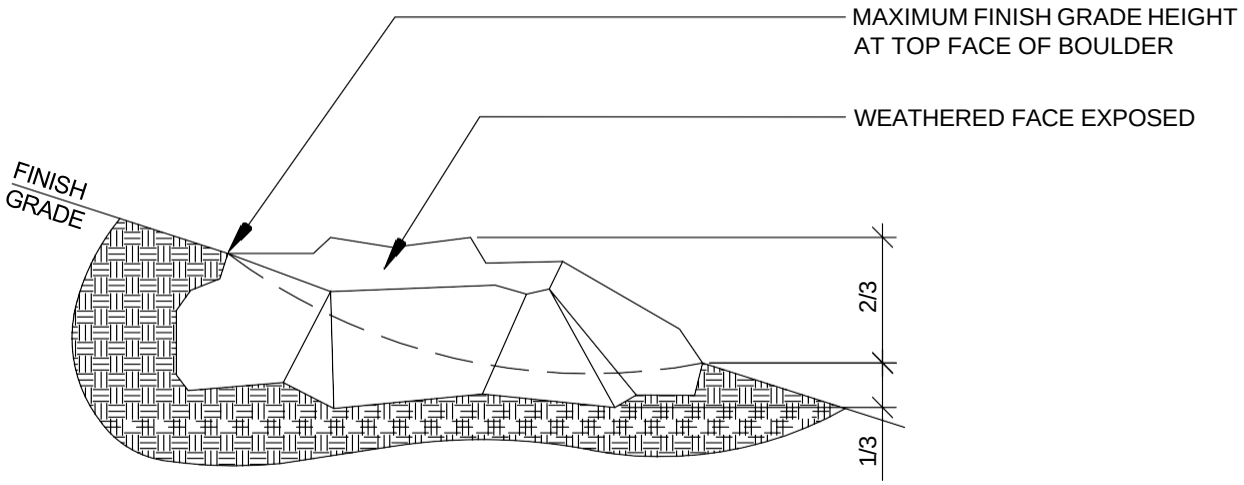
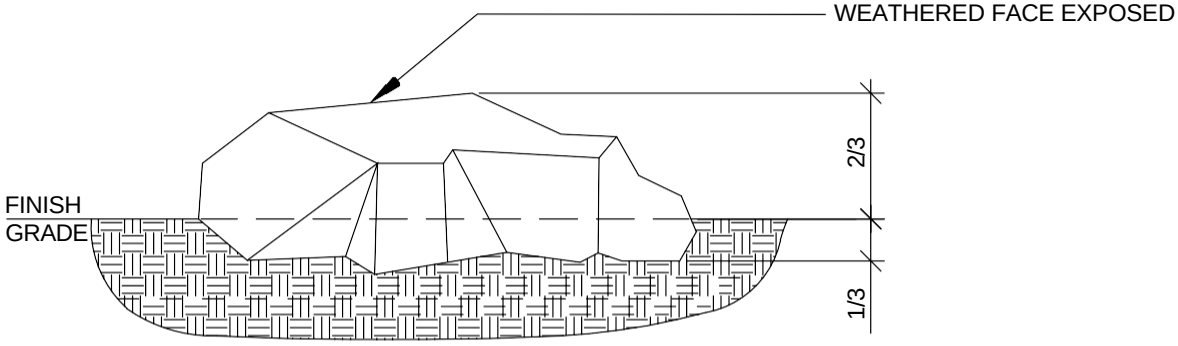


INSTALLATION ON A SLOPE



INSTALLATION ON FLAT GRADE

The City of Morden	BOULDER PLANTING			CM1003-6
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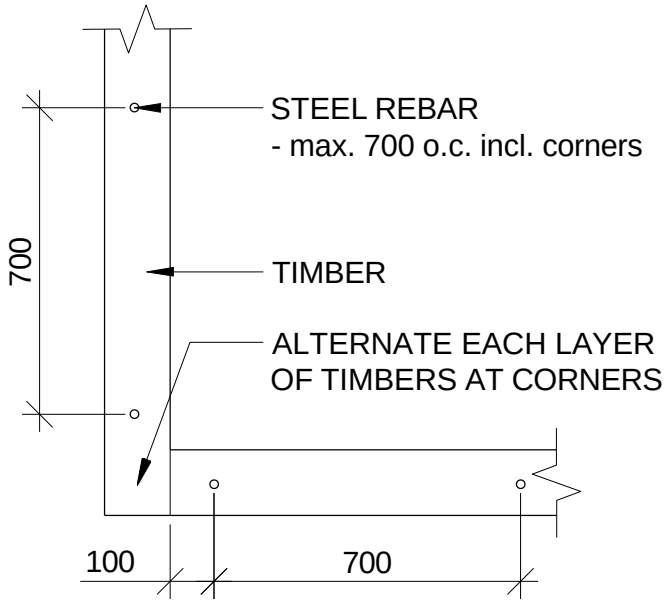
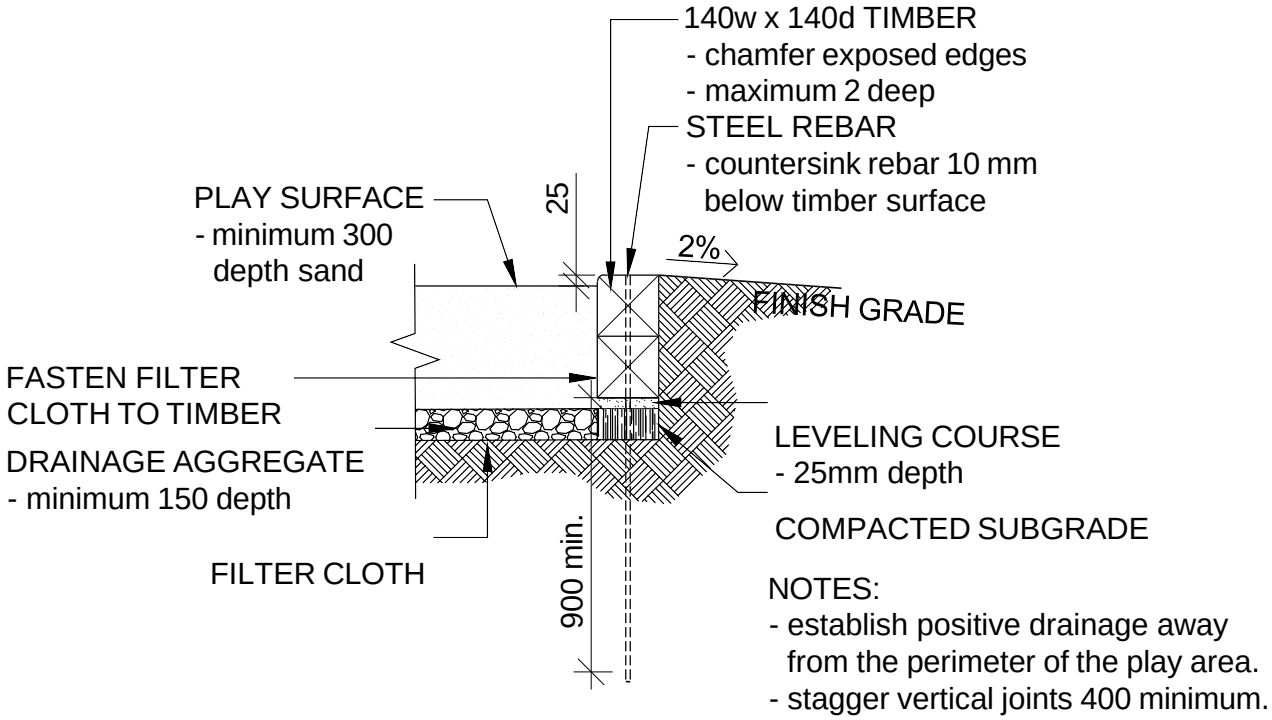


LAYOUT



NOTES:
- establish positive drainage away from the perimeter of the play area.
- stagger vertical joints 400 minimum.

The City of Morden	TIMBER PLAY EDGE	CM1004-1

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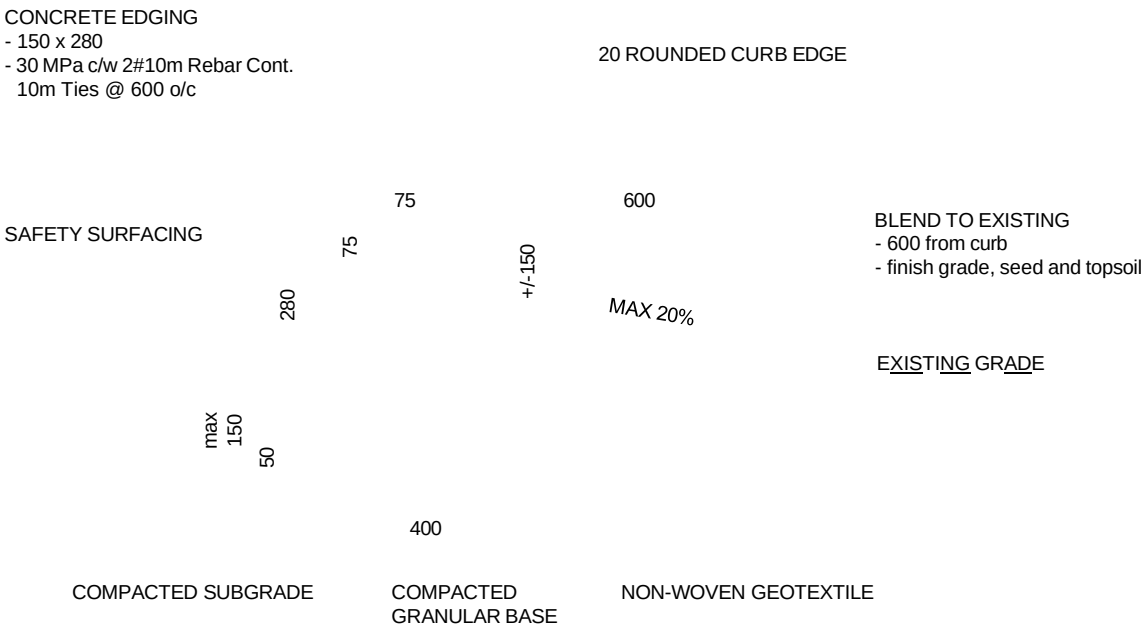

CONCRETE PLAY EDGE

CM1004-2

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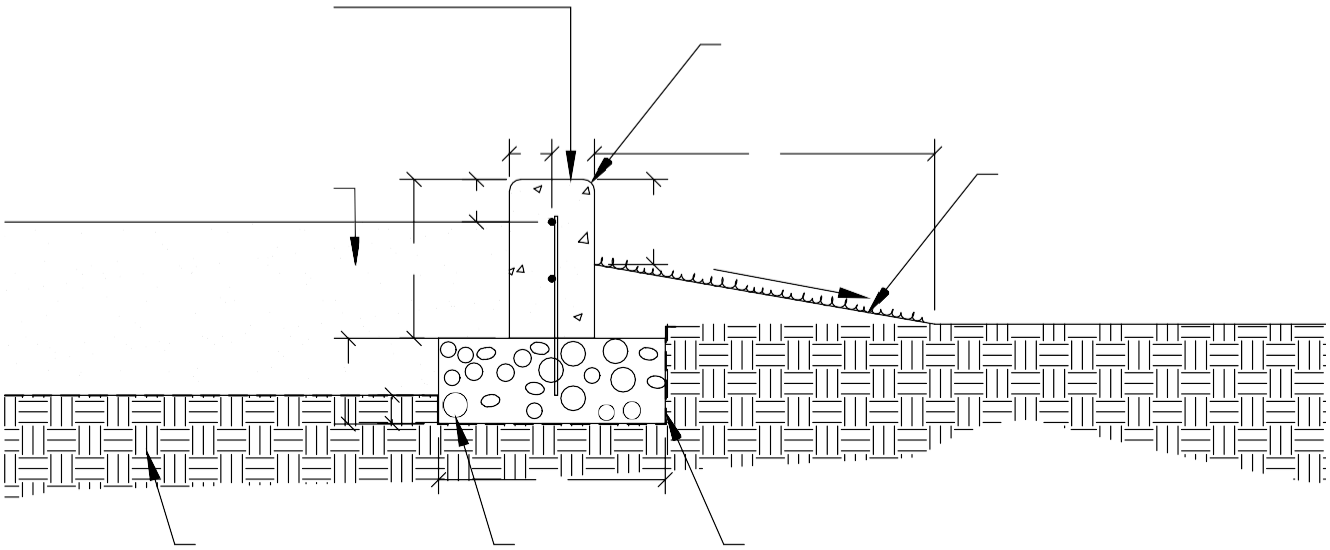
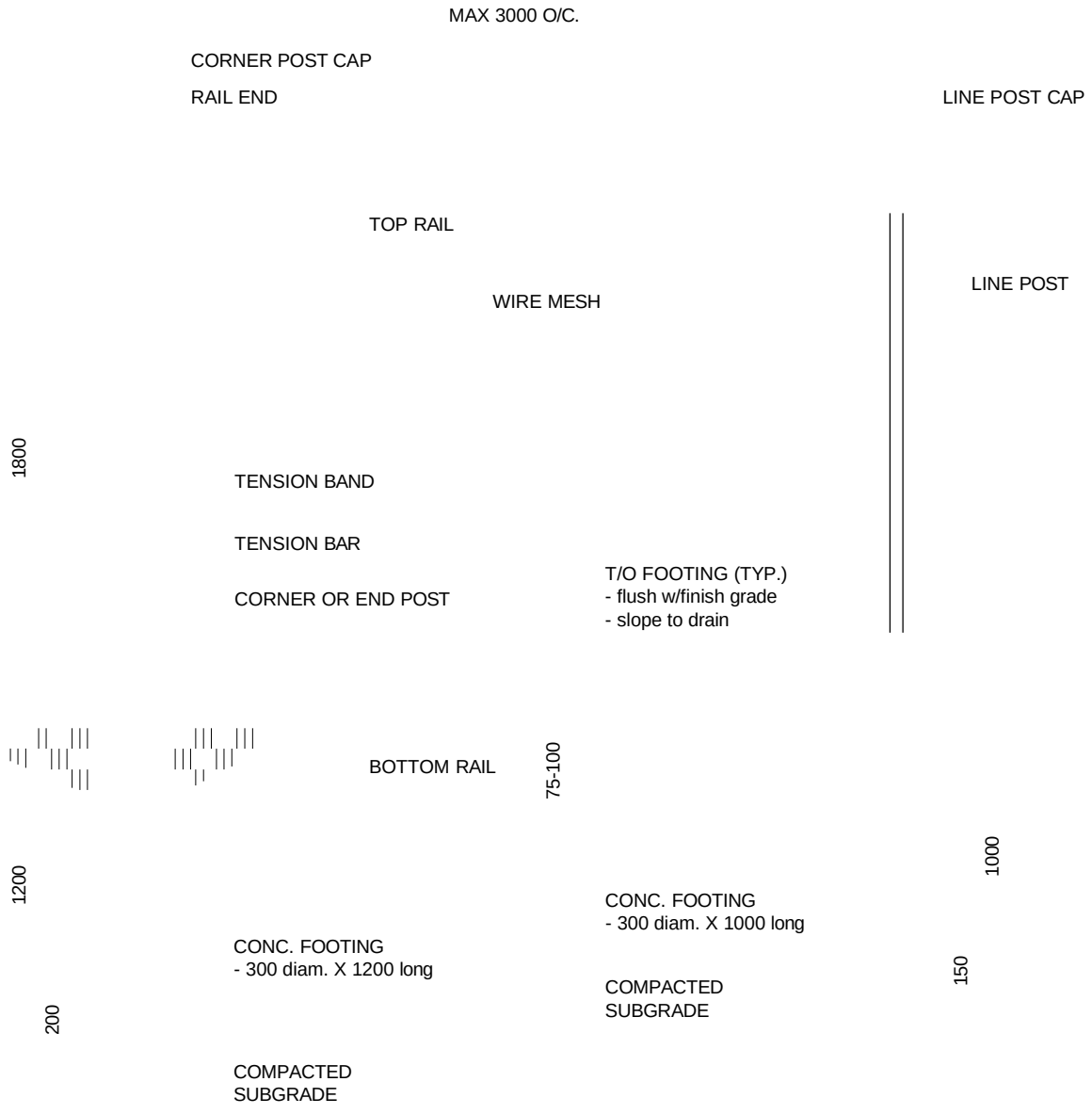


The City of Morden


MAX 3000 O/C.
CORNER POST CAP
RAIL END
LINE POST CAP
TOP RAIL
WIRE MESH
LINE POST
1800
TENSION BAND
TENSION BAR
CORNER OR END POST
T/O FOOTING (TYP.)
- flush w/finish grade
- slope to drain
BOTTOM RAIL
75-100
1000
1200
CONC. FOOTING
- 300 diam. X 1000 long
CONC. FOOTING
- 300 diam. X 1200 long
150
COMPACTED
SUBGRADE
200
COMPACTED
SUBGRADE

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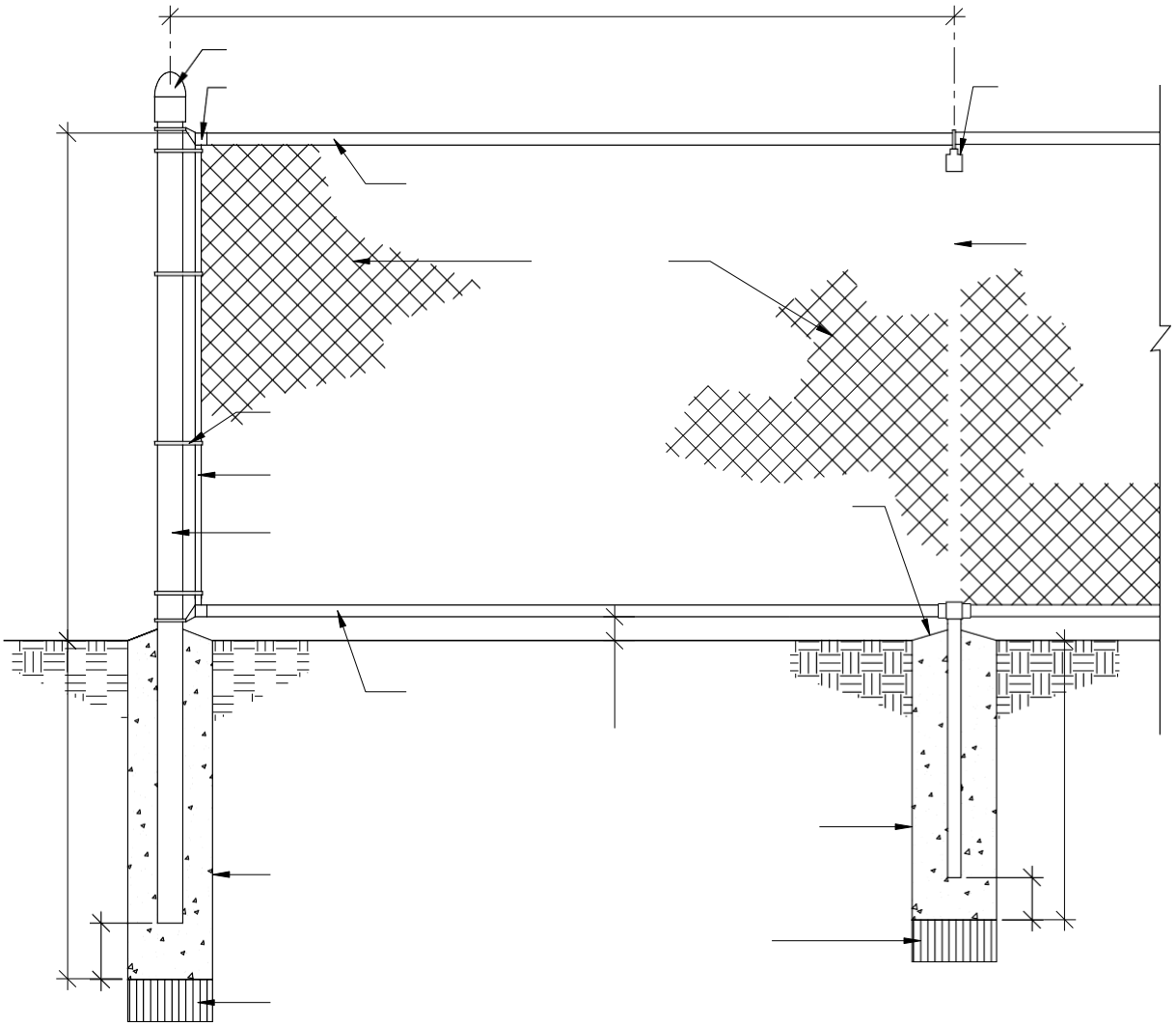
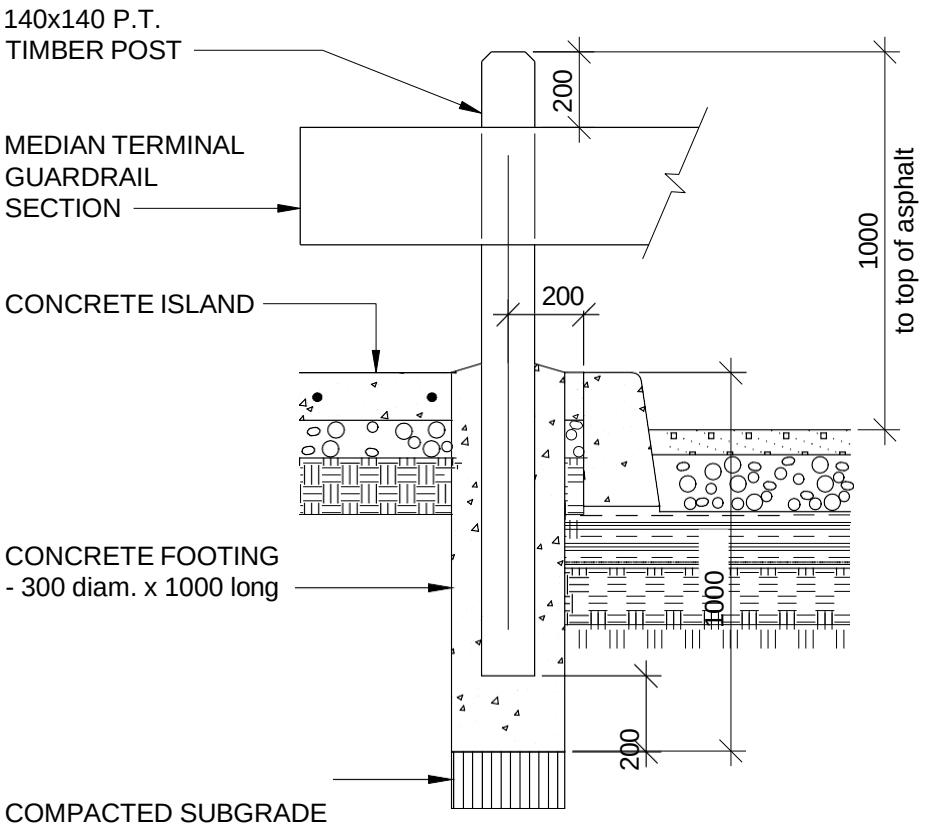


The City of Morden



The City of Morden

GUARDRAIL END POST PLACEMENT

CM1004-4

DRAWING TITLE

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APPENDIX B

APPROVED SPECIES LIST
&
DIVERSIFICATION GUIDELINES

CITY OF MORDEN
PARKS & URBAN FORESTRY DIVISION
2019

APPROVED SPECIES LIST

City of Morden, Parks and Urban Services Division has developed an acceptable tree species list, categorized by mature size, minimum spacing and planting locations. This is an evolving list as trial species are tested, new species become available and climactic trends change.

It is the intention of the City to primarily plant from the Large Tree Species list wherever possible, understanding that larger trees at maturity provide increased benefits to the community and the area in proximity to the tree than that of smaller tree species.

All tree planting on City of Morden property must be approved by the City of Morden, Parks & Urban Services Division; refer to Section 32 93 10.

LARGE TREE SPECIES (Soil Volume: 34m^2)

SPECIES	COMMON NAME	SPACING	BOULEVARD	PARK	NATURAL AREA
Abies balsamea	Balsam Fir	10m	N	Y	Y
Acer negundo	Baron Maple	10m	Y	Y	Y
Acer negundo	Manitoba Maple	10m	N	Y	Y
Acer saccharinum	Silver Maple	10m	Y	Y	Y
Larix laricina	Eastern Larch/Tamarack	10m	N	Y	Y
Picea glauca	White Spruce	10m	N	Y	Y
Pinus ponderosa	Ponderosa Pine	10m	N	Y	Y
Populus deltoides	Eastern Cottonwood	10m	N	Y	Y
Populus tremuloides	Trembling Aspen	10m	N	Y	Y
Populus XACW151	Sundance Poplar	10m	N	Y	Y
Quercus macrocarpa	Bur Oak	10m	Y	Y	Y
Tilia americana	Basswood	10m	Y	Y	Y
Ulmus 'Morton Glossy'	Triumph Elm	10m	Y	Y	Y

MEDIUM TREE SPECIES (Soil Volume: 22m^2)

SPECIES	COMMON NAME	SPACING	BOULEVARD	PARK	NATURAL AREA
Aesculus glabra	Ohio Buckeye	8m	N	Y	Y
Alnus hirsute 'Harbin'	Prairie Horizon Alder	8m	Y	Y	Y
Betula platyphylla	Dakota Pinnacle Birch	6m	Y	Y	Y
Celtis occidentalis	Delta Hackberry	8m	Y	N	Y
Juglans cinerea	Butternut	8m	N	Y	Y
Juglans nigra	Black Walnut	8m	N	Y	Y
Ostrya virginiana	Ironwood	8m	Trial		
Ulmus davidiana var. Japonica	Discovery Elm	8m	Y	Y	N

SMALL TREE SPECIES (Soil Volume: 11m^2)

SPECIES	COMMON NAME	SPACING	BOULEVARD	PARK	NATURAL AREA
Acer ginnala	Amur Maple	6m	Y	Y	N
Acer tatarica	Tatarian Maple	6m	Y	Y	N
Cornus alternifolia	Pagoda Dogwood	6m	N	Y	Y
Elaeagnus angustifolia	Russian Olive	6m	N	Y	N
Malus adstringens	Gladiator Crabapple	6m	Y	Y	N
Malus 'Spring Snow'	Spring Snow Crabapple	6m	Y	Y	N
Sorbus aucuparia	Russian Mountain Ash	6m	N	Y	N
Syringa reticulata	Japanese Tree Lilac	6m	Y	N	N

DIVERSIFICATION GUIDELINES

Tree genera diversity within the City of Morden's Urban Forest will be mitigate impacts from tree mortality, insect and disease epidemics and abiotic events (i.e. wind, ice storms, etc.). The City of Morden, Urban Forest Management Plan states: *There is a generally accepted practical method of procedure for managing species diversity. This method holds that municipalities should maintain densities under 30% for a single family, 20% for a single genus, and 10% for a single species (Lilly & Currid, 2010."* Ash tree material is not permitted.

Parks and Urban Forestry tree inventory indicates that genus, such as *Fraxinus*, or Ash, comprise approximately 37% of the City owned tree population. This high percentage of Emerald Ash Borer susceptible trees poses the risk of having large impacts on the Urban Forest canopy and the associated benefits. The City of Morden, Parks & Urban Services Division is now planning for both genus and species diversity planting now and into the future. Therefore, any trees planted on City property are required to following these guidelines.

For all planting on City property, genus and species diversity shall consist of no more than 20% of a single genus within a planting project. A single genus shall not be planted adjacent, and at a minimum of 1 out of every 5 trees planted. For example, Linden, Elm, Maple, Hackberry and Oak are acceptable and could be planted in the listed order.

TREE PROTECTION POLICY

A Guide for Public Tree Protection

City of Morden, Parks and Urban Forestry

Tree Protection Plan Guidelines

Introduction

The City's Urban Forest Management Plan (UFMP) falls under the 2018-2022 City of Morden Corporate Plan, section 2 Environmental Management. The purpose of the UFMP is to utilize the city-wide public tree inventory data to provide a framework for sustainably managing and enhancing the City of Morden's urban forest now and in the future.

Multiple benefits are provided by our urban trees and we understand trees have positive effects on; air quality, noise reduction, storm water management, property values, wildlife habitat, energy consumption, climate moderation, and links to the health and well being of our citizens. One way in which to conserve these benefits is through tree protection during the planning, construction, and post constructions phases of development.

What is a Tree Protection Plan?

A Tree Protection plan is a written directive included in the construction plans and specifications to control work around protected trees during all phases of the project.[1] A protected tree is designated as such by the City Forester and determined using the criteria in a Tree Resource Assessment. This assessment will take place upon receipt of the application or notification for a development permit, capital infrastructure project, utilities works, and or repairs to infrastructure in which a tree is located within 6 meters or 20 feet of the work area. The tree resource assessment will determine the requirement for a Tree Protection Plan. Under this plan, it is the intention for the City and the property owner (or their authorized agent) to formalize an agreement with respect to tree protection for all phases of development. The agreement will outline the construction practices necessary to conserve the benefits by minimizing the impacts from the construction process.

Impacts on trees resulting from construction activities may involve one or more of the following:

- Physical contact with any living parts of the tree.
- Soil compaction.
- Changes in surface grade.
- Changes in exposure.
- Stockpiling of materials in the root zone.
- Changes to the ground water flow, supply or quality.

[1] American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction). ANSI 300 (Part 5) – 2012

Section 1: Tree Ownership Determination

It can be assumed that trees within the street right-of-way are public or city owned trees. However, for the purposes of the Tree Protection Plan all trees within 6m or 20 feet of the property line require a tree ownership determination. This will be provided by the Parks and Urban Forestry department and communicated in writing. This communication will indicate if no public trees exist or provide a Tree Resource Assessment to the property owner.

Section 2: Tree Resource Assessment (TRA)

An ISA certified and Tree Risk Assessment Qualified arborist will conduct a Tree Resource Assessment. The information with the assessment will include:

- Tree Condition
- Tree Genus and Species
- Tree Diameter in cm at DBH
- Tree Canopy (height, width, condition)
- Tree Location(s)
- Tree Risk Assessment
- Tree Appraisal (CTLA Trunk Formula Method)

The TRA can be supplied by the City of Morden, Parks and Urban Forestry department upon written request by the property owner. If a consulting arborist is used for the TRA, the property owner must supply the name and credentials including a copy of certifications or ISA number. Upon completion of the TRA by a consulting arborist a copy must be submitted to the City Urban Forester for approval and is subject to an audit for accuracy.

Section 3: Tree Protection Plan (TPP)

A Tree Protection Plan helps to define the steps taken during the construction process to avoid impacts on tree health and condition while ensuring the continuation of the benefits to the community.

<u>Tree Protection Plan Check List</u>

- ☑ ***Site Plan***
    - Location of all existing trees and shrubs within 6m of the development site, include tree height and diameter.

- Indicate the Tree Protection Zone and Root Protection Zone location and distances for each tree.
- Construction materials storage area(s).
- The excavation zones, trenching, grade changes, underground utilities and irrigation systems, sidewalks, driveways, parking lots, construction access roads, changes to hydrants, lighting, and utilities.
- Soil compaction reduction treatments and areas.
- Drainage plan

☑ *Tree Protection Zone (TPZ)*

The Tree Protection Zone is the area surrounding a tree defined by a specified distance, in which excavation, compaction, stockpiling and other construction related activities shall be avoided. Its function is to protect all living parts of the tree and the surrounding soil. Table 1 indicates the minimum distances for establishment of a TPZ. In the event of a modification to the TPZ, notification shall be given to the City Forester. The City will determine if the modifications to the TPZ are acceptable and make any further recommendations through communication with the property owner or designate.

Table 1	Tree Protection Zones			
	Diameter of Trunk		**Minimum Protection Distances Required**	
	(DBH) in cm		**(m)**	**(ft)**
	<10		2.13	7
	10 - 30		2.44	8
	31 - 50		3.05	10
	51 - 60		3.65	12
	61 - 70		4.26	14
	71 - 80		4.87	16
	81 - 90		5.48	18
	91 - 100+		6.10	20

1. Diameter at Breast Height (DBH) measurement is taken around the trunk at 1.4m from the ground.
2. Roots can extend from the trunk 2-3 times the distance of the drip line.
3. Tree Protection Zone distances are measured from the outside edge of the trunk flare at the base of the tree outwards towards the drip line.
4. Information is based on – Parks and Open Space, City of Oakville Ontario. Tree Protection Specifications for Construction Near Trees, 2008.

☑ *Tree Protection Barriers*

In addition to the Tree Protection Zone establishment using table 1, a physical barrier must be placed on site at the minimum required distance from the protected tree. Tree protection barriers must be erected prior to any construction related activities. Approval from the City Forester is required for the alteration and/or removal of the tree protection barrier.

The barrier must be a minimum of 1.5m tall above ground and located on all sides of the tree. The height may be adjusted if existing tree limbs are below 1.5m and adjusted to align with streets, curbs, and pedestrian traffic flow. Barrier material may be orange snow fence with a 2x4 constructed frame/staking or a suitable restrictive substitute.

Signage shall be posted on each side the barrier with the following information

TREE PROTECTION ZONE

Grade changes, material storage or equipment are NOT permitted in this area

City of Morden (logo)

204.362.3999

☑ ***Root Protection Zone***

The Root Protection Zone is the soil area surrounding a tree defined by a specific measurement, in which excavation, compaction and other construction related activities should be avoided or mitigated. The RPZ is typically made up of the TPZ and may extend beyond the TPZ. It is known that the root system of a tree may extend from the trunk 2-3 times the distance of the drip line. Therefore, it's important to take precautionary measures to reduce soil compaction, and plan excavation, trenching and root pruning activities.

The following calculation will be used to determine the RPZ:

Diameter (DBH cm) X 12 / 100 = RPZ m

For example a tree with a dbh of 70cm has an RPZ of 8.4m

☑ ***Excavation or Trenching***

Any excavation or trenching as indicated on the site plan within the Root Protection Zone should be planned to minimize root damage.

Preferred methods to avoid damage to roots:

<u>Hand excavation with tools:</u> when a root is encountered, avoid contact with the root and excavate around it.

Pneumatic excavation: tools and equipment are available to use compressed and high pressure air to remove the soil around the roots without damaging the larger roots.

Hydraulic excavation: tools and equipment are available to use high-pressure water to wash and remove soil around the roots without damaging larger roots.

Trenchless pipe installation: tools and equipment are available to install pipes of varying diameter under roots without trenching.

☑ ***Root Pruning***

Roots should not be ripped or torn during excavation. Roots 5cm in diameter or greater require approval by the City Forester and removal by a certified arborist.

If possible, avoid root pruning during periods from bud break to leaf development.

Pruning of all Elms is banned between April 1st to July 31st in Manitoba.

Crown reduction pruning is not an acceptable practice to compensate for loss of roots through root pruning activity.

Roots should be pruned or cut prior to excavation by exposing roots using the above methods.

All exposed or surface roots greater than 40mm diameter damaged at the edge of the TPZ shall be cut cleanly by sawing. Severing or crushing roots by excavator or other mechanical device is not acceptable.

☑ ***Tree Pruning, Removals***

Any planned tree pruning, or removal activities should be identified in the TPP. If pruning is required of City owned trees notification must be given and the City will conduct the pruning activities. In the event that a consulting arborist is hired, the property owner must supply the name and credentials including a copy of certifications or ISA number to the City Forester.

Pruning of all Elms is banned between April 1st to June 31st in Manitoba.

☑ ***Soil Compaction***

Acceptable standards for compaction mitigation in the Root Protection Zone include; spreading a minimum 6 inch layer of woodchip mulch, adding large plywood or steel sheets over the mulch, laying rubberized matting in the travel areas, operating on frozen soils.

It is important to note that equipment/vehicle/skid steer travel within the RPZ is not recommended during high soil moisture conditions OR when continuous travel routes are needed. It is the goal to protect the soil structure and integrity within the RPZ.

☑ ***Drainage Plan***

Changes in ground water flow and surface water will impact trees. Subdrains, catch basins, outfalls, swales, detention and retention ponds should be identified as part of the Tree Protection Plan. Below ground walls or foundations could disrupt the underground water flow. Run-off from a hardscaped surface, such as a parking lot, could introduce contaminates to the soil water.

☑ ***Contact Information***

Provide contact information for a designated person responsible for ensuring the Tree Protection Plan is followed.

Step 1: Pre-Construction Meeting

A Pre-Construction meeting is the first step in the Tree Protection Plan process. This meeting shall give the property owner the opportunity to share site/construction plans, timing and logistics. In turn, this meeting allows the city to review the TRA and establish the TPZ, RPZ and pre-construction, construction and post-construction requirements.

Step 2: Construction

Construction inspections may occur to ensure the Tree Protection Plan is being followed.

Step 3: Post Construction

Post Construction inspection will occur using the data from the Tree Resource Assessment to establish pre-construction condition and take note of damage to any living parts of the tree. At this point the City Forester will advise on the removal of the Tree Protection Zone barrier(s).

Tree Protection Plan Agreement Template:

Please submit a signed copy of this agreement along with a copy of the approved Tree Protection Plan along with Schedule A; Tree Resource Assessment and Schedule B; Tree Protection Map for *XXXXXX*. By signing this document, you agree to the following process:

- ☑ Follow all restrictions as described in the approved Tree Protection Plan.
- ☑ Notify all contractors working on site of the Tree Protection Plan and ensure they are aware of the work restrictions zones.
- ☑ Ensure no construction related activity occurs within the Tree Protection Zone.
- ☑ Ensure the condition of pre-construction soil structure and integrity in the Root Protection Zone is maintained.
- ☑ Notify the City Forester for amendments, changes, unapproved activities.

I, the owner □, authorized agent □, authorized consultant □, state that, to the best of my knowledge, the information provided in the enclosed Tree Protection Plan is accurate, complete and is based on diligent inquiry and thorough inspection and review of all documents and other information reasonably available pertaining to the subject property.

I have read the Tree Protection Plan outline and agree to follow all guidelines within it. I will carry out development activities in accordance with the approved Tree Protection Plan for my site.

_____

Date

_____

Applicant's Name (please print)

_____

Applicant's Signature

_____

Phone Number

_____

Email Address

_____

Company Name

_____

Site Address

_____

Development Permit/Building Permit Number

References:

Compendium of Best Management Practices for Canadian Urban Forests, Tree Canada https://treecanada.ca/resources/canadian-urban-forest-compendium/13-tree-protection-during-construction-trees-and-building-foundations/

American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction). ANSI 300 (Part 5) – 2012

Reducing Infrastructure Damage by Tree Roots: A Compendium of Strategies; 2003, by Laurence R. Costello and Katherine S. Jones

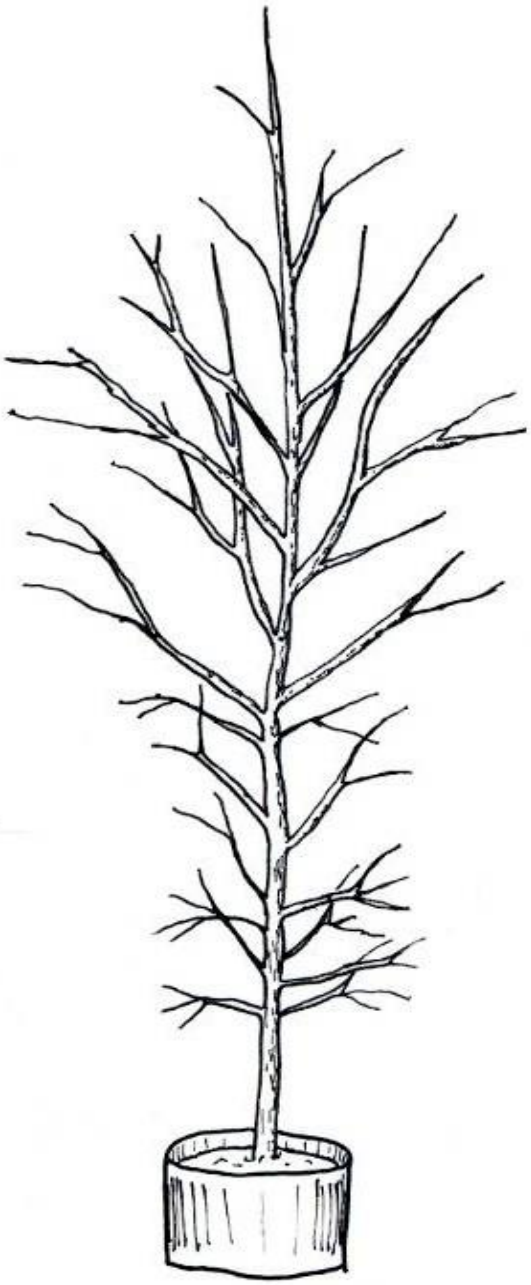
International Society of Arboriculture: Municipal Specialist, Study Guide; 2008, by International Society of Arboriculture

International Society of Arboriculture: Arborist Certification, Study Guide; 2010, by International Society of Arboriculture

City of Calgary, Tree Protection Plan; A Step-by-Step Guide; http://www.calgary.ca/CSPS/Parks/Documents/Planning-and-Operations/Tree-Management/Tree-Protection/tree-protection-plan-guide.pdf?noredirect=1

Town of Oakville, Tree Protection During Construction Procedure; https://www.oakville.ca/townhall/en-tre-001-001.html

Guideline Speci,ications for Nursery Tree Quality



Revision 2009

BACKGROUND

This document is a revision of a previous publication entitled *Guideline Speci,ications for Nursery Tree Quality*, published by the Urban Tree Foundation, which was developed by a committee of horticulture professionals from the nursery, landscape, municipal, consulting, and academic sectors. The original publication has been posted online at the Foundation's Web site (http://www.urbantree.org/specs.asp) since 2002 and has been used by public, private, and nonpro,it groups to select and specify quality nursery trees. Recommendations for improvements to the document received in the past 5 years have been incorporated in this 2009 revision.

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Bob Ludekens, L. E. Cooke Company, Visalia
Greg McPherson, US Forest Service, PSW Research Station, Center for Urban Forest Research
Martha Ozonoff, California ReLeaf, Davis
Ed Perry, UC Cooperative Extension, Stanislaus County
Markio Robert, Caltrans LDA Maintenance Division, Oakland

Illustrations by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida. Adaptions from *Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines*, 4th ed., by R. W. Harris, J. R. Clark, and N. P. Matheny (Prentice Hall, 2003).

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Introduction

This document provides speci,ications for selecting and specifying quality nursery trees in California, with a focus on container stock. Key traits of nursery trees are identi,ied and described to provide growers and buyers with the information they need to distinguish good-quality stock from poor-quality stock. Structural and health characteristics are described, as well as labeling, compliance with laws and regulations, and inspection of nursery stock. If a particular defect or substandard element can be corrected easily, appropriate remedies should be applied as agreed upon by both parties.

I. GENERAL SPECIFICATIONS

A. Proper Identi>ication: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by species and cultivar (as appropriate).

B. Compliance: All trees shall comply with federal and state laws and regulations requiring inspection for plant disease, pests, and weeds. Inspection certi,icates required by law shall accompany each shipment of plants. Clearance from the local county agricultural commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted. Even though trees may conform to county, state, and federal laws, the buyer may impose additional requirements.

C. Inspection: The buyer reserves the right to reject trees that do not meet speci,ications as set forth in these guidelines or as adopted by the buyer. If a particular defect or substandard element can be corrected easily, appropriate remedies shall be applied. If destructive inspection of a root ball is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection, number of trees to be inspected, and ,inancial responsibility for the inspected trees.

D. Delivery: The buyer shall stipulate how many days prior to delivery that delivery noti,ication is needed. Buyer shall stipulate any special considerations to the nursery prior to shipment.

II. HEALTH AND STRUCTURE SPECIFICATIONS

These speci,ications apply to deciduous, broadleaf evergreen, and coniferous species. They do not apply to palms. Note that leaf characteristics will not be evident on deciduous trees during the dormant season.

A. Tree Health

1. Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar. Changes in form caused by wind, pruning practices, pests, or other factors shall not substantially alter the form for the species or cultivar.

2. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress as indicated by wilted, shriveled, or dead leaves.

3. Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

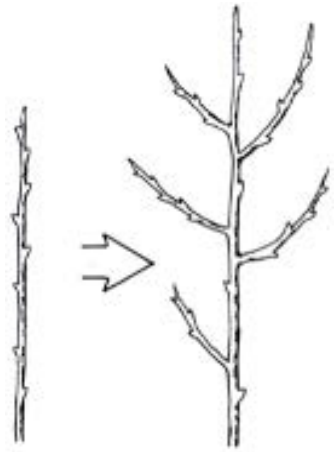
4. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds (except properly made pruning cuts), sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).

5. Roots: The root system shall be substantially free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Root distribution shall be uniform throughout the container substrate, and growth shall be appropriate for the species or cultivar. At time of inspection and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

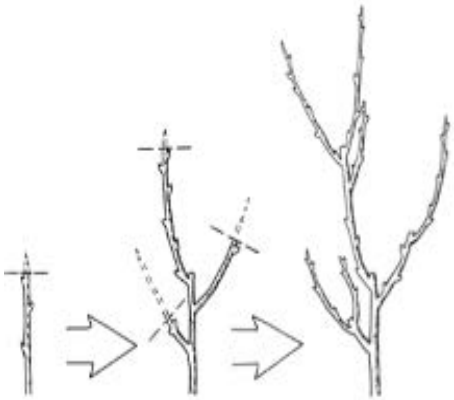
B. Tree Crown

Note: Crown speci,ications do not apply to plants that have been speci,ically trained in the nursery as topiary, espalier, multistem, clump, or unique selections such as contorted or weeping cultivars.

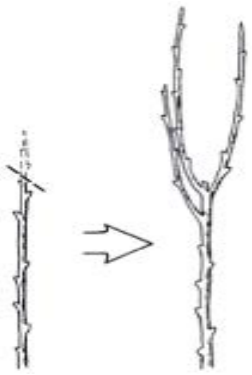
1. Trees shall have a single, relatively straight central leader. They shall be free of codominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.



Not topping is desirable.

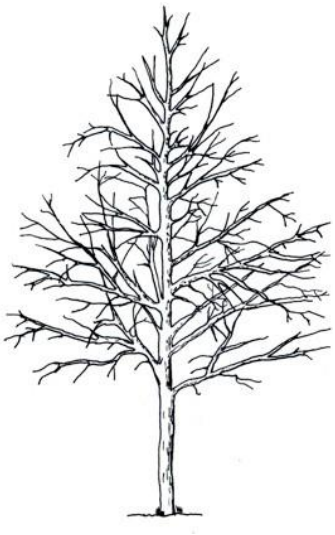


Topping and retaining a leader is desirable.

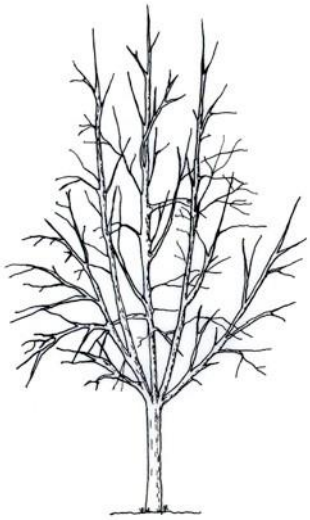


Topping without retaining a leader is not desirable.

2. Main branches shall be well distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.




Desirable



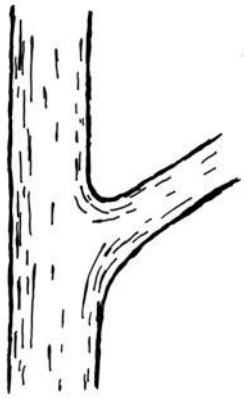

Not Desirable

3. Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch.


Desirable


Not Desirable

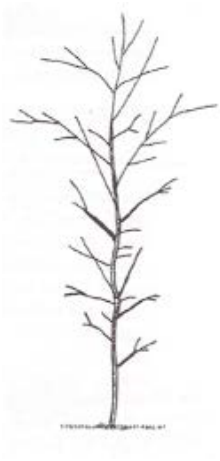
4. The attachment of the largest branches (scaffold branches) shall be free of included bark.




Desirable


Not Desirable

5. Temporary branches, unless otherwise speci,ied, should be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8 inch diameter. Clear trunk should be no more than 40% of the total height of the tree.

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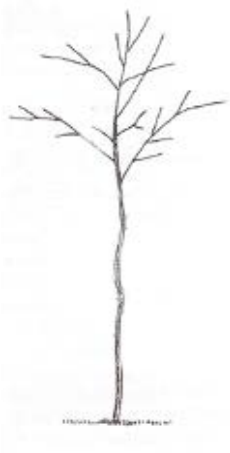



Not Desirable

C. Trunk

1. The trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.

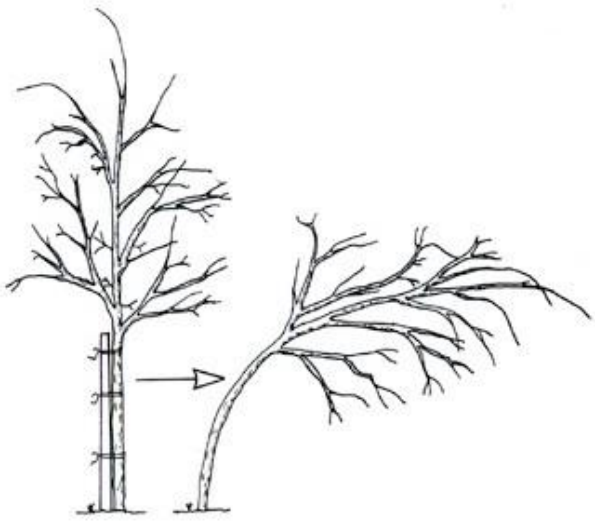
2. Trunk caliper and taper shall be suf,icient so that the tree will remain vertical without a stake. Trunk caliper at 6 inches above the soil media (substrate) surface shall be within the diameter range shown for each container size below:

Container Size -------Trunk Diameter

5. .....0.5" to 0.75"

15. .....0.75" to 1.5"

24-inch box.....1.5" to 2.5"

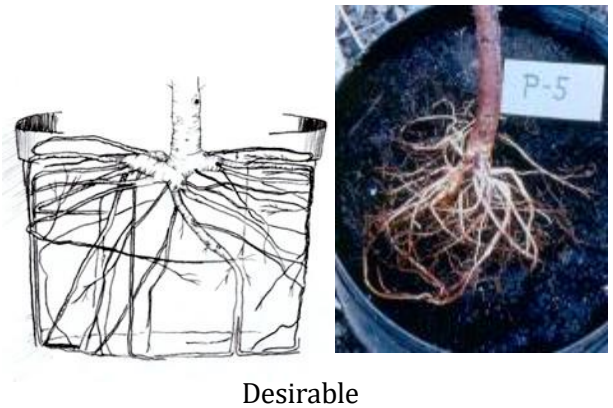



Desirable Not Desirable

D. Roots

1. The uppermost roots or root collar (root crown) shall be within the upper 2 inches of the soil media (substrate).

2. The root collar and the inside portion of the root ball shall be free of defects, including circling, kinked, and stem girdling roots. Soil removal near the root collar may be necessary to inspect the aforementioned root defects.



Desirable

Not Desirable

3. Roots on the periphery and bottom of the root ball shall be less than 1/4 inch in diameter (1/8 inch is preferred). The maximum acceptable root diameter on the periphery should be indicated.

Desirable

Not Desirable

4. The tree shall be well rooted in the soil media (substrate). Root distribution shall be uniform throughout the container media. Structure and growth shall be appropriate for the species/cultivar. When the container is removed, the root ball shall remain intact. When the trunk is lifted both the trunk and root system shall move as one.

5. At the time of inspection and delivery, the root ball shall be moist throughout. The crown shall show no signs of moisture stress as indicated by wilted, shriveled, or dead leaves or branch dieback. The roots shall show no signs of excess soil moisture as indicated by poor root growth, root discoloration, distortion, death, or foul odor.

III. INSPECTION

The buyer reserves the right to reject trees that do not meet speci,ications as set forth in these guidelines or as adopted by the buyer. If a particular defect or substandard element or characteristic can be easily corrected, appropriate remedies are encouraged. If destructive inspection of a root ball or balls is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection, minimum number of trees to be inspected or percentage of a species or cultivar, and ,inancial responsibility for the inspected trees.

VI. DELIVERY

The buyer should stipulate how many days prior to delivery that noti,ication is needed.

GLOSSARY:

caliper. Trunk diameter measured 6 inches from the ground; if caliper is greater than 4 inches, the caliper measurement is taken at 12 inches from the ground.

central leader. A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main branch (scaffold) and extending to the top of the tree. Also referred to as the **dominant leader**.

c**ircling roots.** One or more roots whose diameter is greater than 10% of the trunk caliper circling more than one-third of the trunk.

clear trunk. The portion of the trunk below the crown lacking lateral branches; this includes the portion of the trunk with shortened temporary branches that are below the main crown.

codominant. Two or more vigorous, upright branches or stems of relatively equal size that originate from a common point, usually where the leader was lost or removed.

crown. The portion of a tree beginning at the lowest main (scaffold) branch extending to the top of the tree.

c**ultivar.** A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

included bark. Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge.

kinked root. A main mother root that is sharply bent.

leader. The dominant stem that usually develops into the main trunk.

photosynthate. Sugar and other carbohydrates that are produced by the foliage and stems during photosynthesis.

root collar. The base of a tree where the main roots and trunk meet. Also referred to as the **root flare**.

scaffold branches. Large main branches that form the main structure of the crown.

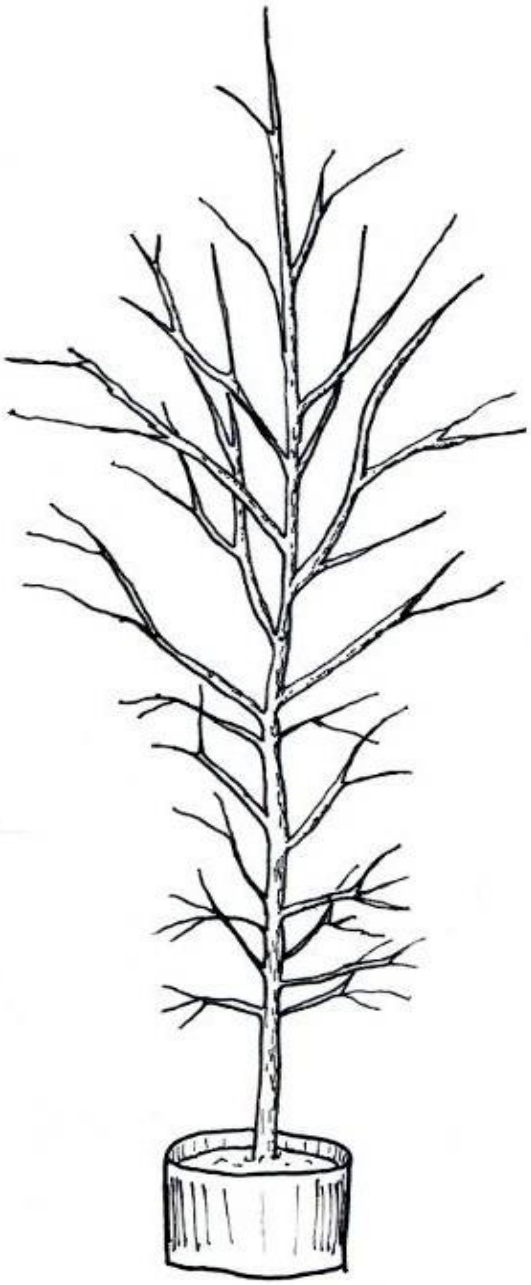
stem-girdling root. A circling, bent, or straight root that touches or rests on the trunk or root flare that can become a permanent root.

temporary branch. A small branch that is temporarily retained along the lower trunk of young trees.

trunk. The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

taper. The thickening of a trunk or branch toward its base.

Guideline Speci,ications for Nursery Tree Quality



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Introduction

This document provides speci,ications for selecting and specifying quality nursery trees in California, with a focus on container stock. Key traits of nursery trees are identi,ied and described to provide growers and buyers with the information they need to distinguish good-quality stock from poor-quality stock. Structural and health characteristics are described, as well as labeling, compliance with laws and regulations, and inspection of nursery stock. If a particular defect or substandard element can be corrected easily, appropriate remedies should be applied as agreed upon by both parties.

I. GENERAL SPECIFICATIONS

A. Proper Identi>ication: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by species and cultivar (as appropriate).

B. Compliance: All trees shall comply with federal and state laws and regulations requiring inspection for plant disease, pests, and weeds. Inspection certi,icates required by law shall accompany each shipment of plants. Clearance from the local county agricultural commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted. Even though trees may conform to county, state, and federal laws, the buyer may impose additional requirements.

C. Inspection: The buyer reserves the right to reject trees that do not meet speci,ications as set forth in these guidelines or as adopted by the buyer. If a particular defect or substandard element can be corrected easily, appropriate remedies shall be applied. If destructive inspection of a root ball is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection, number of trees to be inspected, and ,inancial responsibility for the inspected trees.

D. Delivery: The buyer shall stipulate how many days prior to delivery that delivery noti,ication is needed. Buyer shall stipulate any special considerations to the nursery prior to shipment.

II. HEALTH AND STRUCTURE SPECIFICATIONS

These speci,ications apply to deciduous, broadleaf evergreen, and coniferous species. They do not apply to palms. Note that leaf characteristics will not be evident on deciduous trees during the dormant season.

A. Tree Health

1. Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar. Changes in form caused by wind, pruning practices, pests, or other factors shall not substantially alter the form for the species or cultivar.

2. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress as indicated by wilted, shriveled, or dead leaves.

3. Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

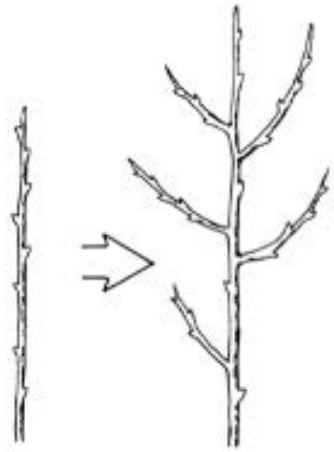
4. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds (except properly made pruning cuts), sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).

5. Roots: The root system shall be substantially free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Root distribution shall be uniform throughout the container substrate, and growth shall be appropriate for the species or cultivar. At time of inspection and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

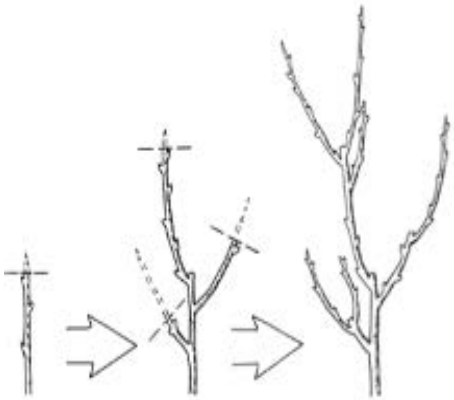
B. Tree Crown

Note: Crown speci,ications do not apply to plants that have been speci,ically trained in the nursery as topiary, espalier, multistem, clump, or unique selections such as contorted or weeping cultivars.

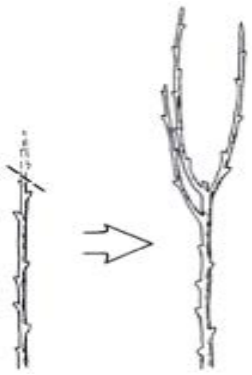
1. Trees shall have a single, relatively straight central leader. They shall be free of codominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.



Not topping is desirable.

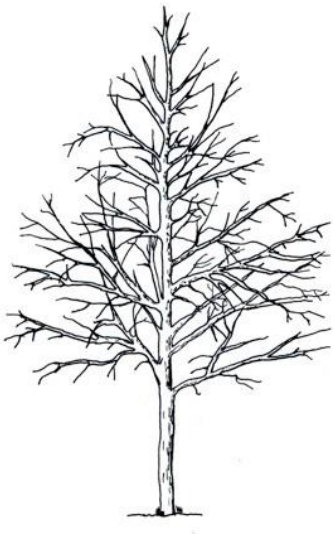


Topping and retaining a leader is desirable.

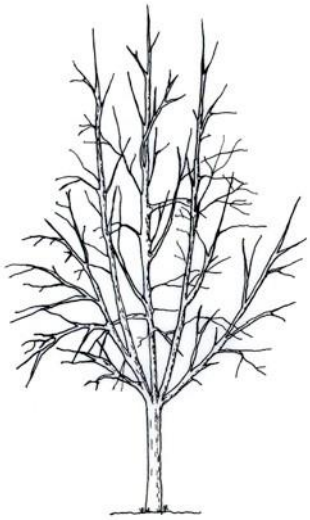


Topping without retaining a leader is not desirable.

2. Main branches shall be well distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.




Desirable



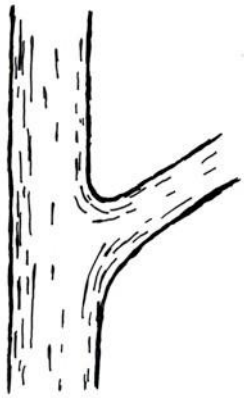

Not Desirable

3. Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch.


Desirable


Not Desirable

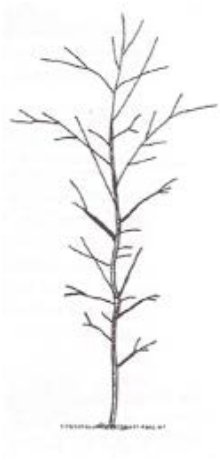
4. The attachment of the largest branches (scaffold branches) shall be free of included bark.




Desirable


Not Desirable

5. Temporary branches, unless otherwise speci,ied, should be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8 inch diameter. Clear trunk should be no more than 40% of the total height of the tree.

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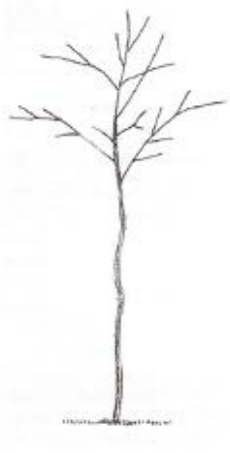



Not Desirable

C. Trunk

1. The trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.

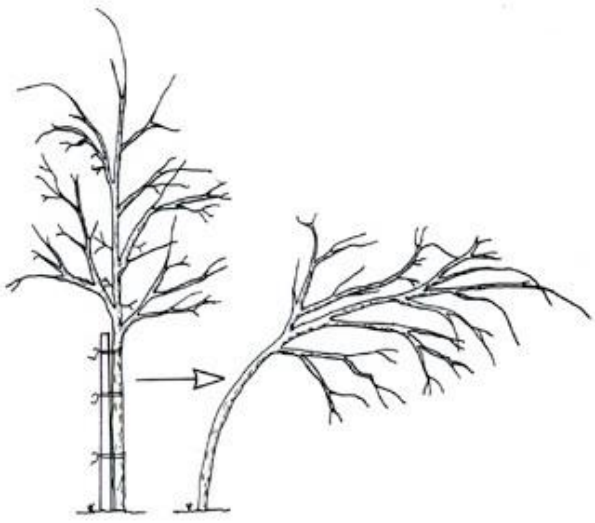
2. Trunk caliper and taper shall be suf,icient so that the tree will remain vertical without a stake. Trunk caliper at 6 inches above the soil media (substrate) surface shall be within the diameter range shown for each container size below:

Container Size -------Trunk Diameter

5. .....0.5" to 0.75"

15. .....0.75" to 1.5"

24-inch box.....1.5" to 2.5"

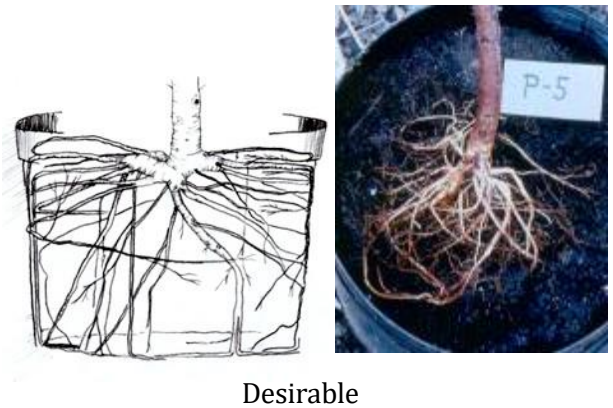



Desirable Not Desirable

D. Roots

1. The uppermost roots or root collar (root crown) shall be within the upper 2 inches of the soil media (substrate).

2. The root collar and the inside portion of the root ball shall be free of defects, including circling, kinked, and stem girdling roots. Soil removal near the root collar may be necessary to inspect the aforementioned root defects.



Desirable

Not Desirable

3. Roots on the periphery and bottom of the root ball shall be less than 1/4 inch in diameter (1/8 inch is preferred). The maximum acceptable root diameter on the periphery should be indicated.

Desirable

Not Desirable

4. The tree shall be well rooted in the soil media (substrate). Root distribution shall be uniform throughout the container media. Structure and growth shall be appropriate for the species/cultivar. When the container is removed, the root ball shall remain intact. When the trunk is lifted both the trunk and root system shall move as one.

5. At the time of inspection and delivery, the root ball shall be moist throughout. The crown shall show no signs of moisture stress as indicated by wilted, shriveled, or dead leaves or branch dieback. The roots shall show no signs of excess soil moisture as indicated by poor root growth, root discoloration, distortion, death, or foul odor.

III. INSPECTION

The buyer reserves the right to reject trees that do not meet speci,ications as set forth in these guidelines or as adopted by the buyer. If a particular defect or substandard element or characteristic can be easily corrected, appropriate remedies are encouraged. If destructive inspection of a root ball or balls is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection, minimum number of trees to be inspected or percentage of a species or cultivar, and ,inancial responsibility for the inspected trees.

VI. DELIVERY

The buyer should stipulate how many days prior to delivery that noti,ication is needed.

GLOSSARY:

caliper. Trunk diameter measured 6 inches from the ground; if caliper is greater than 4 inches, the caliper measurement is taken at 12 inches from the ground.

central leader. A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main branch (scaffold) and extending to the top of the tree. Also referred to as the **dominant leader**.

c**ircling roots.** One or more roots whose diameter is greater than 10% of the trunk caliper circling more than one-third of the trunk.

clear trunk. The portion of the trunk below the crown lacking lateral branches; this includes the portion of the trunk with shortened temporary branches that are below the main crown.

codominant. Two or more vigorous, upright branches or stems of relatively equal size that originate from a common point, usually where the leader was lost or removed.

crown. The portion of a tree beginning at the lowest main (scaffold) branch extending to the top of the tree.

c**ultivar.** A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

included bark. Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge.

kinked root. A main mother root that is sharply bent.

leader. The dominant stem that usually develops into the main trunk.

photosynthate. Sugar and other carbohydrates that are produced by the foliage and stems during photosynthesis.

root collar. The base of a tree where the main roots and trunk meet. Also referred to as the **root flare**.

scaffold branches. Large main branches that form the main structure of the crown.

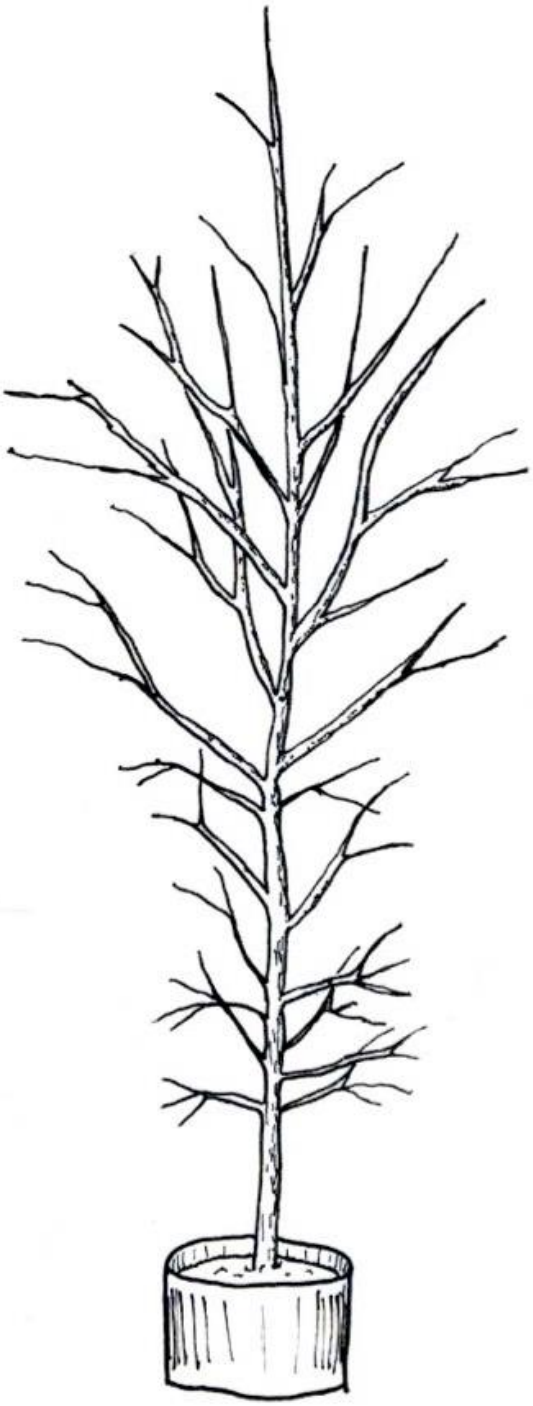
stem-girdling root. A circling, bent, or straight root that touches or rests on the trunk or root flare that can become a permanent root.

temporary branch. A small branch that is temporarily retained along the lower trunk of young trees.

trunk. The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

taper. The thickening of a trunk or branch toward its base.

Strategies for Growing a High-Quality Root System, Trunk, and Crown in a Container Nursery



Companion publication to the *Guideline Specifications for Nursery Tree Quality*

Table of Contents

Foreword

This document presents strategies to assist growers in producing trees that conform to the *Guideline Specifications for Nursery Tree Quality* (Visalia, CA: Urban Tree Foundation). The strategies are based on most-recently-published and ongoing research, combined with the knowledge, skills, and know-how of both the practitioner and researcher, to produce high-quality root systems, trunks, and crowns . As research progresses and new strategies are developed, this document will be revised to incorporate state-of-the-art information.

In addition to being of immediate practical use for growers, this document should provide a basis for further discussion among nursery and landscape professionals and researchers. Many of the strategies herein have been in practice for years in nurseries in California and other parts of the country. While this document contains guidelines based on current and ongoing research, more research is needed to continue to learn what makes trees stable and healthy. It is our aim to encourage site- and species-speciZic research that will become the basis for more uniform implementation of methods known to produce quality trees in a cost-effective manner.

We appreciate the review of this document by nursery and landscape professionals and welcome your comments. We will periodically update the document as it is circulated, reviewed, and edited by growers and researchers. This process is essential to our goal of developing a user-friendly manual that will assist growers in the efZicient production of high-quality trees.

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Guiding Principles for Growing Quality Trees for the Landscape

Good root systems start in the nursery at propagation in the liner stage and require attention each time a tree is shifted into a larger container. Large main mother roots should grow straight from the trunk without circling the trunk or deZlecting downward. Temporary branches are important to trunk development because they build a strong trunk and root system. Shade trees grown in the nursery should have a strong central leader even if the leader will be lost at maturity. Installation contractors must provide simple root and shoot pruning treatments at planting to ensure that sustainable landscapes are created.

Acknowledgments

Steering Committee: Dave Cox, LE Cooke Nursery; Haydi Boething Danielson, Boething Treeland Farms; Thomas Fetch, LE Cooke Nursery; Michael Frantz, Frantz Wholesale Nursery; Mark Marriott, Village Nurseries; John Serviss, Valley Crest Tree Co.; Sal Soriano, Monrovia: Chris Terry, Dave Wilson Nursery; Roger van Klaveren, Generation Growers.

Reviewers: Dr. Jim Clark, Hortscience Inc.; Dr. Laurence R. Costello, University of California Cooperative Extension; Sam Doane, J. Frank Schmidt & Son Co.; Bruce Hagen, California Department of Forestry and Fire Protection, Retired; Dr. Richard W. Harris, Professor Emeritus, University of California, Davis; Mark A. Halcomb, University of Tennessee Area Nursery Specialist Extension; Bruce Hammersmith, Skinners Nursery; Gordon Mann, Mann Made Resources; Michael D. Marshall, Marshall Tree Farm; John Melvin, California Department of Forestry and Fire Protection; Dave MufZly, Oaktopia.net; Dr. Daniel Struve, Ohio State University; Dennis Swartzell, Horticulture Consultants, Inc.; Dr. Gary Watson, Morton Arboretum; Keith Warren, J. Frank Schmidt & Son Co.

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Section 1: Roots
Defects

Root defects that develop during nursery production can lead to poor vigor (Fig. 1) and tree failure (Figs. 2b and c) in the landscape. However, most defects, such as circling roots in the root ball interior, can be mostly eliminated with appropriate and timely management in the nursery. Strategies in the nursery should focus on producing trees that have straight main mother roots growing to the edge of the container. Installation contractors should correct minor root defects near the trunk at planting, as well as root defects on the periphery of the root ball.

Straight roots growing from the trunk form a strong, wide root plate (Fig. 2a). Trees with a wide root plate are stable and require a large force to tip them over. Trees with deZlected, kinked, or bent roots can develop a smaller root plate and represent lesser quality. When main woody roots are deZlected and not straight, there may be no root plate and the tree can become unstable (Figs. 2b and 2c).

A tree's instability can result from the curved or bent shape of the main roots combined with increasing crown size. Growing trees without root management when shifting to a larger container size often results in bent and deformed roots. Some trees are able to remain stable despite root deformities, but they may lose vigor if circling roots meet the trunk and constrict sap Zlow (Fig. 1). A reduced growth rate often precedes the other signs of reduced vigor such as chlorotic foliage and dieback.

Figure 1. Poor vigor and dieback caused by stem-girdling roots. Trees in this condition will not reach maturity in the landscape.

Figure 2a. Straight roots growing from the trunk form a more or less circular root plate. Trees with straight roots are more stable than those with deZlected roots.

Figure 2b. Tree failure resulted from circling roots in the nursery container and being planted too deeply. As the circling roots and the trunk grew in diameter, they eventually rested against each other. As a result the trunk was thinner below the soil than it was above. The root growing against the trunk caused this growth constriction (see entire tree, Fig. 2c). Removing root defects during production and at planting can prevent this.

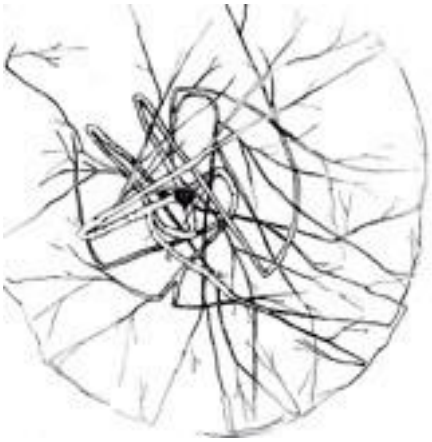
Figure 2c. Increasing crown weight on a defective root system caused this tree to fall in a wind storm.

Like the crown, quality root systems result from appropriate active management. Root balls are often shifted through the production process with little or no correction in root system defects (Figs. 3a and b).

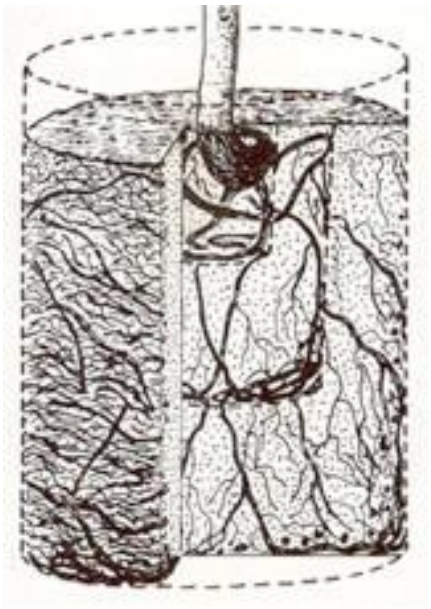
Planting too deeply can also cause defects at the root collar in trees such as maples and elms. Defects on Zinished trees may be correctable if woody roots have not become too large or abundant (Fig. 3b). When defects are hidden and inaccessible or involve large roots, corrective measures can be difZicult or impractical to implement. When roots have been left untreated for too long, corrective measures can be time-consuming. The ability to correct old and severe defects depends on the severity of defects, species of tree, water management practices, size of roots that require cutting, and time of year. It is easier to remove these roots when the plant is younger than the tree pictured in Figure 3b. Ideally, roots should be inspected and defective roots managed at each shift to a larger container, reducing the need to prune heavy roots later.

It is often necessary to remove substrate from the top of the root ball to inspect for root defects (see Fig. 3b). Provided that the main roots are relatively straight (see Fig. 2a), tree quality and stability can be improved by removing kinked, circling, and stem-girdling roots from the top of the ball. Root defects should be removed at the point just behind the bend in the root (Fig. 4). The retained root segment should be relatively straight and should grow radially from the trunk. New roots typically grow from just behind the cut in a radial or fanlike pattern away from the trunk (see Fig. 11b). Some new roots grow down, up, or occasionally kink back toward the trunk. These should be corrected at the next shift.

Figure 3b. Substrate (3 in.) was removed to expose the top roots inside the container. A moderate amount of stem-girdling roots growing over the root collar is correctable. However, it is inefZicient to allow defects to develop to this extent. It is best to prevent this by pruning roots at earlier stages and planting at the correct depth.



Top View



Side View

Figure 3a. Root defects are present at each container size: liner, #5 and #15 (Harris et al. 1999).

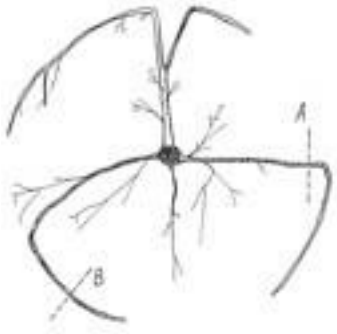


Figure 4. Cut defective roots back to the point just behind the bend (A). The retained root segment is straight. Cutting them at a point after the bend (B) is not recommended because the defect remains.

Liner Management

Objective: The root collar and inside portion of the liner root ball should be free of root defects, including circling or kinked roots and roots growing up or down the side of the container (Fig. 5).

Problem: In the liner stage, a tree's root system can develop in a matter of weeks once growth begins. Some species develop only one or two large main roots; others have a more Zibrous root system. Often, roots grow to the edge or bottom of the container, then branch or deZlect down, up, and around the periphery of the root ball, forming a type of shell. Without management, some of these small roots can eventually become large and woody, retain their deformed shape, and develop into a defect (Fig. 5). Root defects near the root collar can reduce the growth, vigor, and stability of the tree. The liner root ball should not be visible when the trunk of a larger tree is rocked in the container or planted in the ground. Left untreated, root defects that develop at the liner stage can be the most difZicult to address later in production.

Practice: Trees and shrubs should be planted in liner trays and in other systems that minimize root defects and encourage branching of the root system inside the root ball (Fig. 6). Air pruning is especially efZicient at causing a tap root to form branch roots. Liners should be shifted to larger containers before non-correctable root defects form. Table 1 gives several methods of eliminating root defects when liners are shifted to larger containers. Some of these methods may work better than others for certain species, container types, substrate types, liner stage, time of year, and tree age.

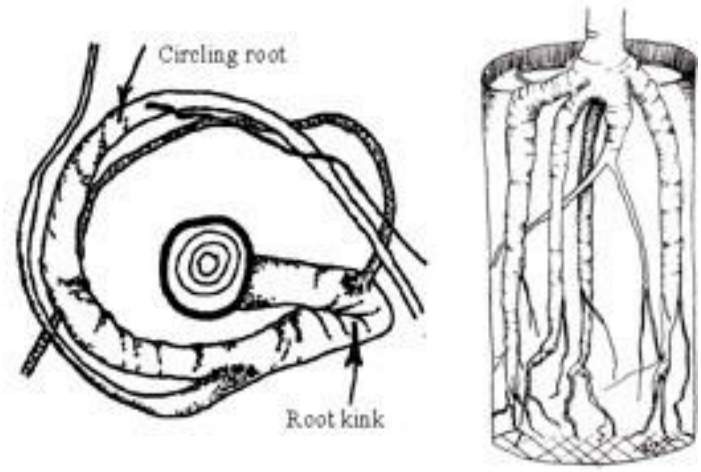


Figure 5. Circling and kinked roots originating in a liner pot (left). Circling and diving roots in an open-bottom liner pot (right). Both trees should be thrown out because defects are too severe to correct. The tree in Fig. 7a can develop these defects unless pruned and managed before shifting.

Figure 6. Traditional propagation pots encourage roots to grow around the pot or along the sides toward the bottom. Some roots then grow back toward the surface (right). Pots that air-prune on bottom and sides encourage branching of the tap root on seedlings and cuttings (top), forming smaller-diameter bottom roots and ample laterals near the surface.

Shaving, pruning, or "peeling off" the shell of roots on the periphery and bottom of the root ball cuts away most defects (Fig. 7). Adequate roots remain inside the root ball in most cases (Figs. 7e and 8). Some liners may be killed by this treatment but it is necessary to remove inferior plants from the inventory and prevent them from failing later in the landscape. Slicing root balls from top to bottom removes some defects but can retain roots oriented downward. Slicing can also leave intact bent root segments that generate new roots, which can grow close to the trunk. Air pruning can be a useful method to reduce root defects. Teasing or pulling roots apart and laying them straight in the substrate of the larger container can also reduce defects if done before roots become too stiff. These and other techniques are designed to encourage roots to grow radially from the trunk (Fig. 2a).

Water management is critical after root pruning to avoid severe wilting and stress. Trees should be irrigated to maintain the water requirements appropriate for the species and weather. In warmer and drier weather, the irrigation frequency and volume may need to be adjusted to accommodate the reduced and disturbed root system. Some growers strip leaves from certain trees to enhance survival.

Table 1. Methods of reducing or eliminating root defects when liners are shifted to larger containers.

- Grow liners in propagation trays designed to reduce defects.
- Shift liners at the appropriate time.
- Score or slice the root ball from top to bottom in several places.
- Shave or peel off roots on the periphery of the root ball.
- Tease roots at the periphery so they lay straight in the substrate of the larger container.
- Prune off the corners from top to bottom of cube-shaped root balls.
- Remove the bottom of the root ball.

Figure 7a. Inspect the root ball.

Figure 7b. Remove peripheral roots.

Figure 7c. Continue root pruning.

Figure 7d. Root pruning complete.

Figure 7e. At left, a liner root ball that is likely to develop permanent defects if not pruned. Roots form a "shell" at the substrate-container interface. Shaving or peeling away the peripheral roots can remove defects, resulting in a root system resembling the one at right, a liner root ball with the substrate removed to show a liner root system free of defects.

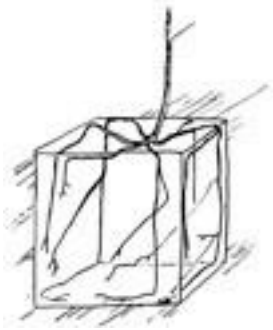


Figure 8a. Finished liner with roots deZlected down and around the pot forming a type of root shell.

Poor root system: Liner root ball was not root pruned as it was shifted into a #1 container.

Good root system: Liner root ball was shaved (Fig. 7) when shifted into a #1 container.

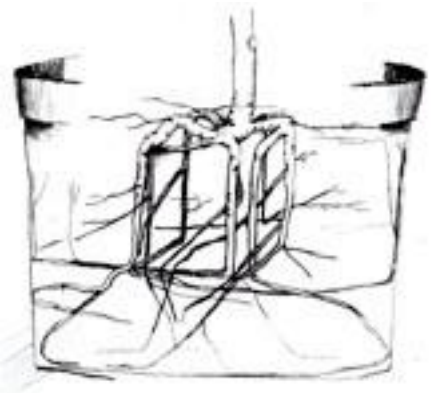


Figure 8b. Two months after shifting, roots that grew down and around the sides of the liner pot became woody and grew in diameter. These woody roots retained their original orientation, and many of the new roots produced in the #1 container grew from the bottom of the liner root ball.

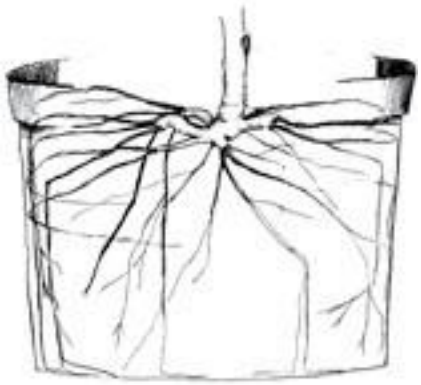


Figure 8d. Two months after root pruning and shifting, the new roots grew horizontally and downward. The roots at the top of the container originated from the top of the liner root ball, providing greater stability for the tree.

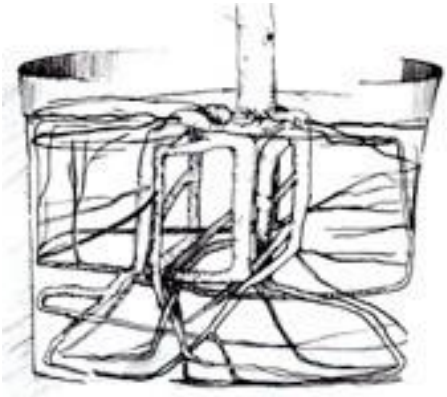


Figure 8c. Six months after shifting, the main woody roots that had been originally deZlected by the liner pot continued to grow in diameter. Many roots that grew near the surface of the root ball originated near the bottom of the liner. The #1 container wall deZlected a second set of roots up, down, and around. Some of these roots will become woody and grow into a second set of defects.

Figure 8e. Six months after root pruning and shifting, the main woody roots were oriented in a more natural form. Some main roots grew horizontally, while others grew downward. Both horizontal and vertical roots are needed for tree stability. The inner root ball was free from defects such as circling, stem-girdling, and kinked roots. However, this plant should be root pruned again when it is shifted to the next container size

or planted in the ground.

Root System Management on Larger Containers

Objective: The root ball periphery should be free of larger circling, girdling, descending, ascending, and bottom-matted roots. Main roots near the substrate top surface should grow more or less straight to the edge of the container.

Problem: Roots growing on the periphery of the root ball often deZlect down and around the container wall and can become large and woody (Fig. 9a). Larger roots at the periphery of #1 and larger containers can result from a rootbound liner, a liner planted with poor root branching or distribution, failure to root-prune the liner, a dominant tap root or lateral root, a tree remaining in a container for too long, and other factors. Small and medium-sized peripheral roots indicate better root distribution (Fig. 9b). Root defects often form on the interior of the root ball if roots are not managed at each shift.

Practice: Shifting before non-correctable defects form, root pruning, air-pruning, and teasing apart small roots at each shift to a larger container can signiZicantly reduce root defects. Air-pruning happens when roots are purposely exposed to air in the absence of high humidity (Fig. 10). Root tips are killed, causing the plant to produce new branching roots. Growing trees in an open-bottom container above the ground air-prunes bottom roots and can reduce the diameter of roots growing toward the bottom of the container. The root ball improves because of an increase in lateral root growth and a more branched root system. Lateral roots that are air-pruned or chemically pruned on container sides also branch.

Root pruning can remove some or all of the outer roots and substrate from the top, sides, and bottom of the root ball (Fig. 11a). The straight portion of the roots on the interior is retained. In #3 containers and larger, roughly the outer 1 inch of substrate contains many of the defects. Teasing apart the outer surface of the root ball can be effective on young trees of certain species when roots are small in diameter (see Fig. 12). These strategies encourage new roots to grow radially away from the trunk. None of these techniques are very effective for treating defects on the interior of the root ball. Therefore, it is imperative that roots on the periphery be inspected and defects removed at each shift to a larger container. All techniques work best when roots are small in diameter.

Figure 9a. Large roots are growing on the periphery of the root ball. These should be removed by shaving or pruning away the bent portion of the roots; however, cutting roots of this size could kill some trees, depending on time of year and water management.

Figure 9b. Small roots are growing on the periphery of the root ball. This root ball should be shaved when shifted.

The trees in Figures 8e and 9b should be root-pruned when shifted to a larger container. Shaving works best because it is likely to cut roots back to a straight radial root segment attached to the trunk (Fig. 4). A shaved root ball will be smaller than it was before pruning (Fig. 13). There may be other ways to cut back roots so that retained roots are positioned radially and straight from the trunk. Slicing and scoring the root ball are less effective because 90-degree bends in main roots often remain (Fig. 4). Shaving continues the process of developing a quality root system that began when the liner was appropriately managed when shifted into the larger container. Root balls should be inspected and defects removed at each shift to a larger container to prevent the formation of large, defective woody roots on the interior of the Zinished root ball.

Figure 10. The valley oak root system grown in a container that prunes roots with air (top) has more lateral roots growing from the trunk and fewer root defects than a tree grown in a smooth-sided container (bottom).

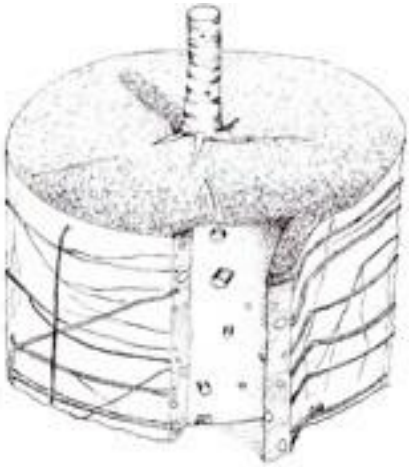


Figure 11a. Shaving, pruning, or "peeling" off the periphery of the root ball removes most of the root defects present at the periphery and bottom of the root ball.

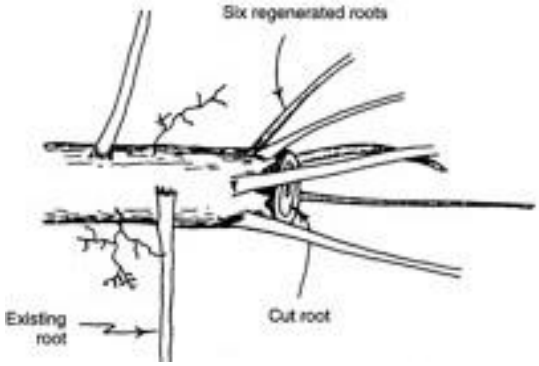


Figure 11b. New roots often grow radially away from the trunk in a fanlike pattern. Some roots may grow at a right angle to the cut root.

Figure 12. Teasing roots away from the root ball periphery encourages roots to grow radially away from the trunk.

Figure 13a. Roots matted at the #5 root ball periphery.

Figure 13b. A hand saw can be used to shave or peel away matted roots from the periphery of the root ball.

Figure 13c. Matted roots removed from the periphery of the #5 container prior to shifting. Note that remaining roots are straight and the root ball is slightly smaller than it was before pruning.

Figure 13d. Three months after root pruning, new roots grew radially from the trunk into the #15 container substrate.

Shaving, pruning, or scoring the periphery of the root ball can be done with a hand pruner, hand saw, machete, digging shovel, or other sharp blade (Fig. 13b). This process dulls sharp tools quickly but uniformly removes matted roots from the periphery and bottom of the root ball (typically about ½ to 1 inch on #1, deeper on larger containers; Fig. 13c). The tree is then ready to be shifted to a larger container or planted in the landscape.

New roots will grow from the cut root ends into the substrate in the larger container or the landscape (Fig. 13d). The resulting root system should have fairly straight roots growing radially from the trunk (Fig. 14 bottom and 15a). Without pruning, deZlected roots can become woody and retain their bent form (Fig. 15b). Shaving or pruning away roots at the periphery each time the tree is shifted should prevent many of these bent roots from becoming permanent defects, while creating a more Zibrous root ball.

Figure 14. This maple was not root-pruned when shifted to this #15 container; note the abundant root defects at the position of the #3 (top). The maple root ball periphery was shaved when shifted to a #15 container (bottom). Note the root defects at the position of the #3 are largely gone and new roots in the #15 are growing mostly radially away from the trunk.

Figure 15a. Washing the substrate away shows that root ball shaving developed a good root system with straight roots free of defects extending radially from the trunk.

Figure 15b. Washing substrate from the top of the root ball shows non-correctable root defects in a #45 container. These defects resulted from failing to prune the roots when shifting from the #5 and #15 containers.

Root Distribution within the Root Ball

Objective: The tree should be well-rooted but not overgrown in the substrate. When removing the container, the root ball should remain mostly intact. When tipping the tree from side to side, both the trunk and root ball should move as one. Root distribution should be uniform throughout the container substrate.

Problem: If a tree is poorly rooted or roots are poorly distributed, a large amount of substrate can fall away from the roots when shifting. Circling and large descending roots at the root ball periphery that are not cut during the shifting process may not extend radially or anchor into the new substrate. This can create a point of weakness. When the trunk is lifted or rocked (Fig. 16, right) the poorly rooted smaller root ball can partially separate from the substrate of the larger container's root ball.

Figure 16. This #5 root ball is not well secured to the #15 substrate because roots are growing from deZlected roots primarily from the bottom of the #5 root ball (left). Pulling up on the trunk (right) causes the smaller root ball to partially separate from the substrate.

Practice: Planting a liner with a balanced, branched root system containing ample root tips, and shifting the tree at the appropriate time, combined with mechanical and air root pruning, helps ensure good root distribution and a quality plant with a long life expectancy (Fig. 17). These techniques help prevent poor connections between smaller root balls and substrate in the larger container and often encourage more roots to grow into the top half of the root ball. Figure 13d shows how shaving the periphery of the root ball of the same species shown in Figure 16 yields better root distribution throughout the root ball.

Figure 17. Roots should be evenly distributed inside the root ball (top). When the container is removed, the root ball should remain intact (left).

Depth of Root Collar

Objective: The root collar (the uppermost main horizontal mother roots) on the Zinished tree should be within the top 1 to 2 inches, and no large roots should cross over the main roots.

Problem: Trees planted too deeply can develop severe root defects at the root collar. Even trees of certain species (e.g., maples) planted at the proper depth can develop root defects. When shifted to a larger container these defects are more easily corrected on trees maintained at the original propagation level than on trees planted too deeply. Defects from deep planting include circling, stem girdling, and kinked roots growing over the root collar or around the trunk (Fig. 18a).

Practice: Trees should be positioned as close to the propagation level as possible unless main roots originate deeper than 1 inch below the substrate surface. If the liner is planted too shallowly, some surface roots could dry out and slightly impede tree growth. If planted too deeply, stem-girdling roots and other root defects may form. When shifting or planting into the landscape (Fig. 19b), substrate and root defects should be removed from the top of the root ball on trees planted too deeply. Substrate can be removed down to the root collar using water or air or by hand. Defective roots can be cut back to a point where the retained root segments are oriented radially from the trunk (Fig. 18).

Figure 18a. A circling root growing over the root collar.

Figure 18b. After removing circling roots, the remaining root segment should be oriented radially from the trunk and straight (Fig. 19a and b).

Figure 19a. The point where the uppermost root grows from the trunk should be positioned close to the substrate surface at each shift.

Figure 19b. Main roots at the top of the root ball should be oriented radially and straight away from the trunk.

Section 2: Trunk
Temporary Branches

Objective: Develop adequate trunk caliper so the tree can stand on its own without a nursery stake.

Problem: Early removal of lateral branches from the lower trunk (4 to 5 feet high) on young trees slows trunk caliper growth (Fig. 20). The combination of staking from a young age and early removal of temporary branches often creates a trunk with little or no taper and a tree that cannot stand on its own (Fig. 21). These practices lead to over-staking in the landscape and trunk breakage at the stake tie. Trees with no taper are difficult to transport and manage in the nursery and in the landscape. Roots, trunk, and crown grow slower if temporary branches are removed too early in the production process.

Practice: Keeping temporary lateral branches along the trunk of young trees allows trees to grow faster (Fig. 22). The length of temporary branches will vary according to your objectives. Longer temporary branches result in more caliper. In some circumstances, it may be desirable to head temporary branches in order to push more growth into the central leader. However, early removal of temporary branches can result in a tall and lanky tree. Headed temporary branches on trees sold to other nurseries as liner stock should not be considered downgrading factors.

The largest-diameter temporary branches should be removed at each pruning in order to keep trunk wounds small. Temporary branches do not have to be removed when trees are sold to another nursery for shifting stock, though it is important to communicate this to your customers so they know what they will be receiving from you. Temporary branches should typically be removed 6 to 12 months before sale to the end user. Temporary branches are most important for encouraging caliper growth in young trees (#15 container and smaller, Fig. 23 left). They can be removed from older trees (Fig. 23, right).

Figure 20. Good taper and caliper developed because of the many temporary branches along the trunk (left). Removing temporary branches too soon results in poor trunk taper, a weak tree, and less total growth (right).

Figure 21. Trees in the nursery are staked to form a straight trunk. This presents a problem only when low lateral branches are removed too soon from the trunk (left). When trunks are about the same diameter at the base as they are just below the crown, they lack trunk taper. This results in a weak tree unable to hold itself up (right).

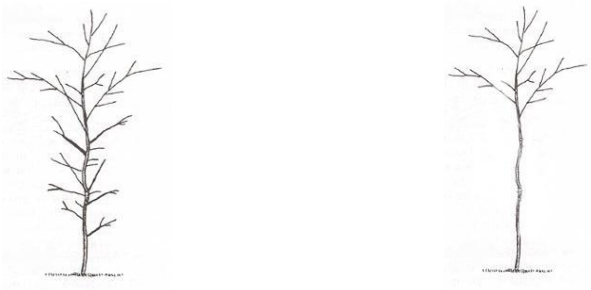


Figure 22. Leaving temporary branches along the lower trunk increases growth of the entire tree (left). The lower trunk will become thicker and roots will be stronger, allowing the tree to hold itself erect. Removing temporary branches too soon weakens the trunk and slows growth (right). In most circumstances, no more than 40% of the lower trunk should be cleared of temporary branches.

Straight Trunk

Objective: As the trunk extends up into the central leader (excluding clump forms), it should be mostly straight and vertical without exaggerated sweeps or sharp bends (Fig. 23). Trunks should also be free of large wounds.

Problem: The market desires a straight trunk that extends up into the central leader with few blemishes. Open or closed pruning wounds or existing headed temporary branches should not be considered blemishes because pruning wounds eventually close with new wood.

Practice: Not all trees require staking; however, many species need a stake to develop a straight trunk (Fig. 23). Bamboo stakes are a popular choice, but many other materials can be used including plastic, Ziberglass, and metal. The trunk should be secured to the stake snugly to prevent rubbing, but not so tight that the trunk is girdled. Stakes should be small in diameter to prevent branch deZlection. Large square wood stakes deZlect branches, often leading to a misshapen or a Zlat-sided crown. The tree can be staked far up into the crown with a variety of materials (Fig. 24). There is no need for the stake to be attached to the ground once the tree can stand on its own.

Figure 23. Low temporary branches are most important on young trees (left). Low temporary branches are less important on older trees; however, they can be retained depending on the species (right). They can be removed prior to sale to the end user.

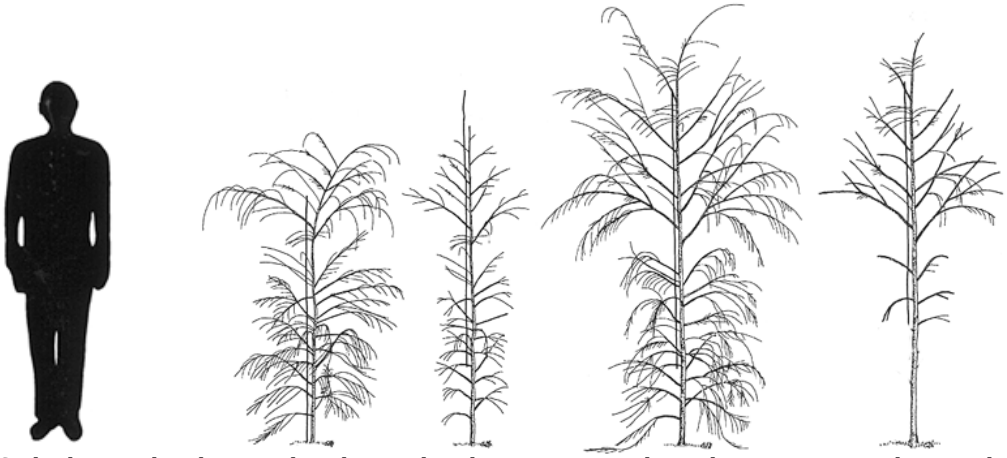


Figure 24. Staked trees develop ample caliper when low temporary branches are managed properly. Temporary branches should be cut back and removed over a period of time. These branches are most important in the earlier stages of production. Stakes can be pulled up the tree to help develop a straight leader to the top of the crown. Branches and the main leader on the tree in the sequence above were headed in order to develop a straight trunk and leader.

Section 3: Crown
Central Leader

Objective: Shade trees should have a single, relatively straight central leader, free of codominant stems or other vigorous upright branches that would compete with the central leader (Fig. 25). This does not apply to plants that have been speciZically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars.

The development of a high-quality crown hinges on the establishment of a central leader that is considerably larger in diameter than all branches. Some species will develop a central leader and crown on their own and require little or no intervention. Others require regular pruning. Pruning practices used in leader training include heading, branch subordination pruning, and staking. Some species can be grown with several leaders, including *Lagerstroemia*, *Photinia* standards, *Albizzia*, *Arbutus*, *Chitalpa*, *Eriobotrya*, *Malus*, *Prunus*, *Salix* and others.

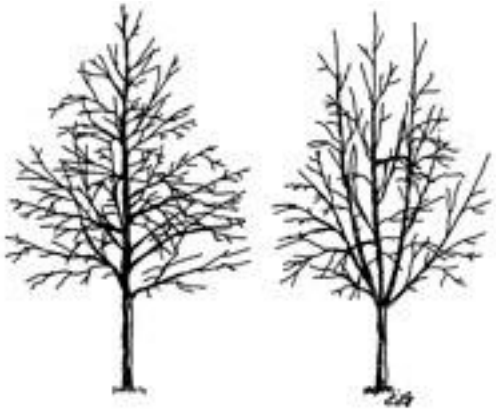


Figure 25. High-quality shade trees have one central leader (left). Poor-quality shade trees have two or more leaders (right).

Leader-dominant species (excurrent form)

Problem: Trees such as London plane tree (*Platanus* × *acerifolia)* will develop a well-shaped crown with a strong central leader without much intervention (see the Appendix for additional species). Trees with a strong central leader require only periodic subordination of aggressive branches to maintain the central leader (Fig. 26).

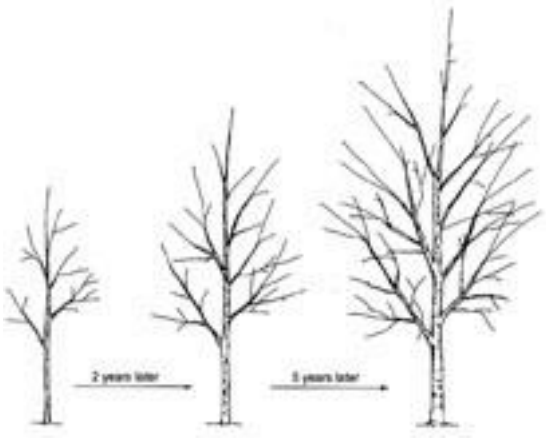


Figure 26. Excurrent (leader-dominant) trees sometimes develop good structure with limited intervention.

Practice: Reduction, or branch subordination pruning, is an important tool for developing an attractive and structurally sound crown. Branches that are vigorous and upright can be kept from becoming codominant with subordination pruning (Fig. 27). Subordination removes enough branches to slow growth by the desired amount. Codominant branches should be cut back to lateral branches, shoots, or buds pointed away from the central leader. In some cases codominant branches should be removed altogether, such as when they are nearly the size of the leader or when they cluster close together.

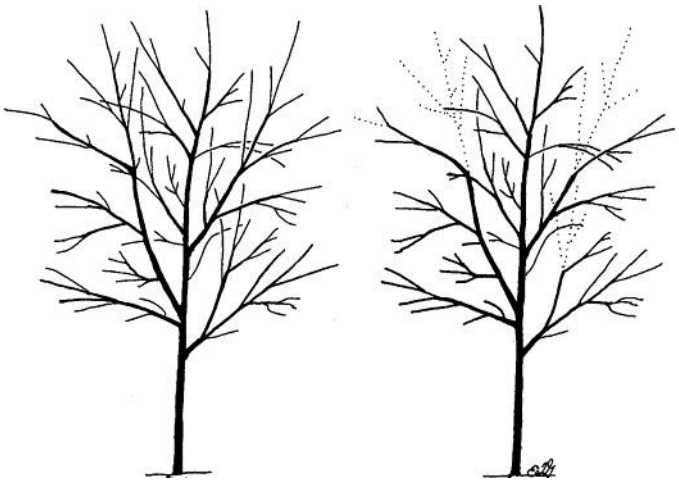


Figure 27. Subordination pruning reduces the length of codominant branches (dotted lines) back to a lateral branch pointed away from the trunk. The growth slowing effect is proportional to the amount removed.

Branch-dominant trees (decurrent form)

Problem: Trees such as elm (*Ulmus* spp.), zelkova (*Zelkova serrata*), and camphor (*Cinnamomum camphora*) are branch-dominant (see the Appendix for additional species). Species with this form typically develop codominant branches that grow as fast, or faster, than the central leader. These trees will grow into a round or vase-shaped form at a very early age. This growth habit requires regular pruning to shorten branches and develop an attractive and structurally sound crown. When trees of this form are not trained properly in the nursery, they can develop structural defects as they continue to grow in the landscape.

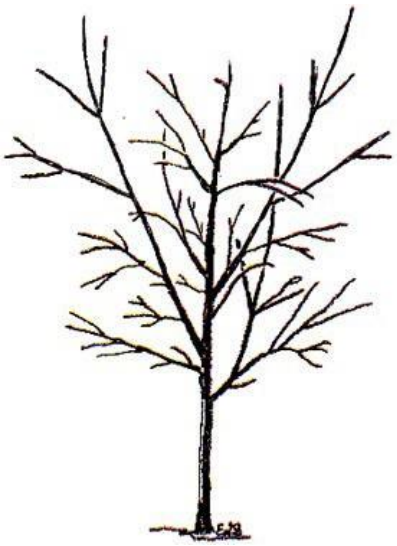


Figure 28a. Codominant branches typically grow as fast, or faster, than the central leader.

Practice: Branch management should begin early in the production process and continue until the tree is sold. Regular branch subordination and branch removal ensures that competing branches grow more slowly than the central leader and do not become codominant (Figs. 28a and 28b).

Branches in the crown should be less than half the diameter of the central leader measured 1 inch above the attachment. Branch tips should be below the tip of the central leader (Fig. 28b). Branches that are vigorous may require substantial subordination to slow their growth (Fig. 29). Branches should be cut back to shoots or buds pointed away from the central leader. Branches may need to be shortened repeatedly in the production process. In most cases, codominant branches should be removed altogether, especially if upright.

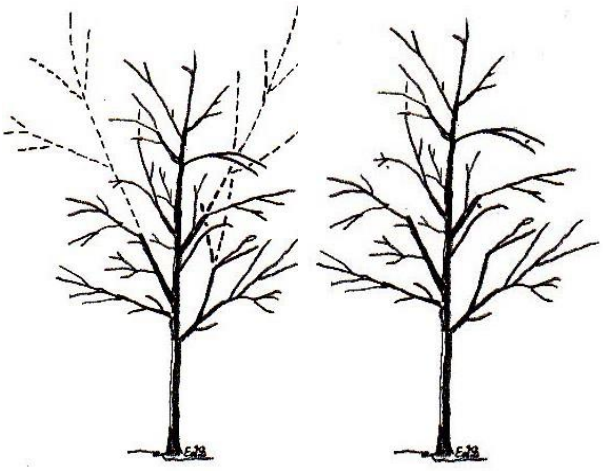


Figure 28b. Three codominant branches were subordinated (reduced) by 60 to 70% to slow their growth and encourage the central leader to develop.

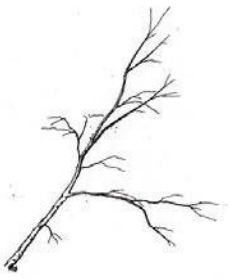


Figure 29a. Codominant branches are typically vigorous and upright before pruning.

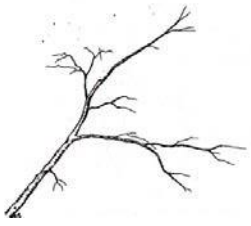


Figure 29b. A light subordination pruning showing removal of 30 to 40% of foliage.

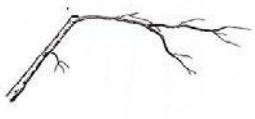


Figure 29c. A heavy subordination pruning showing removal of 60 to 70% of foliage.

Trees that do not branch

Problem: Trees such as Chinese pistache (*Pistacia chinensis*), jacaranda (*Jacaranda mimosifolia*) and honeylocust (*Gleditsia triacanthos*) often do not branch on their own at a young age (Fig. 30; see the Appendix for additional species). Trees without branches do not fare well in the marketplace. The practice of heading stems to promote branching without retraining a central leader can create codominant branches clustered close together (Fig. 31). This clustering is considered a structural defect because it becomes a weak point in the tree as it grows (Fig. 32). The structural weak point is largely due to the lack of follow-up pruning and staking in the nursery.

Practice: The central leader can be headed to promote branching; however, the tree should be trained with a new central leader (Fig. 33). One method of training a new central leader uses a bamboo stake tied in several places to the trunk. The stake should extend well beyond the heading cut. After heading the central leader, several new shoots should grow from below the point where the central leader was headed (Fig. 33). The most vigorous upright shoot should be selected and pulled tight against the stake. This shoot will become the new central leader (Fig. 34). The heading cut should not exceed about ¾ inch in diameter.

Shoots other than the one chosen for the new central leader should be headed to prevent them from becoming codominant. These shoots should be headed back to a bud oriented away from the central leader. This practice can be repeated throughout the production process to develop a full-branched crown.

Figure 30. Some species do not branch when they are young (see the Appendix for a list).

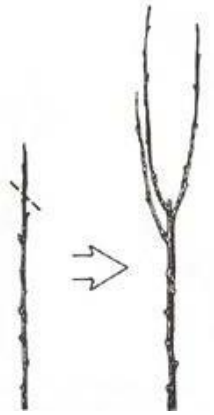


Figure 31. Heading the central leader encourages branching (left and center; from Harris et al. 1999). Poor branch structure results without follow-up pruning (right).

Figure 32. These trees probably failed because they were headed in the nursery without follow-up pruning.

Heading and Re-training the Central Leader

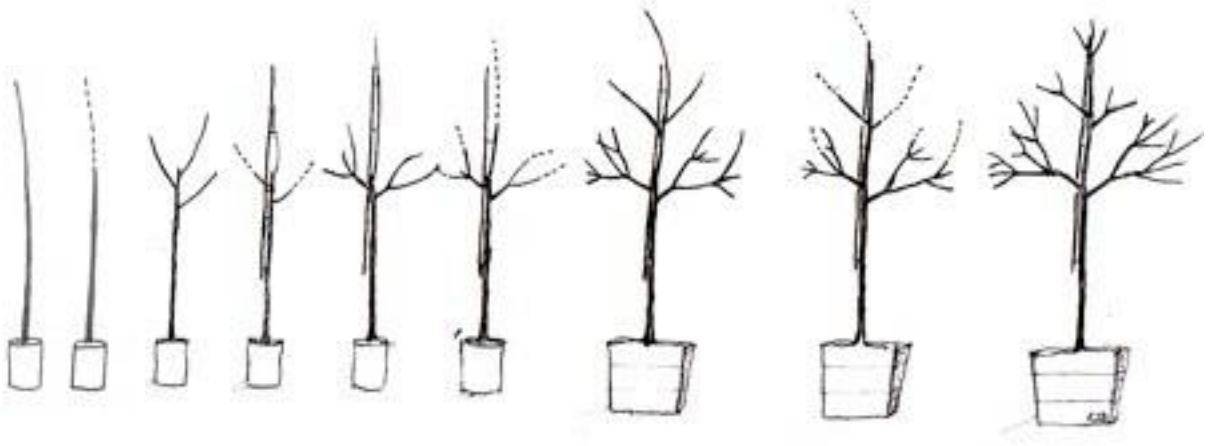


Figure 33. Heading the leader promotes branching (left to right). The top shoot is tied to a stake and the others are headed to promote branching. This process continues throughout the production process (see Fig. 34 for staking detail).

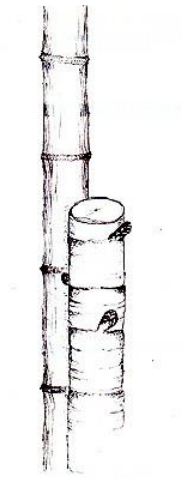


Figure 34a. The central leader is headed at the point where branches ar needed. A stake (left) is tied to the leader so it extends beyond the cut.

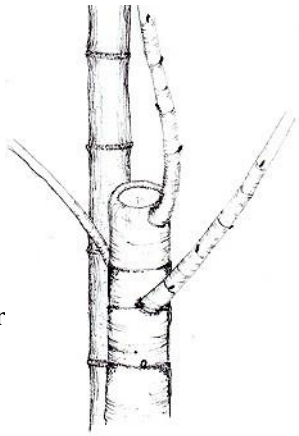
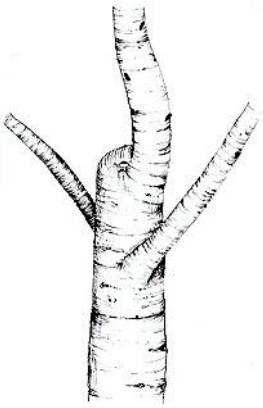


Figure 34b. Three buds developed into shoots just behind the heading cut. The top shoot is tied to the stake while the shoots are still soft.



'igure 34c. The new leader is rowing larger. The pruning vound is almost closed. The vood in the new central leader vill harden and remain traight. The stake can be emoved or adjusted.

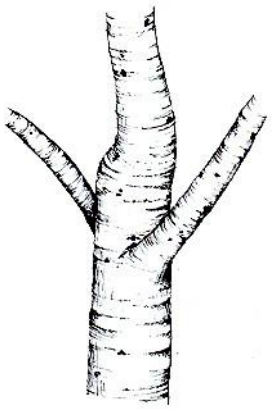


Figure 34d. The pruning wound is closed and the tree now has a new central leader with two branches. The two branches were headed (not shown in illustration) to slow their growth and to create more branches.

Branch Diameter

Objective: The diameter of all branches should be less than half the diameter of the trunk and the central leader as measured about 1 inch above the branch union (Fig. 35).

Problem: Branches larger than half the trunk diameter can grow too aggressively and compete with the central leader (Fig. 36, top). Branches that are smaller than the trunk are better attached and typically do not compete with the leader. Branches that are larger than the trunk have a weaker attachment to the trunk.

Practice: Branches with a diameter greater than half the trunk diameter should be removed or severely subordinated to slow their growth (Figs. 28b and 29).

Figure 35. This nearly Zinished nursery tree has good branch size in relation to the trunk and a strong central leader. Since these branches are small, they will be easy to remove as the tree grows in the landscape or is shifted to a larger container.

Figure 36. The branch on the right is large in relation to the central leader and should be removed or reduced in order to slow its growth (top photo). Branches should be less than half the trunk diameter, not the same diameter as the trunk. Medium-sized branches (see Zinger) can be pruned moderately in order to slow their growth (bottom). Smaller branches may not need pruning.

Branch Distribution

Objective: Main branches should be distributed along the central leader (Fig. 37a) and not clustered at a few points (Fig. 37b). Conifers often grow with many branches close together; in most cases, this is Zine.

Problem: Clustered branches often outgrow the central leader, and this retards growth of the central leader (Fig. 37b).

Practice: When trees have clustered branches, they must be pruned in a timely manner, otherwise tree quality and salability will suffer. A combination of branch removal and branch subordination is required (Fig. 38). Ideally, the larger-diameter branches should be removed and the smaller branches cut back to a bud or shoot growing away from the central leader. This practice will maintain a structurally sound and well-distributed nursery crown. Pruning should be scheduled to avoid adverse impacts from environmental extremes of weather.

Figure 37a. This tree has a strong structure and well-spaced branches in relation to the trunk. Notice that the central leader has a uniform taper.

Central Leader

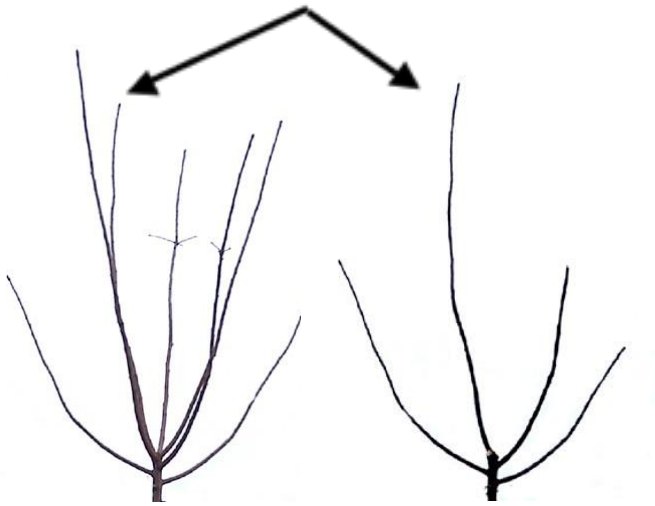


Figure 38. This is an example of how a cluster of branches could develop into codominant stems (left). The tallest stem takes over or several grow to choke out the leader. The cluster causes a reduction in the vigor and diameter of the central leader above the cluster. After selecting the central leader, the largest three branches were removed, and the remaining two smaller branches on the right were reduced by half. The branches were cut back to a bud pointed away from the central leader (right).

Figure 37b. A tree is weak when most branches are clustered together. Notice the signiZicant reduction in diameter of the central leader just above the cluster of large branches. This indicates that the branches are growing more aggressively than what was the leader.

Crown Form

Objective: Trees should have a balanced form and not be misshapen by breakage, wind, pruning practices, pests, spacing, or other factors. A consistent tree form is an important attribute for sales and landscape value. It is easier for buyers to choose from a block of trees that have consistent nursery crowns.

Problem: Aggressive or oversized branches can cause the crown to become asymmetrical or one-sided, which reduces the salability of the trees.

Practice: Tree form can be improved by reducing, removing, and heading branches to create a uniform nursery crown (Fig. 39). Vigorous branches can be brought back into a consistent and uniform shape. Trees previously headed or topped, or those with a thin crown on one side, can be balanced by removing and reducing branches on the heavy side (Fig. 40).

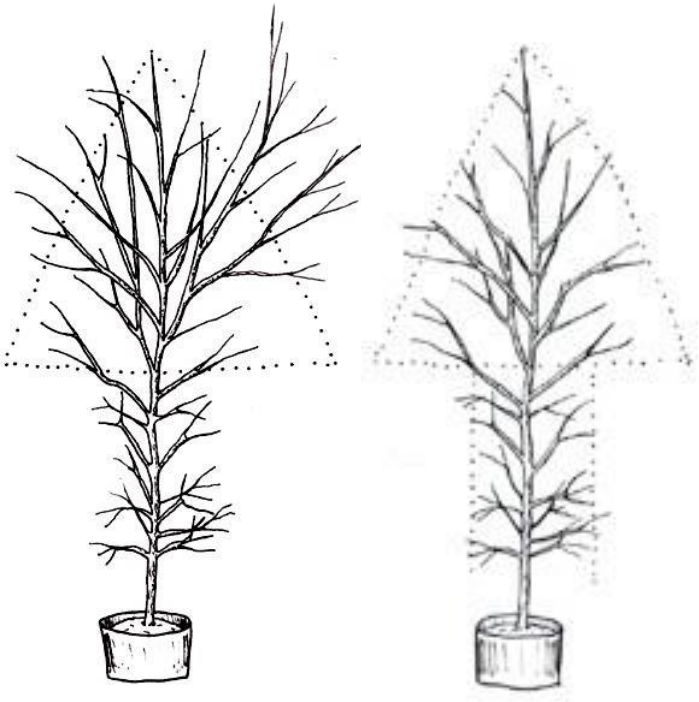


Figure 39. The crown is lopsided on the right side of the photo on the left. Reducing the large upright branch and heading some smaller branches results in a more uniform nursery crown (right). Ideally, branches growing outside an imaginary pyramid (dotted lines) should be pruned.

Figure 40. Before pruning (left), the crown is lopsided. After pruning (center), the central leader is more prominent and the crown is better balanced. Reduction cuts (right, arrow), removal cuts, and heading cuts can balance the nursery crown.

Bark Inclusion

Objective: Scaffold branches with bark inclusions in the crown should be removed or severely headed.

Problem: A branch is well attached to the trunk when a bark ridge is present (Fig. 41a). A bark ridge indicates that normal wood is growing over the union. Conversely, bark inclusions in the branch union reduce the strength of the branch attachment because bark and wood fold inward (Fig. 41b). This makes for a weak branch attachment.

Branches with inclusions tend to be vigorous and upright with narrow angles of attachment (Fig. 42). They shade the leader, which can prevent branches with good unions from developing higher in the crown. If not removed early in production, removal can later lead to a deformed crown.

Practice: Branches that have bark inclusions should be removed when the tree is young and before the branch becomes an important part of the crown. If removal will leave the crown one-sided, the branch should be subordinated. Branches with bark inclusions often require regular subordination.

Figure 41a. Branches with bark ridges on the top of the union are well secured to the trunk.

Figure 42. A union with a bark inclusion forms a V shape (see Fig. 41b). The union is weak and breaks apart easily because there is no wood on top of the union connecting branch to trunk.

Figure 41b. Unions with inclusions are weak and can easily break from the trunk. The crack is the bark inclusion.

Vigor and Foliar Characteristics

Objective: The current year's shoot growth should be vigorous (showing vitality) as indicated by appropriate shoot growth (length and diameter) throughout the crown for the age and size of the species or cultivar (Fig. 43). Trees should have no dead, diseased, infested, cracked, broken, distorted, or otherwise injured branches.

The size, color, and appearance of leaves should be appropriate for the time of year and stage of growth of the species or cultivar (Fig. 44). Leaves should not be undersized, misshapen, tattered, discolored (chlorotic or necrotic), or otherwise atypical in appearance (Fig. 45).

Problem: Trees that have poor health or lack vigor are often shifted into larger container sizes and allowed to remain in the production system. These practices are bad for growers and their customers. Shifting poor-vigor trees into the larger container sizes should be avoided when possible.

Practice: Less-vigorous trees should be culled and not shifted to larger containers. It is important to cull trees that exhibit poor health and poor vigor early in the production process to reduce cost. Management efforts should be focused on vigorous plants.

Figure 43. The tree on the left shows very poor vigor for the species, with only 3 inches of shoot growth. The tree on the right exhibits good vigor appropriate for the species, with 16 inches of shoot growth.

Figure 44. The tree on the left displays the appropriate leaf color. The tree on the right is partially chlorotic.

Figure 45. This tree shows scorched and chlorotic leaves.

Glossary

air root pruning. Root pruning done in containers that causes root tips to be killed by exposure to dry air, resulting in several new roots branching behind the dead root tip.

apical. Of or relating to the main upright shoot of a plant.

apical dominance. Inhibition of lateral buds by the terminal bud of a shoot.

branch union. The point where two stems, or a stem and a branch, meet.

branch. A stem that is smaller than the main trunk to which it is attached.

caliper. Trunk diameter measured 6 inches from the ground; if caliper is greater than 4 inches, the caliper measurement should be taken at 12 inches from the ground.

central leader. A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main branch (scaffold) and extending to the top of the tree. Also referred to as the dominant leader.

circling roots. One or more roots whose diameter is greater than 10% of the trunk caliper circling more than one-third of the trunk.

clear trunk. The portion of the trunk below the crown lacking lateral branches, including the portion of the trunk with shortened temporary branches below the crown.

codominant. Two or more vigorous, upright branches or stems of relatively equal size that originate from a common point, usually where the leader was lost or removed.

crown. The portion of a tree beginning at the lowest main (scaffold) branch extending to the top of the tree.

cultivar. A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

descending roots. Roots that grow to the container wall and down the inside of the pot. Also known as plunging or descending roots.

decurrent species. Species with strong apical dominance and weak apical control. Buds do not elongate in the season they were initiated (strong apical dominance); but, when they do elongate, they have growth equal to the central leader (weak apical control).

excurrent species. Strong apical control but weak apical dominance. Lateral branches are capable of elongating in the year they were initiated (weak apical dominance), but their elongation is under strong apical control.

finished tree. A tree in its final container.

heading cuts. Cutting through a stem or branch just above a live bud that is typically oriented away from the central leader.

included bark. Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge.

kinked root. A main mother root that is sharply bent.

lateral. Branches growing from the sides of the main trunk.

leader. The dominant stem, which usually develops into the main trunk.

liner. A plant in its first or second container.

liner tray. A small container or group of containers designed to hold germinating seeds or rooted cuttings.

main roots. The largest-diameter mother roots typically growing from the trunk or main taproot that form the main structure of the root system.

media. See **substrate.**

minor root defects. Small-diameter roots circling or crossing the top of the root ball.

peripheral roots. Roots growing in the outer inch of the container root ball sides and bottom.

radial. Positioned around a central point or axis.

propagation depth. Depth at which tree was positioned in the first container or field soil.

photosynthate. Sugar and other carbohydrates that are produced by the foliage and stems during photosynthesis.

reduction cut. Cutting a stem or branch back to a live lateral branch that is typically oriented away from the central leader; also referred to as a subordination cut.

root defects. Circling, kinked, or stem-girdling roots resulting from growing in a container. Roots that deflect up or down once they reach the container wall are also considered defects.

removal cut. Removing a branch back to the trunk, or removing a secondary branch from a main branch.

root ball shaving. Removing the outer substrate and roots on the periphery of the root ball, typically using a sharp blade or saw.

root collar. The base of a tree where the main roots and trunk meet. Also referred to as the root flare.

root flare: See **root collar**.

root plate. The combination of roots and soil close to the trunk that holds the tree erect in the landscape.

scaffold branches. Large main branches that form the main structure of the crown.

shifting. Removing the root ball from a container and placing it in a larger container; also referred to as repotting, bumping up, or stepping up, up canning.

stem-girdling root. A circling, bent, or straight root that touches or rests on the trunk or root flare that can become a permanent root.

subordinate. See **reduction cut**.

substrate. The mixture of bark, peat, sand, compost, wood, and other materials used in containers to grow plants at commercial nurseries. Also referred to as media.

tap root. The primary, typically large-diameter dominant root that emerges from a seed.

teasing the root ball. Gently pulling roots on the root ball periphery away from the periphery and positioning them more-or-less straight in a radial position in the substrate of a larger container.

temporary branch. A small branch that is temporarily retained along the lower trunk of young trees.

thinning cut. See **removal cut**.

trunk. The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

taper. The thickening of a trunk or branch toward its base.

wound. A discontinuity resulting from removal of bark and cambium. Pruning cuts that are not closed over are not considered wounds.

Appendix

Selected branch-dominant shade tree species
Acacia
Bauhinea
Camphor
Celtis
Cercis
Cladrastis
Ficus
Fraxinus
Gleditsia
Koelreuteria
Laurastinus
Quercus
Ulmus
Zelkova

Selected leader-dominant shade tree species
Acer
Alnus
Brachychiton
Cedrus
Grevilia
Liriodendron
Liquidambar styraciflua
Magnolia grandiflora
Pinus
Platanus
Podocarpus
Sequoia
Sequoiadendron
Taxodium distichum

Selected tree species that do not branch on their own in the nursery
Delonix
Eucalyptus
Ginkgo
Gleditsia
Jacaranda
Koelreuteria
Pistacia
Pyrus

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CITY OF MORDEN
NATIVE GRASS AND WETLAND LONG TERM MAINTENANCE MANUAL

1.0 Native Grasses

1.1.1 It is recommended that an inspection by a professional agronomist be completed each summer to confirm the maintenance tasks, if any, that should be undertaken for the growing season.

1.1.2 The following summarizes the Native Grass Maintenance Do's and Don'ts:

1.1.2.1 Mowing
- .1 Only once every 5 years or so; set mower 4" high
- .2 Only after July 15 so young plant species and wildlife are not disturbed too soon.
- .3 Remove grass clippings/thatch after mowing.

1.1.2.2 Lawn Clippings
- .1 Do not dump grass clippings on native grasses.
- .2 Dispose of your grass clippings in your compost, at City composting sites or in your garbage.
- .3 Clippings will block sunlight new seedlings need.

1.1.2.3 Topsoil
- .1 Only extremely pure, seed-free topsoil can be carefully added to native grasses. Note: most topsoils contain seeds that should never be mixed with native grasses

1.1.2.4 Trees/Shrubs/Flowers
- .1 Do not plant shrubs or trees, annuals or perennials among native grasses.
- .2 Native grasses require sunlight and do not do well in shade.
- .3 Digging holes can disturb the root structure of the native grasses and promote weed growth.

1.1.2.5 Do not use fertilizers or insecticides.

1.1.3 Native Grass Maintenance Management

1.1.3.1 Invasive Species
- .1 Native grass areas should be inspected by a certified agronomist for invasive species once per year between mid-July and early August to determine weed population distribution and density.
- .2 Due to the level of experience involved with identifying weed species, we recommend consulting with an agronomist when inspecting and managing weedy species.

1.1.3.2 Removal of excess dead 'litter' or duff is required approximately every 5 years.
- .1 Controlled burns are the primary means of managing stands of native upland grasses, and under certain conditions, mowing is used as an alternative to burning.
- .2 A controlled burn should occur in spring or fall depending on factors such as plant type and growth characteristics and seasonal temperatures.

.3 Due to the experience level involved in conducting a controlled burn, we recommend consulting with a certified agronomist specializing in upland grasses when determining whether it is appropriate to do so, ensuring that the longevity of the native grassland is not compromised.

1.1.3.3 Mowing can provide many benefits similar to burning.

.1 Mowing techniques must be low to the ground in order to break up the layer of accumulated thatch, and clippings must either be finely chopped and spread or removed completely.

.2 Summer and fall mow activities should be inspected and assessed for their suitability.

.3 Spot mowing can also be used to provide weed control and stand management benefits.

1.1.3.4 Weed Control

.1 Manual control (pulling, digging or cutting weeds) may be the most effective means of eliminating a single undesirable species from a small area if done on a regular basis.

.2 Herbicides can be used as an integrated approach to reduce weeds. Spot spraying weeds is an effective method to diminish invasion with proper use of herbicides on target species and knowledge of plant physiology

Table 1

A description of potential problems that may be encountered with upland areas and associated adaptive management strategies for correction.

Observation	Habitat Indicators	Adaptive Management Strategies
Thatch/Litter (dead plant material) accumulation on the soil surface	• Lack of vegetation cover (i.e., <40 plants per square meter) • Low plant diversity (i.e., monotypic stands of vegetation present, particularly weeds)	• Assess land management history • Conduct a burn or mow management
Low plant diversity	• Monotypic stands of vegetation present • High abundance of invasive species	• Assess land management history • Conduct a burn or mow management • Control invasive species using one or more of the following methods: herbicide application, mowing or weedwacking before weed goes to seed, manually pulling weeds • Re-vegetate stand
Lack of vegetation cover	• Exposed soil surface is dominant (>40% of site)	• Re-vegetate stand
Elevated salinity	• Evidence of salt on soil surface (e.g., white crust from elevated salinity) • Change in species composition from native grassland to introduced species with salt tolerances • Decrease in plant diversity over time • Poor vegetation cover	• Control salinity at the source (i.e., runoff water) • Increase flushing/dilution with clean source • Assess soil health • Establish appropriate salt tolerant plant communities
Rill Erosion (Active runoff channels cause depressions on exposed soil surface)	• Soil and site stability compromised: wind and water erosion, poor plant cover	• Assess current status and strategize restoration methods (i.e., Installation of erosion control materials, re-vegetate stand)

2.0 Wetlands and Shoreline Vegetation

2.2.1 It is recommended that an inspection by a professional wetland biologist be completed each summer to confirm the maintenance tasks, if any, that should be undertaken for the growing season.

2.2.2 The following summarizes the Wetland and Shoreline Vegetation Maintenance Do's and Don'ts.

2.2.2.1 Wetlands should not be disturbed in any way unless specifically recommended by the professional biologist in yearly inspection (see 2.2.1).

.1 Wetlands are biological systems that host a wide array of plants and animals which work together to purify water and can also be an effective tool for flood control (thick vegetation allows it to act as a sponge, slowly releasing water and decelerating its flow).

2.2.2.2 Shoreline vegetation should not be disturbed in any way unless specifically recommended by the professional biologist in yearly inspection (see 2.2.1).

.1 Bulrushes, cattails and other plants on the shoreline of the wetlands are specifically chosen for their ability to filter nutrients before they reach the water's edge, as well as for their capacity to regulate the flow of water coming in from the uplands. These plants are able to tolerate dry conditions and periods of prolonged flooding while providing a habitat to a wide variety of wildlife species.

2.2.2.3 Trees/Shrubs/Flowers

.1 Do not plant shrubs or trees, annuals or perennials in wetland or shoreline areas.

.2 Wetland and shoreline vegetation require sunlight and do not do well in shade.

.3 Digging holes can disturb the root structure of the wetland and shoreline vegetation and promote weed growth.

2.2.2.4 Do not use fertilizers or insecticides.

2.2.2.5 Do not attempt to clear algae using mechanical or chemical means.

2.2.3 Wetland Maintenance Management

2.2.3.1 Monitor

Visual inspection of pond should be done once per year to identify any disturbances (e.g., dying vegetation, abnormal flooding, etc.).

.1 The best time to assess a naturalized stormwater pond is from mid-July and early August when plants are at their peak productivity.

.2 Monitoring should also involve regular checks for invasive species in the wetland and upland areas so that these species can be controlled before they set seed.

.3 Monitoring intervals of stormwater ponds should also be increased following extreme rain events or during abnormally wet years. Water levels should not remain above NWL for periods longer than 30 days.

2.2.3.2 Water Levels

.1 Managed drawdowns are sometimes used to expose mudflats and shoreline, which allows the seeds of wetland plants to begin to germinate or existing vegetation to be cultivated. If a managed drawdown is required to improve a pond's state, they generally begin in early June with some water returned by late summer if plants are responding well.

.2 Some of the signs that may indicate the pond is not functioning properly include:

- Water loss/drying
- High rate of infilling with sediments
- Subsidence/compression of wetland bottom
- Elevated salinity
- Toxicity
- Lack of vegetation
- Low plant diversity
- Presence of harmful algae communities

.3 Water levels should not remain above NWL for periods longer than 30 days.

2.2.3.3 Algae

.1 Algae are an important, and naturally occurring, component of a healthy wetland ecosystem and they play a critical role in the exchange and balance of nutrients between the water column and the rest of the wetland vegetation.

.2 Natural algal communities assist in the proper functioning of the system; however, when the ratio of nitrogen to phosphorus required for algal growth shifts out of balance, the ecosystem may instead become occupied by potentially toxic blue-green algae.

.3 Algal growth reaches its maximum during the warm summer months. If large amounts of algae persist beyond these warm summer months this can be an indication that nutrient levels within the wetland are unbalanced and inquiries into the cause should be made

Table 2

A description of the potential problems that may be encountered in naturalized stormwater pond and the associated adaptive management strategies for correction.

Observation	Habitat Indicators	Adaptive Management Strategies
Water loss/drying	• Exposed soil areas • Salts present at soil surface • Invasive plant coverage	• Assess control structure for performance, settling • Assess and reduce outflows (control structure) • Conduct as-built to evaluate wetland surface elevations • Convert drier areas from wetland habitat to upland habitat • Reduce Active evapotranspiration (AET) (windbreaks, shading, shift in vegetation • Install a vegetative plant mix that possesses species which thrive in both drier and wetter conditions • Reduce recharge (incorporate fine-grained substrate) • Change water management schedules to take advantage of when water is available and when itis not
Abnormal increase of water levels for prolonged period (flooding)	• Water above NWL • Expansion of open water areas • Decrease in plant coverage or species flooded above top of biomass • Vegetation die-off • Littered biomass floating on the surface of the pond	• Manage a drawdown • Assess the cause of the flooding (e.g., pipe and/or outfall blockage, system backed-up, control structure failure)
High rate of infilling with sediments	• Increased turbidity • Decrease in vegetative and biological diversity • Increase in invasive plant species • Blocking of pipes and outfalls	• Dredge and reclaim • Stabilize upland soils with fast-growing vegetation using appropriate species • Add sediment traps upland / upstream • Use vegetative buffer throughout watershed • Slow flows to help sediments settle out
Subsidence/compression of wetland bottom	• Wetland water depths deeper than designed • Expansion of open water areas • Thinning in coverage of deeper emergent plant species over time	• Add to the sediment cap (infill back to original depth) • Allow to stabilize and adapt target functions • Manage water levels at lower elevations than planned
Elevated salinity	• Evidence of salt on soil surface • Change in species composition from freshwater plant species to saline species • Decrease in plant diversity over time • Establishment of saline ring around outer wetland edge	• Increase flushing / dilution • Control / increase surface input sources • Increase / change cap on bottom substrates • Establish saline-tolerant communities
Toxicity	• Fish and wildlife die-offs • Vegetation die-off	• Increase microbial community • Change organic content, nutrients (fertilizers, peat)

Lack of vegetation	• Decrease in abundance of wetland vegetation	• Conduct summer drawdown • Decrease time between drawdowns • Fertilize • If a consequence of herbivory (muskrats), then trap and remove muskrats.
Low wetland plant diversity	• Monotypic stands of vegetation present	• Control invasive species • Change water quality or adapt vegetation plantings to suit • Plant species which have low rates of natural dispersal • Manipulate water levels to encourage improved plant growth and wetland coverage
Presence of harmful algae communities	• Presence of harmful algae communities	• No management required if dominant algal communities are epiphyton, metaphyton and/or epipelon • Seek out second opinion if phytoplankton is dominant community to determine if community is harmful and whether it is a sporadic occurrence or result of a permanent shift in wetland Conditions