APPENDIX 1 - Requirements of Qualified Professionals for Arboricultural Works

APPENDIX 1 – REQUIREMENTS OF QUALIFIED PROFESSIONALS FOR ARBORICULTURAL WORKS

1.0 Tree Owners should engage appropriate Qualified Professionals to undertake different types of tree works. The recommended requirements of Qualified Professionals for different types of tree works are illustrated in the following tables.

Type of Tree Work	**Training / Academic / Professional Qualification and Work Experience**
Tree risk assessment and associated mitigation measure(s), including: ▪ Undertake on-site inspection; ▪ Recommend necessary mitigations for risk abatement; ▪ Supervise / undertake the recommended mitigation measure(s); and ▪ Prepare tree inspection report.	Follow the requirements of Inspection Officer as stipulated in the latest edition of “Guidelines on Tree Risk Assessment and Management Arrangement” issued by the GLTMS of DEVB.
Supervise / undertake tree operations, including: ▪ Preparation / updating of tree inventory; ▪ Tree planting; ▪ Regular tree maintenance, such as watering, weeding, fertilising, mulching, staking, pest and disease control, soil amelioration, etc.; ▪ Tree pruning; and ▪ Preparation of tree maintenance report.	Possess an academic / professional qualification in arboriculture and with minimum 3 years related post-qualification local experience.

2.0 Tree Owners can refer to GLTMS website at www.greening.gov.hk for information on the qualified professional groups for tree works, professional institutes for tree management work and other relevant information.

APPENDIX 2 - Sample Brief for Procurement of Arboricultural Services

APPENDIX 2 – SAMPLE BRIEF FOR PROCUREMENT OF ARBORICULTURAL SERVICES

This sample brief is for reference only. Tree Owner shall modify the content / scope of work to suit your own requirements in conducting tree works.

1.0 Objective of the Assignment

1.1 The objective of this Assignment is to *prepare / update tree inventory, carry out tree risk assessment, and undertake associated mitigation measures for trees** within the assessment area. The location and extent of assessment area is shown in Appendix .

2.0 Scope of Work

2.1 Arboricultural services to be carried out under this Assignment shall cover the following scope of work.

(i) Prepare / update* tree inventory for existing trees;

(ii) Carry out tree risk assessment through on-the-ground or aerial inspection (optional) for trees within the assessment area;

(iii) Record the inspection findings;

(iv) Recommend appropriate mitigation measures; and

(v) Carry out, supervise and record all the recommended mitigation measures (optional) [*Tree Owner can consider to carry out the mitigation measures under a separate contract].*

3.0 Description of the Assignment

3.1 The services provided by the Contractor to complete this Assignment shall meet the requirements as listed in clause 3.2 to 3.3 and to the satisfaction of the Employer.

3.2 <u>Preparation / Updating* of Tree Inventory</u>

3.2.1 The Contractor shall prepare / update* the tree inventory to record all information of existing trees within the assessment areas. Basic tree information, including tree identity number, species, size, health and structural conditions, and site information, such as number of each tree species, photos, tree layout plan, shall be included in the Tree Inventory.

3.2.2 After the completion of Tree Inventory, the Contractor shall submit an assessment report with the following information:

(i) Tree Schedule;

(ii) Tree Layout Plan; and

(iii) Photos of each individual tree.

3.3 Tree Risk Assessment (TRA)

The TRA should be carried out in accordance with to the latest version of "Guidelines for Tree Risk Assessment and Management Arrangement" issued by the Greening, Landscape, and Tree Management Section (GLTMS) of the Development Bureau (DEVB).

3.3.1 Identification of Target Areas

(i) The Contractor shall Identify the target areas within / adjacent to the assessment area according to the intensity and frequency of use.

3.3.2 Tree Basis Assessment - Tree Group Inspection (Form 1)

(i) After identification of target areas within the assessment area, the Contractor shall carry out Tree Group Inspection for the trees within target areas.

(ii) The main objective of Tree Group Inspection is to facilitate an initial screening of trees. Each tree in a tree group has to be inspected systematically for identifying potential tree hazards or tree required for more detailed individual tree risk assessment.

(iii) The Contractor shall carry out of any tests to the trees necessary for identifying trees for remedial action or detailed tree risk assessment.

(iv) The Contractor shall submit the report comprising the following to the Employer.

(a) The completed and endorsed Tree Group Inspection Form(s);

(b) Tree Layout Plan(s) showing the locations of the trees within target areas;

(c) Photo record(s) of the trees;

(d) Recommendations of mitigation measures for risk abatement; and

(e) Records of mitigation measures* *[delete if mitigation measures to be carried out under a separate contract].*

3.3.3 Tree Basis Assessment - Individual Tree Risk Assessment (Form 2)

(i) After completion of the Tree Group Inspection, the Contractor shall carry out "Individual Tree Risk Assessment" for the tree(s) recommended in the Tree Group Inspection report.

(ii) The Contractor shall submit the Individual Tree Risk Assessment report comprising the following to the Employer.

(a) The completed and endorsed Individual Tree Risk Assessment Form(s);
(b) Tree Location Plan;
(c) Photo record(s) of the tree;
(d) Other documents, such as any test report on the tree as necessary for further investigating the suspected defects to facilitate assessment of the tree condition and tree failure potential;
(e) Recommendations of mitigation measures for risk abatement; and
(f) Records of mitigation measures* *[delete if mitigation measures to be carried out under a separate contract].*

3.3.4 The Contractor shall provide all necessary tools, equipment and transportation for carrying out the Tree Group Inspection, Individual Tree Risk Assessment and mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*.

3.4 Mitigation Measures*
[delete if mitigation measures to be carried out under a separate contract]

(i) The Contractor shall submit a detail proposal of mitigation measures for each tree as recommended in Tree Group Inspection and Individual Tree Risk Assessment to the Employer for approval prior to commencement of the works. The proposal shall include:

(a) Work description;
(b) Annotated plan(s), photo(s) and drawing(s) for clear indication of the proposed arboricultural work; and
(c) Method statement for the proposed arboricultural work.

(ii) The Contractor shall adopt a suitable and safe method with compliance to the relevant prevailing occupational safety and health requirements and guidelines as promulgated by the Labour Department and the GLTMS of DEVB.

(iii) The Contractor shall submit the report comprising the following to the Employer:

(a) Record of the completed mitigation works; and

(b) Photo record(s) before and after operation.

4.0 Deliverables

4.1 The Contractor shall provide the following deliverables after completion of each stage of the works as part of the Assignment.

(i) _________copies of the updated* Tree Inventory;

(ii) _________copies of Tree Group Inspection Report;

(iii) _________copies of Individual Tree Risk Assessment Report; and

(iv) _________copies of record of completed mitigation measures*. *[delete if mitigation measures are carried out under a separate contract]*

4.2 All the submitted reports shall be in the form of an A4-sized, bound report which shall bear a report cover indicating the Contract number, the Contract title, the date of the report, and that the report is prepared and signed by the Inspection Officer. The format of the report shall be agreed by the Employer prior to submission of the report.

4.3 The Contractor shall provide hard and soft (electronic files) copies of all drawings and documents as required by the Employer during the contract period of the Assignment.

5.0 Programme of Implementation

5.1 The due date for the commencement of the Assignment shall be_____________. The due date(s) for the completion of Section 3 of the Assignment, including the submission of Inspection Reports and all necessary mitigation measures* *[delete if mitigation measures to be carried out under a separate contract]*, shall be_____________.

5.2 The Contractor shall submit the draft programme and revised draft programme within the following periods:

(i) Submission of the draft programme:

Within weeks of the due date for commencement of the Assignment

(ii) Submission of revised draft programme:

Within weeks from the instruction of the Employer

5.3 The draft programme and revised draft programme shall detail the activities to be carried out and target dates for particular tasks. The Contractor shall discuss with the Employer during the above periods to agree the timing of submission of reports, other documents and plans for each of the main elements of the Assignment.

6.0 Standards and Specifications

6.1 The Contractor shall adopt such guidelines, standards and specifications as are applicable to and in current use by the Government of the Hong Kong Special Administrative Region or, if non-existent, international Codes of Practice and Specifications. Reference can be made to the list of guidance documents in tree risk assessment and tree maintenance in the website of GLTMS at www.greening.gov.hk.

7.0 Information Provided by the Employer

7.1 All available information relevant to the Assignment will be provided to the Contractor.

Notes: * Deleted if not applicable.

APPENDIX 3 - Sample Format of Tree Inventory

APPENDIX 3 – SAMPLE FORMAT OF TREE INVENTORY

TREE INVENTORY

A. General Information

Property Name:		**Address:**			
Contract No. & Title:		**Survey Date:**		**Revision:**	

B. Tree Schedule

Tree No.	**Photo No.**	**Tree Species**		**DBH (mm)**	**Overall Height (M)**	**Crown Spread (M)**	**Structural Condition (Good / Fair / Poor)**	**Health Condition (Good /Fair / Poor)**	**Remarks**
		Chinese Name	**Botanical Name**						

C. Attached Information

☐ Tree Layout Plan(s) ☐ Tree record photo (s)

☐ Other drawing(s), e.g. updated planting plan to illustrate removed or added tree (Please specify)
____

☐ Tree management suggestion(s) ______________________________

Prepared by: ____________________ **Reviewed by:** ____________________

Post: ____________________ **Post:** ____________________

Signature: ____________________ **Signature:** ____________________

Date: ____________________ **Date:** ____________________

APPENDIX 4 - Guidelines for Tree Risk Assessment and Management Arrangement

GUIDELINES FOR TREE RISK ASSESSMENT AND MANAGEMENT ARRANGEMENT

(10th Edition)

人樹共融
綠滿家園
PEOPLE • TREES • HARMONY

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU

2023 (10th Edition)

CONTENT

Part 1 - RESPONSIBILITIES OF TREE MANAGEMENT DEPARTMENTS

1.1 PURPOSE

The Guidelines for Tree Risk Assessment and Management Arrangement (TRAM Guidelines) serve to provide technical and performance guidance on tree risk assessment, management, monitoring and maintenance. The key objectives are to:

(a) Maximise public safety

(b) Establish sustainable tree care practices

The TRAM Guidelines are based on international best practices with due consideration to the circumstances in Hong Kong. They should only be applied, supervised and endorsed by qualified inspection officers when exercising their professional judgment. They should not be used in a prescriptive manner, nor inhibit the development of new techniques or approaches that aim to add value to existing tree management practices. During the process of tree risk assessment, tree maintenance departments, inspection officers should consider the life-cycle of the tree and its relationship with its surrounds.

1.2 OBJECTIVES

For Tree Maintenance Departments[1]

- Recognise your role and responsibilities in tree risk assessment and management (TRAM) for all trees within your purview.
- Understand the importance of prioritising resources for undertaking TRAM of trees within high priority areas.
- Understand the importance of quality tree maintenance and risk assessment in protecting public safety.

For TRAM Inspection Officer

- Recognise your role and responsibilities in delivering quality TRAM work.
- Follow the TRAM Guidelines.
- Demonstrate competency and professionalism in your tree risk assessment.

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[1]Tree maintenance department refers to departments demarcated with tree maintenance responsibilities under DEVB TC(W) No. 6/2015 and its Appendix A.

1.3 STRUCTURE OF GUIDELINES

The Guidelines comprise the following four parts, together with a list of supplementary appendices.

Part 1 highlights the purpose and objective of the Guidelines, and the importance of adopting an integrated approach and strategic risk assessment in tree management.

Part 2 provides the overall framework and details in implementation of tree risk assessment.

Part 3 covers a set of baseline considerations to help the decision–making process in tree care.

Part 4 provides some practical checklists to facilitate tree management works.

1.4 INTEGRATED APPROACH IN TREE MANAGEMENT

The Government has adopted an ‘integrated approach’ in assigning responsibilities for preserving and maintaining trees on Government land among relevant departments. It is the responsibility of all tree maintenance departments to manage all assets, including trees, within areas, facilities and premises under their maintenance ambit.

A holistic process is adopted to the management of our assets. It is fundamental to understand that our trees are inextricably connected to and thus impacted by numerous bio-physical, bio-mechanical and urban conditions. Hence, the more dense and compact our urban environment, the more stress our trees will suffer. Trees grow on land that is managed by a range of responsible parties. This land may also contain soil, other vegetation and a host of other infrastructure and landscape elements that must be managed and maintained in a holistic manner.

1.5 STRATEGIC RISK ASSESSMENT IN TREE MANAGEMENT

Making reference to overseas best practices and taking into account the urban conditions in Hong Kong, the TRAM is based on a dual approach – Area Basis Assessment and Tree Basis Assessment.

Area Basis Assessment

- *Identify high priority areas where public will be affected if a tree fails.*

Tree Basis Assessment

- *Identify valuable trees (i.e. Old and Valuable Trees, stonewall trees, and Large Trees) and high risk trees within high priority areas.*
- *Assess tree conditions in accordance with a standardised format with emphasis on the risk angle.*

1.5.1 IDENTIFY YOUR HIGH PRIORITY AREAS FOR TREE RISK ASSESSMENT

Tree maintenance departments are required to identify areas where tree failure will pose a hazard to public safety, damage to property or cause disturbance to human activity and hence categorise the land under their management into tree risk management zones according to the intensity of use in target areas.

1.5.2 PRIORITISE RESOURCES FOR VALUABLE TREES AND HIGH RISK TREES

By identifying valuable trees and high risk trees, tree maintenance departments can allocate resources to conduct tree risk assessment efficiently and undertake appropriate mitigation measures as far as practicable in a timely manner to alleviate tree risk and prioritise management of these trees.

1.5.3 MITIGATE TREE RISK TO PROTECT PUBLIC SAFETY

Human safety is the most important aspect in tree risk management. Tree maintenance departments must undertake management diligence to keep trees in healthy and structurally sound conditions, identify hazardous trees and take appropriate mitigation measures as far as practicable in a timely manner to protect human safety. In case of conflict between tree preservation and public safety, the latter should be given the higher priority.

1.6 ENHANCEMENT MEASURES

The Task Force on Roadside Tree Planting and Maintenance proposed a number of improvement measures in tree management at the end of 2022, including the enhancement of TRAM guidelines. The key enhancement measures adopted in this updated version of TRAM are as follows:

1.6.1 EXPANDING THE SCOPE OF INDIVIDUAL TREE RISK ASSESSMENT

Noting that some tree failures involve relatively large trees growing at locations with stress, the scope of individual tree risk assessment (Form 2) is expanded to cover additional trees with a diameter at breast height (DBH) at 500 mm or above; or with overall height at 9 m or above; and are growing in confined areas, i.e. in tree pits or tree rings, or in unstable formation. This would help ensure that trees with potential high risk can be identified early (Part 2.4 of this guidelines refers).

1.6.2 ENHANCING IMPLEMENTATION OF RISK MITIGATION MEASURES

When a tree is identified as having health and/or structural problems, it is essential to work out appropriate mitigation measures to suitably reduce tree failure risk by specifying clearly the scope, nature and timeline of actions to be taken. An internal procedure to alert senior management of departments of delay in timely completion of necessary risk mitigation work should be put in place. (Part 2.5 of this guidelines refers).

1.6.3 MORE EXTENSIVE USE OF TECHNOLOGY IN TREE MANAGEMENT

Review of past tree incidents shows that use of suitable aid or equipment could have been very useful in providing additional information to supplement visual inspection for assessing the risk level of trees more accurately. This is particularly so for internal decay which is often not visible from the outside and defects of trees at high level which is hard to inspect from ground level. (Part 2.3.2 of this guidelines refers).

PART 2 – TREE RISK ASSESSMENT

2.1 IDENTIFY YOUR LAND ALLOCATION AND TREE STOCK

Before carrying out tree risk assessment, tree maintenance departments have to:

#	Requirements
1	Reconfirm the extent of all areas with trees under your maintenance ambit. It is recommended to refer to the Geospatial Information Hub (GIH) in the Government intranet (https://geoportal.landsd.ccgo.hksarg/geoportal/papp1/core/rgih/view/auth/landing) and check with Lands Department on the extent of all your land allocation. Reconfirm tree maintenance responsibilities demarcated under Development Bureau Technical Circulars.
2	Ensure all trees under your maintenance ambit are included in your tree risk assessment and maintenance works.

2.2 UNDERTAKE TREE RISK ASSESSMENT ON AREA BASIS

Tree maintenance departments are required to categorise all the sites under their management into tree risk management zones with reference to the intensity of use in target areas.

The tree risk assessment on an 'Area Basis' aims to:

- Identify areas where tree failure will pose a hazard to public safety or cause disruption to human activity; and
- Prioritise resources for tree risk management according to the frequency of use of the area.

Targets are people, property, or human activity that can be injured, damaged, or disrupted by a tree failure, e.g. partial or complete road closure. A tree cannot be a hazard without the presence of a target. For sites managed by departments, tree risk management zones are determined based on the intensity of use in target areas which would be affected by tree failure.

Such site categorisation also covers sites temporarily under the management of works departments during the course of public works projects. Works departments have to approach the departments that previously managed the trees, including the Maintenance Agent of SIMAR Slopes if any, to obtain the records of previous tree inspections for at least one year or as appropriate, and familiarise themselves with existing tree conditions prior to commencement of works.

2.2.1 CATEGORISATION OF TREE RISK MANAGEMENT ZONES

Categorisation of tree risk management zones is shown in the following table.

1. Intensive Use	
Definition	Areas of high traffic flow and/or high pedestrian flow, i.e. areas having traffic flow and/or pedestrian flow for at least a large portion of a day or a week.
Examples	Popular urban public parks and playgrounds, crowded streets, busy carriageways, open car parks, busy footpaths, areas adjacent to schools and buildings, popular barbecue sites in country parks, etc.
Tree Risk Management Zone	High (Category I)
Priority for Tree Risk Management	Top priority
Tree Risk Management Frequency	At least once a year before onset of wet season and when necessary (e.g. act on complaint)
2. Infrequent use	
Definition	Areas of low traffic flow and/or low pedestrian flow, i.e. target is present infrequently or irregularly within the areas.
Examples	Road verges of limited access, countryside roads, village footpaths, hiking trails, picnic sites in remote country parks, work site of a government project with hoardings and/or restricted access (except fall zone of trees, along edges of works site and abutting accessible road/ footpath, which may be classified as Zone 1 category), catchwater roads, country parks forest tracks, etc.
Tree Risk Management Zone	Medium (Category II)
Priority for Tree Risk Management	Second priority
Tree Risk Management Frequency	Every 3 to 5 years, if resources permit, and when necessary(e.g. act on complaint)
3. Rare use	
Definition	Areas of rare access such as inaccessible areas, i.e. target is not commonly present within the areas.
Examples	Remote countryside slopes, dense woodlands within water gathering grounds and/or country parks, maintenance access not open to public, etc.
Tree Risk Management Zone	Low (Category III)
Priority for Tree Risk Management	Low priority
Tree Risk Management Frequency	When necessary (e.g. act on complaint)

Appendix 1 - Working Examples of Demarcation of Tree Risk Management Zone

2.3 UNDERTAKE TREE RISK ASSESSMENT ON TREE BASIS

Once high tree risk management priority areas (i.e. Category I Zones) are identified, tree maintenance departments are required to undertake the risk assessment on tree basis for trees within Category I Zones.

#	Actions
1	Identify the valuable trees and high risk trees within Category I Zones.
2	Assess health and structural conditions of the identified trees systematically and professionally with particular emphasis on the risk perspective.
3	Use standardised forms promulgated by the DEVB to record the inspection findings.

2.3.1 TREE GROUP INSPECTION (FORM 1)

#	Objectives of Tree Group Inspection (Form 1)
1	Facilitate initial screening of trees within Category I Zones.
2	Keep records for further monitoring.
3	Make reference to the “Common Tree Problems” (https://www.greening.gov.hk/en/tree-care/common-tree-problems/index.html) and “Pictorial Guide for Tree Maintenance” (https://www.greening.gov.hk/filemanager/greening/en/content_28/Pictorial_Guide_for_Tree_Maintenance.pdf) to identify potential tree hazards for appropriate mitigation measures or for more detailed individual tree risk assessment using Form 2.

#	Actions for Undertaking Tree Group Inspection (Form 1)
1	Follow requirements for Inspection Officers in Appendix 3 to undertake Tree Group Inspection.
2	Inspect each tree in the tree group systematically.
3	Follow requirements as stipulated in Section 2.4 to undertake TRIAGE System.
4	Pay particular attention to potential tree hazards due to the health or structural conditions of each individual tree.
5	Use binoculars, or drone when applicable to obtain a closer view of the conditions of the canopy.
6	Use appropriate equipment and hand tools such as mallet, hand spade and probe, etc. for preliminary assessment of individual trees. (Please also refer to checklist 4.3.1)
7	Conduct sounding tests for trunks or accessible scaffold limbs with decay or suspected decay cavity, to assess the extent of structural problems.

#	Actions for Undertaking Tree Group Inspection (Form 1)
8	Undertake mitigation measures for trees with minor defects to mitigate tree risk.
9	Decide if an Individual Tree Risk Assessment (Form 2) will be necessary for a particular tree (Please refer to section 2.4.4).
10	Record all the findings in Form 1: Tree Group Inspection Form in Appendix 4 and upload the completed Form 1 to the TMCP.
11	Provide photo records in accordance with requirements as listed in Checklist 4.3.2 and Appendix 6.

For users with Tree Management Common Platform (TMCP) accounts, the use of Form 1 under the TMCP Windows Application is required. Departments using interface to transfer tree information shall continue to use TMIS until new interface between department and the TMCP system is established.

Appendix 2 –Landscape and Location Conditions

Appendix 3 - Requirements for Inspection Officers

Appendix 4 - Form 1: Tree Group Inspection Form

Appendix 5 - Explanatory Notes for Form 1

Appendix 6 - Photo-taking Guidelines for Tree Risk Assessment

2.3.2 INDIVIDUAL TREE RISK ASSESSMENT (FORM 2)

Form 2 is used for conducting detailed assessment of individual trees that need more attention. Using of technology in detailed assessment of individual trees (Table 2.3.2) such as aerial inspection of tree at height or checking internal conditions of trees are recommended.

#	Actions for Undertaking Individual Tree Risk Assessment (Form 2)
1	Follow requirements for Inspection Officers in Appendix 3 to undertake Individual Tree Risk Assessment.
2	Walk completely around the tree to inspect the site conditions, root collar, trunk, and branches including inspection of the tree from some distance away, as well as close up, to assess the tree condition in relation to its surroundings.
3	Use appropriate equipment and hand tools such as binoculars, mallet, hand spade and probe, etc. when required. Resistograph, tomograph or equipment for root detection should be arranged when necessary.
4	Conduct sounding tests for trunks or accessible scaffold limbs with decay or suspected decay cavity to assess the extent of structural problems.
5	Conduct root collar inspection for trees growing at confined sites or having suspected root defects which may adversely affect tree stability.
6	Conduct aerial inspection by tree climbing or drone when appropriate to assess the structural conditions for trees in areas with frequent use and suspected structural defects which are difficult to inspect at ground level.
7	Make reference to the 'Manual of the Management of Brown Root Rot Disease' and 'Note on Common Wood Decay Fungi on Urban Trees of Hong Kong' for tree inspection. Soil BRR disease and pathogen tests should be arranged when necessary.
8	Make reference to Appendix 2 - Landscape and Location Conditions for inspection of stonewall trees, trees in confined space, trees with ground disturbance and trees on slopes. Equipment for root detection can be arranged when necessary.

#	Actions for Undertaking Individual Tree Risk Assessment (Form 2)
9	Rate the tree risk rating with recommendations on follow-up mitigation actions to address the identified defects and tree problems. Please make reference to Appendix 8. Inspection Officer shall note: (a) If the tree species falls within the 20 common tree species requiring special attention or the tree has one or more major defects or health problems as shown in section 2.4.3, the rating for “Likelihood of Failure” should be duly considered to be rated at “ “Probable” or “Highly Probable” depends on the severity of the defects; (b) If the “Risk Rating” is “High” or “Extreme”, mitigation measures shall be recommended against the tree part with the target identified; (c) If mitigation measures is recommended, the “Residual Rating” shall be lower to “Moderate” or lower, otherwise, reconsideration of mitigation measures is required.
10	Follow the ‘Management Guidelines for Mature Trees’ and ‘Management Guidelines for Stonewall Trees’ in conducting tree inspection and formulating mitigation measures.
11	Record all the findings in Form 2: Tree Risk Assessment Form in Appendix 7 and upload the completed Form 2 report to the TMCP.
12	Provide photo records in accordance with requirements as listed in Checklist 4.3.2 and Appendix 6.

Table 2.3.2 - Examples of technology using in tree management

Technologies	Brief description	Application
1. Resistograph	Resistograph is a mechanical resistance measurement device. A long, thin needle driven to record the wood density, often to identify areas of decay. The equipment is intrusive in nature and should be used with care.	Trunk, branch and root defects

Technologies	Brief description	Application
2. Sonic Tomograph	The sonic tomograph is used for internal assessment of tree decay, measures the thickness of the residual wall of trees with internal defects such as cavities or decay non- invasively.	Internal decay, cavities or wound openings
3. Equipment for root detection, such as sonic tomograph	Sonic tomograph can detect the extent and conditions of roots under soil or pavement.	Tree root restriction in confined areas
4. Drone	Drone is unmanned aviation system that support reviewing tree conditions and defects at height.	Tree defects at branches or crown at height.

For users with TMCP accounts, the use of Form 2 under the TMCP Windows Application is required. Departments using interface to transfer tree information shall continue to use TMIS until new interface between department and the TMCP system is established.

Appendix 3 - Requirements for Inspection Officers

Appendix 6 - Photo-taking Guidelines for Tree Risk Assessment

Appendix 7 - Form 2: Tree Risk Assessment Form

Appendix 8 - Explanatory Notes for Form 2

2.4 THE TRIAGE SYSTEM

The Triage System is only for trees in Category I Zones. The purpose is to:

(i) Identify trees that require more urgent attention than others.

(ii) Prioritise these trees based on a combination of factors that impact a tree's structural health.

(iii) Prioritise mitigation works based on the TRIAGE classification of a tree.

2.4.1 TRIAGE TREES

- Dead trees
- Trees confirmed with Brown Root Rot (BRR) disease infection
- Old and Valuable Trees (OVTs)
- Stonewall trees (SWTs)
- Large trees with an individual trunk(s) DBH ≥ 500mm or overall height at 9 metres or above

2.4.2 TRIAGE CLASSIFICATION AND COLOURS

How TRIAGE System works?		
Tree maintenance departments have to classify their trees as per Section 2.4.1 within Category I Zones into the following four categories;		
Black	**= Hazardous**:	Trees programmed to be removed
Red	**= Attention:**	OVTs/SWTs and trees identified for prompt inspection and mitigation measures
Orange	**= Stressed:**	Large trees identified in confined growing environment or growing on unstable foundation that may be vulnerable to tree failure
Yellow	**= Remaining Triage Trees:**	Trees not in 'Black', 'Red' and "Orange" category

Categorisation, necessary action and monitoring requirements of Black, Red, Orange and Yellow trees are illustrated in the following tables.

Black	
Criteria	▪ Dead trees; or ▪ Non-OVTs confirmed with BRR disease infection.
Action	1. Tree removal within 4 weeks after completion of Form 1 inspection; or 2. If removal cannot be completed in 4 weeks, departments have to provide appropriate temporary mitigation measures as far as practicable to ensure public safety.
Monitoring Requirement	1. For Non-OVTs confirmed with BRR disease infection, (a) Undertake Form 2 assessment every 3 months to monitor the tree condition until the removal of the tree; and (b) Upload the completed Form 2 report to the TMCP.

RED	
Criteria	▪ OVTs / SWTs; or ▪ Large trees with individual trunk(s) DBH ≥ 500mm or overall height at 9 metres or above and with crown spread within dripline of confirmed BRR disease infected tree; or ▪ Large trees with individual trunk(s) DBH ≥ 500mm or overall height at 9 metres or above having one or more major structural defects or health problems. (please refer to 2.4.3).
Action	1. Undertake Form 2 assessment and complete appropriate mitigation measures within 6 weeks as far as practicable after completion of Form 1 inspection. 2. Upload the completed Form 1 and Form 2 reports to the TMCP.
Monitoring Requirement	1. Close monitoring by Form 2 assessment: (a) Every 3 months for BRR disease infected OVTs. (b) Every 6 months for remaining 'Red' category trees; and 2. Upload the completed Form 2 report to the TMCP; and 3. Undertake emergency inspection within 7 calendar days as far as practicable after the lowering of: (a) Typhoon Signal No. 8 or above; and

RED	
	(b) Red or Black Rainstorm Signal. The emergency inspection should focus on the damage, stability and potential hazard that the tree poses to the public.
Downgrading Mechanism	1. To downgrade a 'Red' category tree to "Orange" or 'Yellow' category, tree maintenance department needs to: (a) Undertake all the mitigation measures as recommended in Form 2 assessment to alleviate the residual risk rating to "moderate" or below. (b) Confirm the major structural defects or health problems have been mitigated. (c) Record the recommendation for downgrading the tree to "Orange" or 'Yellow' category in Form 2. (d) Upload the completed Form 2 report to the TMCP.

ORANGE	
Criteria	▪ Large trees with individual trunk(s) DBH ≥ 500mm or overall height at 9 metres or above; and ▪ Trees are growing in confined site, i.e. tree pits or tree rings or growing on unstable foundation, i.e. large rock or thin soil layer with root ball exposed; and ▪ Trees are not genera or species of the family Arecaceae (Palmae)
Action	1. Undertake Form 2 assessment and upload the completed Form 2 report to the TMCP; and 2. Undertake appropriate mitigation measures.
Monitoring Requirement	1. Undertake Form 2 assessment every 12 months; and 2. Undertake appropriate mitigation measures within 6 weeks after Form 2 assessment as far as practicable; and 3. Upload the completed Form 2 report to the TMCP.

YELLOW	
Criteria	▪ Triage trees that are not classified in 'Black', 'Red' and 'Orange' categories.
Action	1. Undertake Form 2 assessment and provide appropriate mitigation measures to trees that have no visible or with minor structural defects or health problems if resources permit. 2. Upload the completed Form 2 report to the TMCP
Monitoring Requirement	1. Undertake Form 2 assessment and provide appropriate mitigation measures if resource permit; and 2. Upload the completed Form 2 report to the TMCP.

2.4.3 MAJOR DEFECTS OR HEALTH PROBLEMS OF A TREE

Examples of major structural defects or health problems are as follows:

(a) Leaning ≥ 15 degree in any direction (except stonewall tree) AND with restricted root growing / cut root on the tension side;

(b) Co-dominant trunk with splitting included bark;

(c) Large crack, split trunk or open cavity having the longest axis ≥ 1/3 of trunk diameter;

(d) Root crack or split more than 120 degree on the root flare;

(e) Root rot extended to more than 1/3 on the root flare;

(f) Root plate movement and dead root/severe root cut/restricted at the tension side;

(g) Extensive growth of fruiting bodies of wood decay fungi at trunk and root zone within dripline; and

(h) Anomaly when compared with trees of same species in the vicinity, e.g. untimely defoliation, dieback.

2.4.4 TREES NOT UNDER TRIAGE SYSTEM

For other trees in Category I Zones not assessed through TRIAGE System, tree maintenance departments are required to identify the trees with the following criteria in Tree Group Inspection for implementing proper mitigation measures and undertaking Individual Tree Risk Assessment (Form 2) if necessary.

- Trees on a complaint list with structural or health problems.
- Trees belonging to species with brittle wood structure and having

unsatisfactory health or structural conditions with failure potential.

- Trees with major defects or health problems (please refer to 2.4.3).
- Trees growing in very stressful site conditions, i.e. severe root restriction, severe headroom restriction, with failure potential.

If a detailed tree risk assessment of individual tree is required, Form 2 shall be used for assessment on the tree conditions and formulation of appropriate mitigation measures. The completed Form 2 report shall be uploaded to the TMCP.

2.5 MITIGATION MEASURES

To ensure public safety, tree maintenance departments are required to carry out necessary mitigation measures, such as tree pruning, installation of support system, pest and disease control, site condition improvement works and / or tree removal promptly to alleviate the risk of failure.

#	Requirements
1	Refer to the "Guidelines on Arboriculture Occupational Safety and Health" issued by the DEVB and ensure adequate occupational safety and health measures in carrying out the tree works.
2	Refer to the guidelines promulgated by the GLTMS on proper pruning practices, such as "Guidelines on Tree Pruning", "Do's and Don'ts in Pruning" and "Tree Management Practice Note No. 3: Tree Pruning".
3	Refer to the "Guideline on Pavement Renovation Works and Tree Stability" issued by the GLTMS for trees in stressful conditions.
4	Refer to guidelines promulgated by the GLTMS on pest and disease control, such as "Manual of the Management of Brown Root Rot Disease" and "Note on Common Wood Decay Fungi on Urban Trees of Hong Kong".
5	Refer to the "Proper Planting Practice – Staking and Guying" promulgated by the GLTMS on the installation of support system.

Please refer to GLTMS website at https://www.greening.gov.hk/en/home/index.html for the latest Guidelines or Practice Notes on tree care.

2.5.1 MITIGATION MEASURES COMMENSURATE WITH THE RISK LEVEL

For trees assessed "High" or "Extreme" on "Overall Tree Risk Rating" in individual tree risk assessment, i.e. Form 2, appropriate mitigation measure shall be recommended to lower the "Overall Residual Risk" rating to "Moderate" or lower. If the proposed mitigation measures cannot achieve the lowering of risk rating, revised mitigation measures or removal of the whole tree shall be considered. Furthermore, departments should put in place internal procedures to alert senior management of delay in timely completion of necessary risk mitigation work.

Tree maintenance departments are required to follow the requirements as stated in the Technical Circular on 'Tree Preservation' (DEVB TC(W) No. 4/2020 or its latest version) to carry out tree removal and compensatory planting. Factors, such as available growing space and soil to sustain healthy tree growth, gradient of slopes, etc. have to be considered.

2.6 SENSITIVITY ANALYSIS

Please refer to Section 3.3 for the details of Sensitivity Analysis.

2.7 RECORD KEEPING

Tree maintenance departments are required to keep retrievable and accurate records of tree risk assessments, risk mitigation measures, monitoring programme undertaken for the trees under their management and tree failure report. ALL completed Form 1 and Form 2 reports shall be submitted to the TMCP for recording within two months from date of inspection.

2.8 AUDIT INSPECTION

Tree maintenance departments are required to set up a departmental audit checking mechanism to:
(a) Ensure tree risk assessment is carried out properly and professionally.
(b) Ensure necessary mitigation measures are carried out promptly.

#	Actions
1	Refer to 'Guidelines on Audit of Tree Risk Assessment' on the GLTMS website.
2	The audit checks shall cover not less than 10% of total number of Form 1 and 10% of Form 2 carried out by in-house staff and / or tree risk assessments conducted by outsourced service providers.
3	Conduct the audit checks by qualified personnel as stipulated in 'Guidelines on Audit of Tree Risk Assessment' as soon as practicable to monitor the quality of the assessment. In-house audit should be conducted by different team to ensure the impartiality.
4	Review the accuracy and completeness of records.
5	Check for appropriateness of the mitigation measures and against the timelines for completion.
6	Follow up promptly with any irregularities identified during the audit checks.
7	Upload the "Audited" forms to the TMCP. Tree risk assessments and related procedures carried out by departments are subject to further audit checks by the GLTMS.

PART 3 – TREE CARE

Responsible tree care is a team effort. Its success is founded upon the clarity of roles, responsibilities and communication amongst internal and external personnel. The following sections provide a set of baseline considerations to help the decision–making process in delivering quality work to international best practice.

3.1 MANAGEMENT

The table below illustrates the different levels of responsibilities in the process of decision-making:

Strategic Decision (directorate)	Professional Decision (managerial)	Operational Decision (frontline)
• Establish the direction of steer. • Formulate principles of judging the alternatives. • Brainstorm and analyse the different choices. • Give steer. • Oversee outcome. • Evaluate feedback and prioritise departmental resources.	• Recognise the need for a steer. • Generate alternatives. • Evaluate the alternatives. • Green light to execute or seek steer. • Monitor outcome. • Gather feedback. • Evaluate feedback and refine work processes.	• Identify, verify and establish the tree problem. • Carry out assessment and determine the constraints. • Identify alternatives and recommend the preferred option. • Execute or seek steer. • Evaluate results and provide feedback.

Purpose
To maximise the long-term efficiency and effectiveness of tree management, maintenance, monitoring and compliance.

#	Actions
1	A robust institutional set up of qualified and trained in-house staff to undertake the required duties to meet the short, medium and long-term delivery on all aspects of tree management.
2	A strategic framework to progressively procure, train and qualify in-house staff to meet the short, medium and long-term needs.
3	Verify tree works are carried out, supervised, monitored and validated by relevant personnel.
4	Communication and consultation are efficiently and effectively undertaken to manage public expectations and sensitivities.
5	The tree management supply chain complies with all requirements at all stages of works.

#	Communication
1	Communication framework that clearly identifies the following: ▪ Chain of command;

	▪ Feedback loops; ▪ Timeframes for communicating to different parties; ▪ Consultation requirements to parties such as, but not limited to: stakeholders; local residents; District Councils; government departments, bureaux and agencies; ▪ Method of communication and consultation such as types and frequency of meetings; notifications; forums; displays.
2	A developed and tested emergency communication procedure in the event of tree failure or emergency tree removal.
3	Suite of communication templates that can be readily deployed to succinctly and factually articulate: ▪ Upcoming scheduled works; ▪ Chronology of events; ▪ Progressive updates.
4	Assigned personnel to execute the communication framework across all stages of works.

#	Documentation
1	A robust set of contract documents and technical specifications that covers all required aspects of tree care to meet the quality standards as detailed in all relevant Technical Circulars, Guidelines and Standards, the British Standards BS3998, the American National Standards ANSI Z133 and ANSI A300 as the reference.
2	Contract documents that clearly articulate the following: ▪ Defined standards-based scope of works. ▪ Required services with onus on the Contractor to deliver methodology of works; completeness of documentation; inspection points; sign-offs; regulatory approvals during all stages of works. ▪ Measurable outputs through contract enforcement procedures.
3	Verify documentation and compliance to record-keeping standards and protocols.

3.2 MAINTENANCE

Quality tree care starts when a tree is selected and planted. Good maintenance assures the tree's sound establishment and healthy growth throughout its life, minimises remedial costs and significantly contributes to tree safety.

Purpose
To instill a positive culture and quality practices toward the long-term care of your tree assets and minimise risk to 'As Low As Reasonably Practicable' (ALARP).

#	Actions
1	Confirm that the contract specifies all maintenance requirement details.
2	Make reference to prevailing technical circulars, practice notes and guidelines, such as "Tree Care" and "Resource Centre" under the Greening, Landscape and Tree Management Websites of Development Bureau (https://www.greening.gov.hk/en/home/index.html)
3	Conform to government planting guidelines and international best practices.
4	Right tree in the right place: ▪ Plant with clear objectives. Choose the right species. ▪ Procurement of quality nursery stock: Buy young, buy healthy. ▪ Thorough site and stock preparation before planting. ▪ Provide and maintain optimal environment for healthy tree growth such as but not limited to: adequate aerial and underground space for sustainable growth; fertile soil of appropriate type, well aerated, correct soil volume and optimum moisture content; proper drainage.
5	Structural training at right age and right time to achieve structural integrity for life.
6	Draw up maintenance planner to plan ahead and coordinate effectively.
7	Engage qualified professionals to assess and maintain the trees. Undertake TRAM to maximise tree safety (Part 2 refers).
8	Instill proper arboricultural practice in all facets of tree maintenance.
9	Protect trees from construction damage.
10	Build and upkeep staff knowledge, skills and quality of work through continuous training and knowledge sharing.

#	Communication
1	Proactive communication both internally and externally with suppliers and contractors for: ▪ Recognising areas for improvement for prompt follow-up; ▪ Establish feedback loop for improvement; ▪ Regular review of maintenance planner to improve workflow and better use of resources.
2	Close and constant liaison with suppliers for provision of quality stock and equipment.
3	Maintain supervisory accountability through establishing communication two-way across all levels to facilitate supervision and reflection.

#	Documentation
1	Succinct and informative maintenance manual.
2	Clear, retrievable maintenance records.
3	Up to date inventory or database of tree asset.
4	Regular | Scheduled | Programmed update of tree inventory with a particular focus on OVTs, SWTs, TRIAGE trees and trees require regular monitoring (Section 2.7 refers); Upload tree risk assessment forms to the TMCP timely.

3.3 SENSITIVITY ANALYSIS

Trees of particular interest often draw intense public attention. When removal (including dead trees) or transplanting of these particular types of trees is necessary, tree maintenance departments are required to undertake a Sensitivity Analysis to consider the potential social impact to the community for advance planning and decision-making before tree removal. The purpose of Sensitivity Analysis is to address social concern, to improve communication and prepare proactive responses to stakeholders in the community.

3.3.1 TREES FOR SENSITIVITY ANALYSIS

The objective of Sensitivity Analysis is to enhance transparency, assist in communication with the Urban Forestry Advisory Panel (UFAP) members, and address potential public concern on particular tree removal.

Tree maintenance departments shall undertake Sensitivity Analysis when considering the proposed removal (including dead tree) or transplanting of trees of particular interest under non-emergency circumstances. Examples of trees of particular interest are listed as below for reference:

(a) OVTs and trees that are potentially registerable in the Register of OVTs;
(b) Trees of 100 years old or above;
(c) Trees with trunk diameter equal to or exceeding 1.0 m (measured at 1.3m above ground level), or with height/canopy spread equal to or exceeding 25 m;
(d) Stonewall trees or trees of outstanding form (taking account of overall tree sizes, shape and any special features);
(e) Rare tree species listed in ‘Rare and Precious Plants of Hong Kong’ published by Agriculture, Fisheries and Conservation Department;
(f) Endangered plant species protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap 586);
(g) Tree species listed in the Forestry Regulations (Cap 96A) under the Forests and Countryside Ordinance (Cap. 96);
(h) Well-known Fung Shui trees;
(i) Landmark trees with evidential records to support the historical or cultural significance of the trees;
(j) Trees which may arouse widespread public concerns; or
(k) Trees which may be subject to strong local objections on removal.

3.3.2 CHECKLIST FOR SENSITIVITY ANALYSIS

Responsible officer of senior professional rank or equivalent is recommended to follow the checklists in Section 4.3.3 to undertake the Sensitivity Analysis.

3.4 MONITORING

Improvement in tree management performance relies on continuous monitoring and evaluation which help track work progress and facilitate decision making. Monitoring and evaluation processes can be undertaken in-house or outsourced, but independence of the monitoring team is important in ensuring credibility.

Purpose

To validate the integrity of your tree management programme and facilitate continuous feedback and improvement.

#	Actions
1	Establish clear objectives in drawing up the monitoring programme.
2	Sound, systematic and consistent monitoring methodology.
3	Compliance check against contract specifications, government guidelines and regulations.
4	Desktop review for quality of output and deliverables.
5	Site checks for accuracy against written records.
6	Track progress.
7	Promptly rectify identified anomalies. Investigate and analyse the cause.
8	Carry out regulatory actions as required.
9	Forward-looking evaluation to improve workflow and refine approaches.
10	Review effectiveness and make adjustments in future work.

#	Communication
1	Clear chain of command for effective communication and prompt follow-up.
2	Evidence based findings clearly conveyed to staff and contractors.
3	Clear time frame for reporting rectified output.
4	Inform management on systematic issues identified.

#	Documentation
1	A set of record that clearly articulate the following: ▪ Date, time, personnel involved, type of tree management work, observations, result of each monitoring event; ▪ All communications with outsourced service provider (consultants and contractors); ▪ Follow-up action of identified anomaly and / or disorder.
2	Monitoring manual with clear objectives, methodology and schedule.
3	Retrievable records of monitoring results.
4	Updated records of rectified deliverables.
5	Report on systematic issues and improvement recommendations.

3.5 COMPLIANCE

Compliance reflects competence and success of departments in meeting the required standards and delivery of quality work. It involves an ongoing process of auditing and monitoring.

Purpose
To validate the accuracy of tree management actions, communication and documentation against current internal and external policies, procedures, regulations and guidelines.

#	Actions
1	Establish systematic internal control procedures that comply with the "Guidelines on Audit of Tree Risk Assessment" (Section 2.9 refers).
2	Engage independent personnel, such as in-house audit by a different team, to achieve an objective audit as far as practicable.
3	Identify key elements for audit.
4	Review output and deliverables for evidence of non-compliance.
5	Investigate the cause of non-compliance.
6	Explore ways to rectify non-compliance.
7	Recommend improvement measures to prevent recurrence of non- compliance or non-conformity.
8	Senior management to review the need for refinement of departmental policies, strategies, regulations, guidelines, procedures and resource allocation.
9	Senior management to identify and recommend areas for long-term improvement.

#	Communication
1	Verify compliance to set communication processes.
2	Verify completeness of communication and consultation material including but not limited to: minutes of meetings; follow-up actions; confirmation of recorded information; prompt correction to inaccurate or misleading public statements.
3	Auditors to maintain constructive communication with auditees.
4	Auditees to receive feedback from auditors with openness.
5	Encourage information sharing on feedback and recommendation to bridge performance gaps across different teams of the department.

#	Documentation
1	Audit manual or guideline with clear objectives, scope and schedule.
2	Retrievable records of audit results and recommendations.
3	Retrievable records of improvement measures implemented.

PART 4 – FORMS | TEMPLATES | CHECKLISTS

Good planning and close supervision are essential to the delivery of quality tree management work. This part provides some tools including forms, templates and checklists to assist you in carrying out your work more effectively. You can customise them to suit your departmental use.

4.1 FORMS

Good forms help to define the scope and level of details of the data required, standardise the format of the acquired data to facilitate data management and analysis, and provide structured way of understanding the attributes of the tree management results so that the senior management can understand how results are reported. The Form 1 and 2 provided under this guidelines serve to list out the fundamental details that the Inspection Officer has to collect on site and any supplementary information including photos, site plans, elaborated observations, results of inspection through advanced equipment should complement the forms to give a comprehensive account of the conditions of the inspected trees.

4.2 TEMPLATES

Templates control the overall look and layout of any required messages to facilitate communication within each department and with stakeholders and interest groups. They contain essential information / elements of common interest.

4.2.1 REPORTING

From time to time, there are cases that draw media and / or public attention and written reports apart from tree inspection records are essential to enhance public understanding of the situation. Written reports produced under these situations should be comprehensive, concise, convincing and conclusive. The format of reporting should refer to the ANSI A300 (Part 9) – 2017 Tree Risk Assessment, Section 94 .6.2.1. This should be the minimum standard adopted by all inspection officers. It is the responsibility of such officers to provide a well-planned and considered report. The content should be thorough in its investigation and assessment; quantifiable in data and completeness in facts and documentation.

Identification and location of the specified tree(s);

A description of the methods used;

Tree risk assessment data;

Recommendations for mitigating risk or additional assessments; and

Recommendations for monitoring and follow-up.

4.2.2 SIGNS AND NOTICES

Display of signs and notices on site well in advance are useful for communication with the local community and enhances transparency of departments' work on specific trees. They also serve as visual reminders to the general public on hazards that may be associated with the trees. Some suggested examples are provided below:

Warning sign on pest treatment

植物噴有農藥，切勿觸摸。

Plants sprayed with pesticides / insecticides.
Do not touch

負責樹木護養部門:
Responsible tree maintenance department: ______________________

聯絡電話:
Contact telephone number: ______________________

Notice on tree hazard and removal

經樹藝師詳細檢查後，確認此樹

[根系腐爛/顯著傾側/其他缺陷(請簡述)]，

並有潛在倒塌危險，此樹將於___月___日移除，

以保障公眾安全。

After detailed inspection by arborist, this tree was confirmed to have potential danger of collapse due to *(decay / leaning / other defects to be specified)*. This tree will be removed on (Date) to ensure public safety.

負責樹木護養部門:
Responsible tree maintenance department: ______________________

聯絡電話:
Contact telephone number: ______________________

4.3 CHECKLISTS

Good checklists can provide record and aid the management in ensuring that all aspects of the work and / or processes are considered comprehensively.

The following checklists are provided for reference.

#	Content
1	Basic Equipment / Tools and Personal Protective Equipment for Tree Inspection
2	Photographic Documentation for Tree Risk Assessment
3	Sensitivity Analysis
4	Tree Removal (non-emergency situation)

4.3.1 CHECKLIST: BASIC EQUIPMENT / TOOLS AND PERSONAL PROTECTIVE EQUIPMENT FOR TREE INSPECTION

Equipment / Tools and Personal Protective Equipment for Tree Inspection	
I. Basic Equipment / Tools	
Camera	☐
Mallet	☐
Binoculars	☐
Diameter tape / Tape measure / Tapeline	☐
Notepad and Stationery	☐
Hand spade (Optional)	☐
Probe (Optional)	☐
Gloves (Optional)	☐
Shoe covers (Optional)	☐
Clinometer (Optional)	☐
Magnifying glass (Optional)	☐
Portable flashlight (Optional)	☐
Note Equipment shall be kept clean and maintained in good condition. Equipment that has been in contact with confirmed / suspected Brown Root Rot infected trees should be disinfected immediately after operation. Gloves and shoe covers should be disinfected or properly disposed after use.	
II. Personal protective equipment (PPE)	
Clothing and footwear appropriate for work condition and weather	☐
Drinking water	☐
First-aid kit	☐
Hard hat / Helmet	☐
Reflective vest	☐
Sun glasses (Optional)	☐
Sun screen (Optional)	☐
Insect repellent (Optional)	☐
Responsibilities Employers have duties on guidance, training and supervision with respect to use of PPE. They should ensure that their employees know why and when PPE is used, its maintenance or replacement schedule and limitations. They should regularly monitor proper use of PPE and thoroughly investigate causes of any non-compliance in using PPE. Appropriate and regular reminder to employees to use PPE is necessary, such as job briefing, signs posted on work sites etc. **Enquiries** For enquiries about occupational health and hygiene matters, you may contact the Labour Department's Occupational Safety and Health Branch through: Telephone: 2852 4041 Fax: 2581 2049 Email: enquiry@labour.gov.hk. Information on the services offered by the Labour Department and on major labour legislation can also be found on website at http://www.labour.gov.hk.	

4.3.2 CHECKLIST: PHOTOGRAPHIC DOCUMENTATION FOR TREE RISK ASSESSMENT

Photographic Documentation for Tree Risk Assessment	
I. General	
All photos are illustrated with dates and time.	☐
All photos are coloured.	☐
Proper annotations and descriptions are provided.	☐
For record of remedial measures, photos should be taken from similar view angles and clearly show the tree condition before and after the operation.	☐
All photos are taken in a specific manner to reflect the change of the tree groups or the individual trees when comparing to the relevant and retrievable records.	☐
II. Form 1	
Overall views showing the tree group and its adjacent site conditions.	☐
All trees should be clearly seen in photos, though a photo can cover more than one tree. Closer views of the tree group from different angles clearly showing its conditions.	☐
Views showing site conditions or changes that may have an impact on tree health or structural conditions.	☐
Views showing the potential impact on targets / sensitivity in case of tree failure.	☐
Views clearly showing tree health and structural conditions, in particular for stand-alone trees and street trees, are captured as far as practicable.	☐
Close-up views clearly showing trees having notable arboricultural defects, disorders or anomalies (if any).	☐

Photographic Documentation for Tree Risk Assessment	
III. Form 2	
A. Overall Condition	
Overall views showing the tree from different angles, its adjacent site condition and extent of leaning (if applicable).	☐
Views showing site conditions or changes that may have an impact on tree health or structural conditions.	☐
Views showing the potential impact on targets / sensitivity in case of tree failure.	☐
B. Crown Condition	
Views showing general conditions of the crown to illustrate the vigour, foliage density and colour.	☐
Close up views for crown defects.	☐
C. Trunk and Branch Condition	
Views showing general conditions of the trunk(s) and major branches illustrating the structural integrity.	☐
Close up views for trunk and / or branch defects.	☐
D. Lower Trunk / Root Condition	
Views showing general conditions of the root flare and disturbance that may damage the root zone.	☐
Close up views of lower trunk and / or root defects.	☐

4.3.3 CHECKLIST: SENSITIVITY ANALYSIS

Responsible officer of senior professional rank or equivalent is recommended to follow the checklists to undertake the Sensitivity Analysis.

Sensitivity Analysis	
I. Actions	
Report to the departmental directorate level of the tree maintenance department on the proposed removal of tree.	☐
Explore alternative options of mitigation measures.	☐
Directorate level officer to validate tree removal proposal and options of mitigation measures; and evaluate reporting requirements to address public concern on the tree removal proposal.	☐
Consult GLTMS on the proposed mitigation measures and the UFAP when necessary.	☐
Seek appropriate approval of the tree removal proposal.	☐
II. Communication	
Involve other relevant professionals for further site inspection or review alternative mitigation measures if necessary.	☐
If tree removal is still considered necessary, engage concerned stakeholders in communication prior to commencement of any tree works.	☐
Prepare proactive responses to stakeholders in the community.	☐
Identifying the parties, key opinion leaders and community personalities in the community (e.g. District Council (DC), local organisations, local residents, relevant concern groups, etc. to be consulted and the likely responses of these parties.	☐
Appropriate initiatives (e.g. community involvement event, memorabilia, replanting, etc.) in commemoration of the tree should also be considered and included in the community engagement plan.	☐
All consultation should be undertaken with clarity of risk rationale in conjunction with the landscape enhancement plan.	☐
III. Documentation	
Tree Risk Assessment Forms (i.e. Form 1 and 2).	☐
Tree Risk Assessment reports, e.g. tree inspection reports by resistography or sonic tomography.	☐
Records of mitigation measures.	☐
Previous maintenance records.	☐

4.3.4 CHECKLIST: TREE REMOVAL (NON-EMERGENCY SITUATION)

Tree Removal (non-emergency situation)	
A. Actions	
Department to prepare Tree Preservation and Removal Proposal (TPRP) for TWVP approval as appropriate; or check for blanket approval from LandsD to process TPRP.	☐
Check if trees of particular interest, irrespective living or dead, are involved, conduct Sensitivity Analysis when necessary.	☐
B. Relevant Documentation	
TPRP as required by relevant DEVB's technical circular.	☐
C. Signs and Notices	
Display of signs and notices well in advance of proposed tree works	☐

Appendix 1 - Work Examples of Demarcation of Tree Risk Management Zone

1. Example One: Shing Mun Country Park

Step 1: Desktop Demarcation

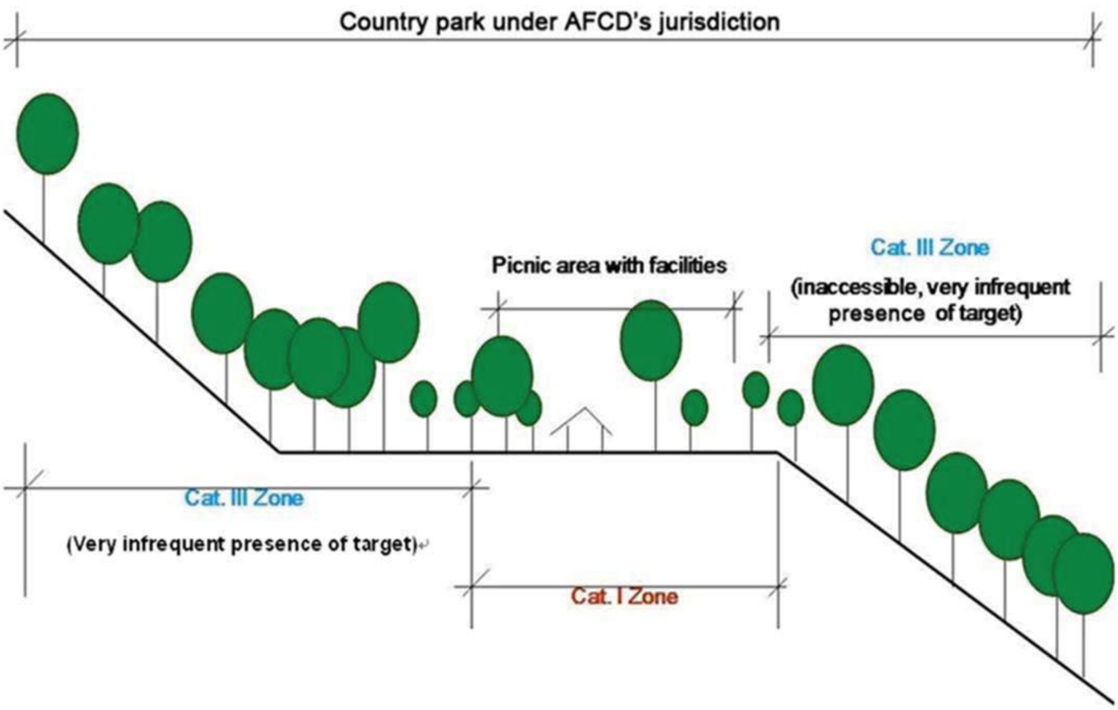
Step 2

Step 3

Step 4

(source of photo: AFCD)

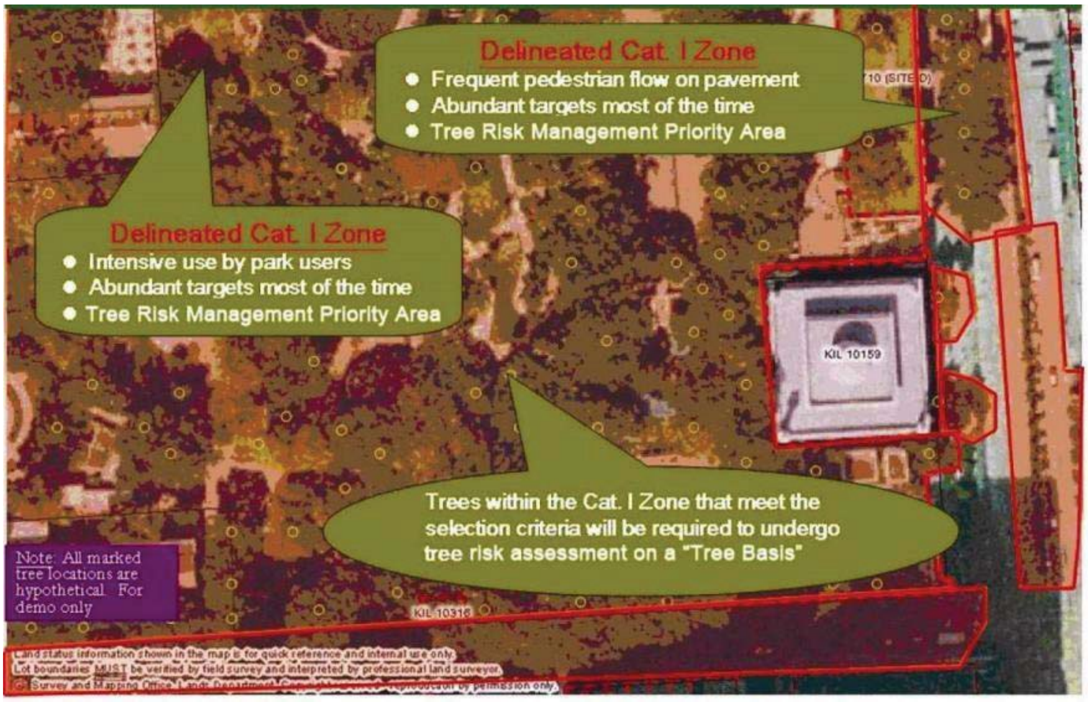
Step 5



2. Example Two: Kowloon Park and pavements along Nathan Road, Tsim Sha Tsui

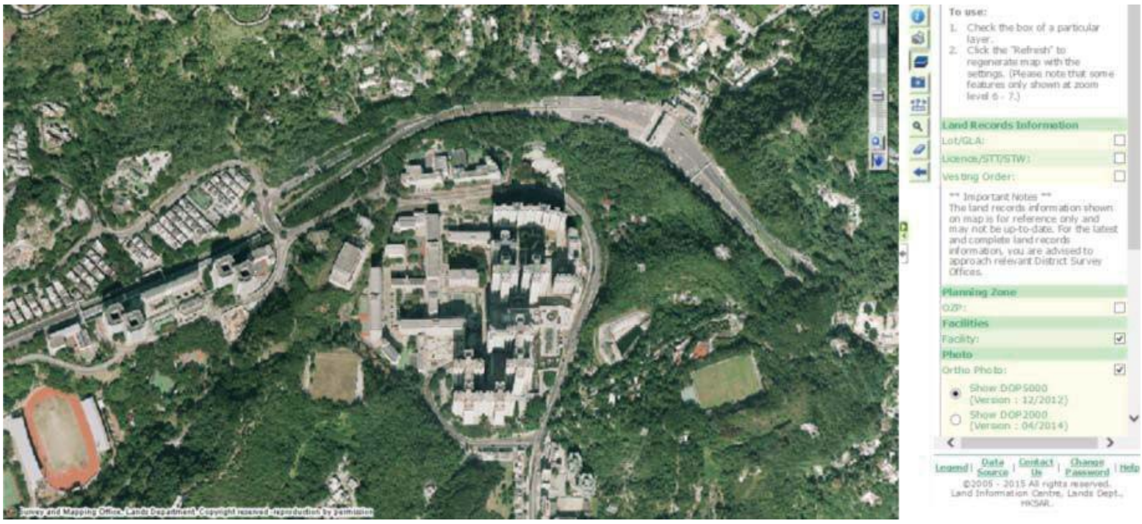
Step 1: Desktop Demarcation

Step 2



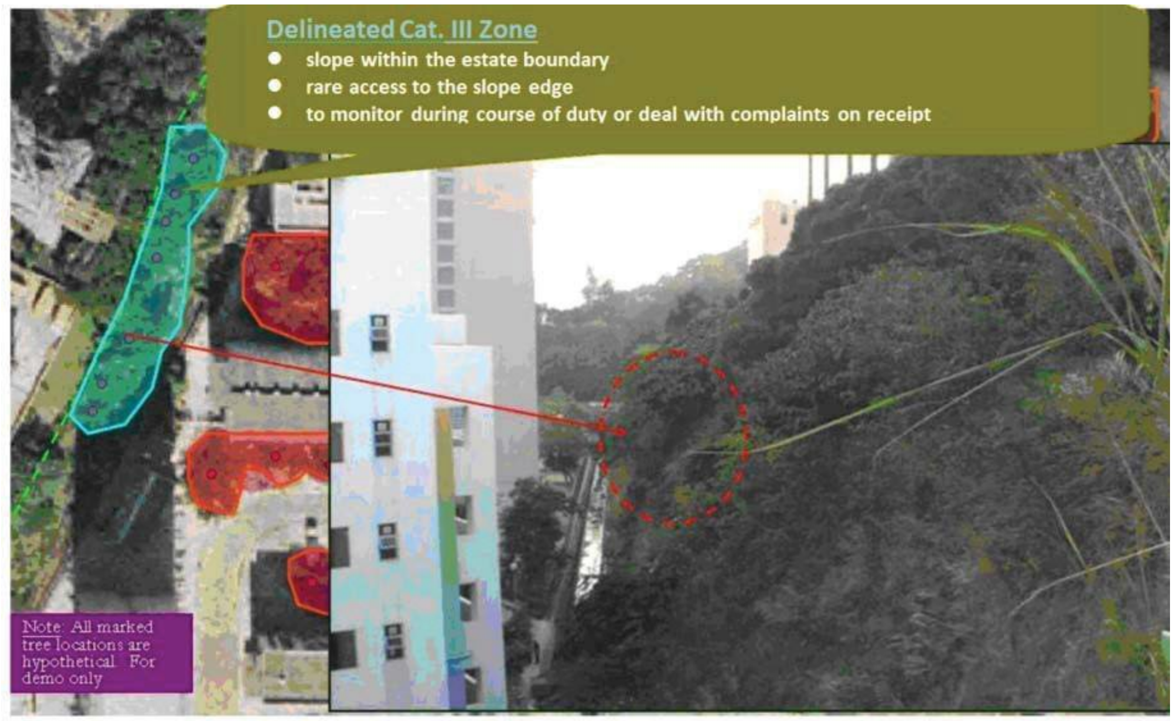
3. Example Three: Lei Muk Shu Estate, Kwai Chung

Step 1: Desktop Demarcation

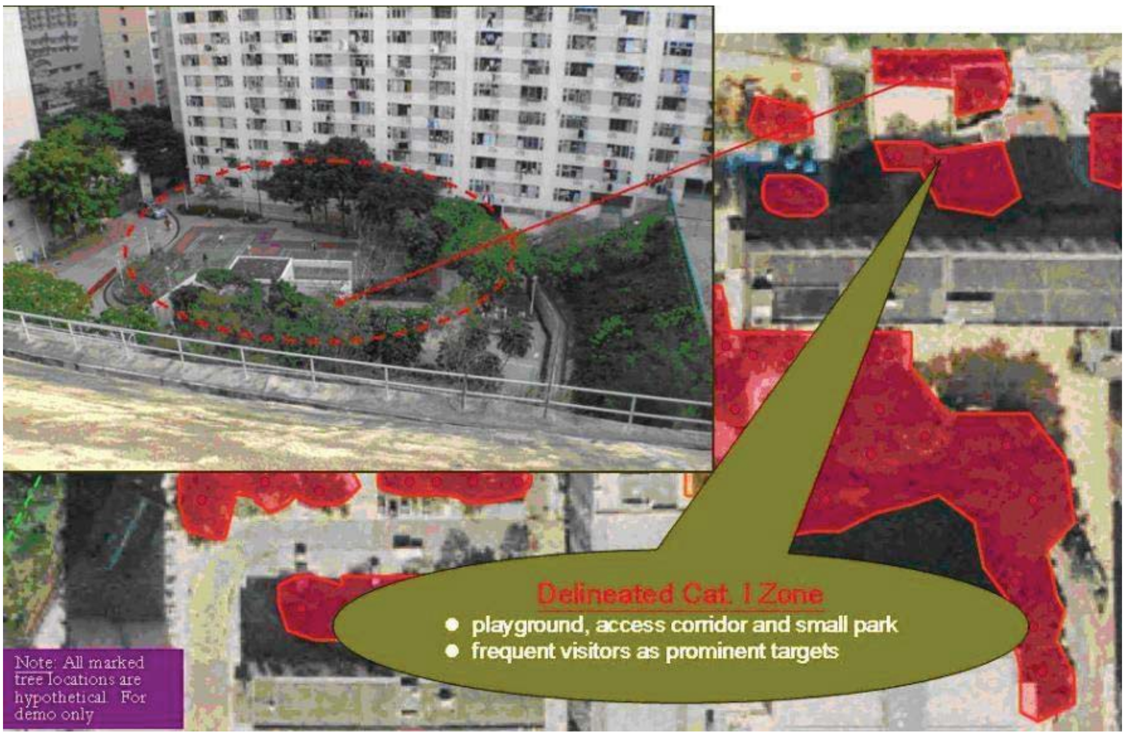


Step 2

Step 3

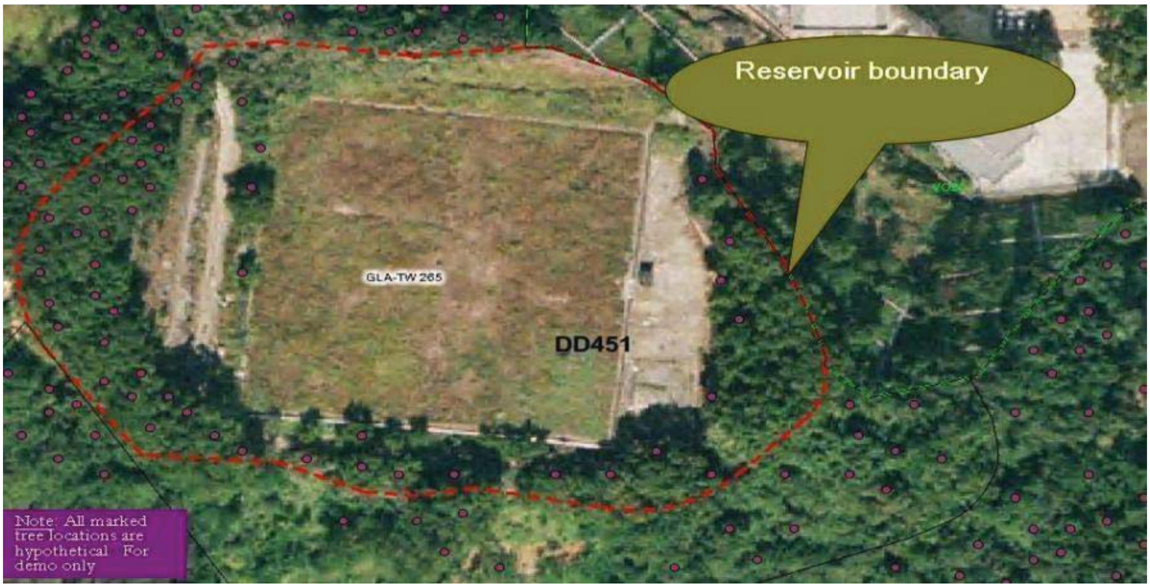

Delineated Cat. III Zone
slope within the estate boundary
rare access to the slope edge
to monitor during course of duty or deal with complaints on receipt
Note: All marked tree locations are hypothetical. For demo only

Step 4

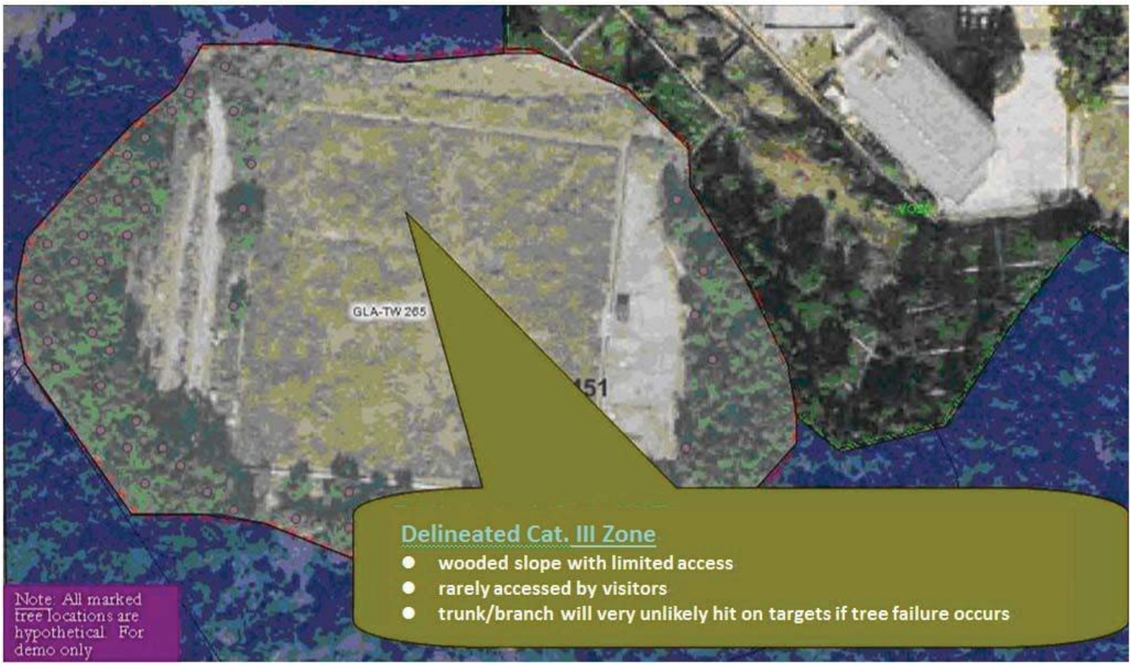

Delineated Cat. I Zone
playground, access corridor and small park
frequent visitors as prominent targets
Note: All marked tree locations are hypothetical. For demo only

4. Example Four: Tsuen Wan No. 2 Fresh Water Service Reservoir, Kwai Chung

Step 1: Desktop Demarcation



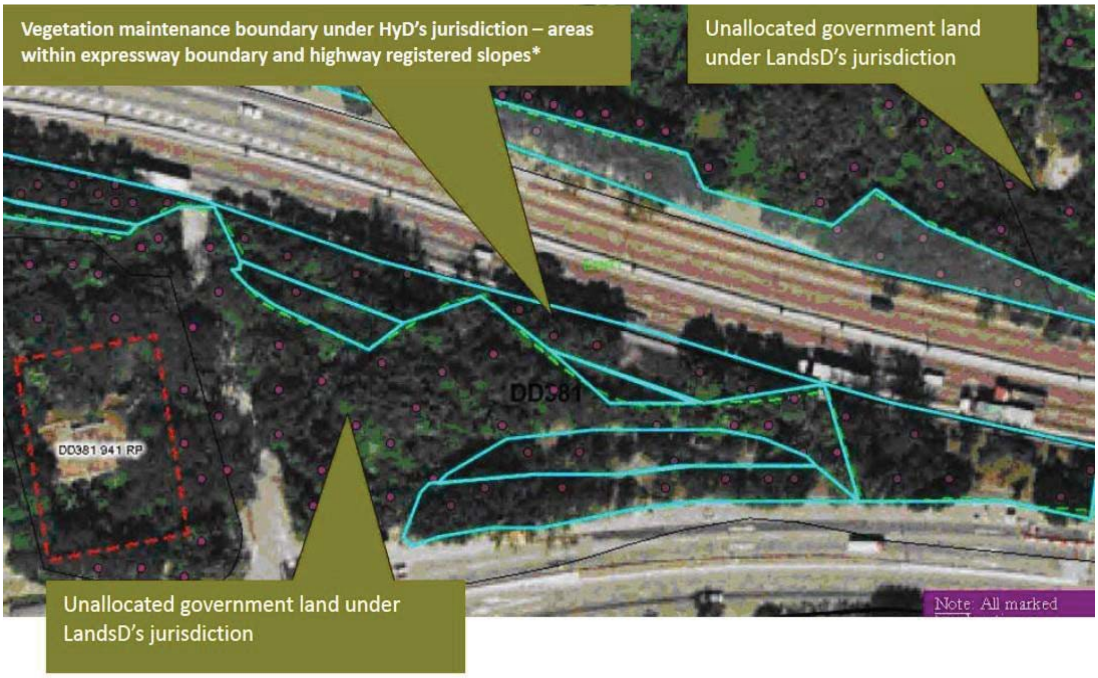
Step 2



5. Example Five: A site along Tuen Mun Road

Step 1: Desktop Demarcation

Step 2

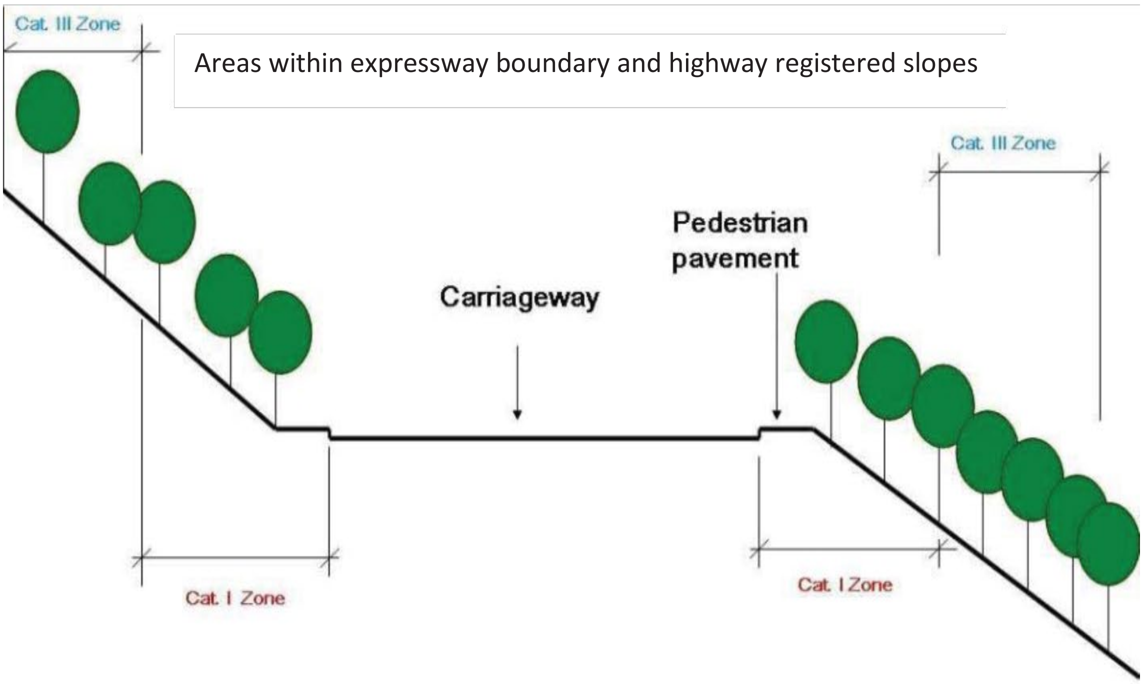


*highway registered slopes mean slopes maintained by HyD as registered in the Slope Maintenance Responsibility Information System (SMRIS) of LandsD

Step 3


Delineated Cat. I Zone
● trees next to busy expressway
● prominent targets due to busy traffic
DD381
Delineated Cat. III Zone
● trees far away from carriageway
● limited access
● trunk/branch will very unlikely hit on targets if tree failure occurs
Note: All marked tree locations are hypothetical. For demo only

Step 4


Cat. III Zone
Areas within expressway boundary and highway registered slopes
Cat. III Zone
Pedestrian pavement
Carriageway
Cat. I Zone
Cat. I Zone

6. Example Six: A construction site

As a general principle, the party maintaining the tree when risk assessment is required should be responsible for undertaking the tree risk assessment. Therefore, the party being either the project proponent or its works agent of a construction site, which should be responsible for the maintenance of the trees located within the Works Site no matter whether there are Temporary Government Land Allocation or not, should also be responsible for undertaking tree risk assessment of these trees. After construction, if a works department is still maintaining a tree during the establishment period or the aftercare period for OVTs, the works department concerned should be responsible for the tree risk assessment. If a tree has been handed over to the maintenance department for long-term maintenance after construction, the maintenance department concerned should then be responsible for the tree risk assessment.

Trees in construction sites may be subject to higher stress than normal due to changes in their environmental conditions (e.g. dust, vibration, soil compaction, changes in underground water table levels, damages to feeder and/or anchor roots, etc.). Therefore, more tree inspections in accordance with the advice from Inspection Officer should be conducted timely upon the commencement of construction/site works and at a time of major changes in site circumstances of the development/project/works site.

Appendix 2

LANDSCAPE AND LOCATION CONDITONS

OBJECTIVES

Healthy trees with sound structure are valuable assets to the community. Very often, trees are confronted with various environmental stresses such as space limitation, soil compaction, lack of nutrients, abnormal soil pH, damage by construction and roadwork activities, etc. where restricted root growth, root damage and soil disturbance leading to poor root anchorage are major factors causing tree decline thus affecting stability.

A series of location types of trees highlighting unfavourable tree growth conditions affecting tree stability, such as trees on stonewalls, in confined space, with ground disturbance and on slopes are identified to draw special attention when undertaking the tree risk assessment in order to minimise the potential tree risk.

Figure 1 - Location Types of Stonewall Trees (SWT) with Surface Attachment on Stonewall

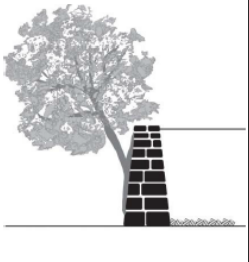
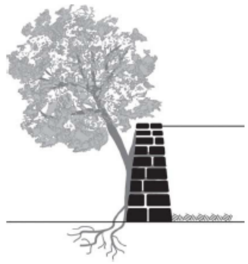
Root spread on masonry wall	 **(a) Surface attachment only**	 **(b) Surface attachment and ground roots at toe**	 **(c) Surface attachment and ground roots at crest**	 **(d) Surface attachment and ground roots at crest and toe**
Structural condition of tree anchorage	• Support solely by the surface root mass on wall with unknown amount of root penetration • Roots are mostly confined within masonry wall only	• Support by the surface root mass on wall with unknown amount of root penetration and additional ground roots protruded to the wall toe • Only limited physical support could be provided by roots at toe	• Support by the surface root mass on wall with unknown amount of root penetration and additional ground roots protruded to the wall crest • Provides additional strength on the tension side of SWT for anchorage	• Support by the surface root mass on wall with unknown amount of root penetration and additional ground roots protruded to both wall crest and toe • Provides additional strength on the tension side of SWT for anchorage
Health Condition	• Nutrient / water uptake limited to confined space behind the masonry wall	• Nutrient / water uptake would be facilitated by the extended ground roots at wall toe	• Nutrient / water uptake would be facilitated by the extended ground roots at wall crest	• Nutrient / water uptake would be facilitated by the extended ground roots at both wall crest and toe
Attention on tree anchorage (among stonewall trees)	High	High	Low	Low

Figure 2 - Stonewall Trees (Modes of Failure)

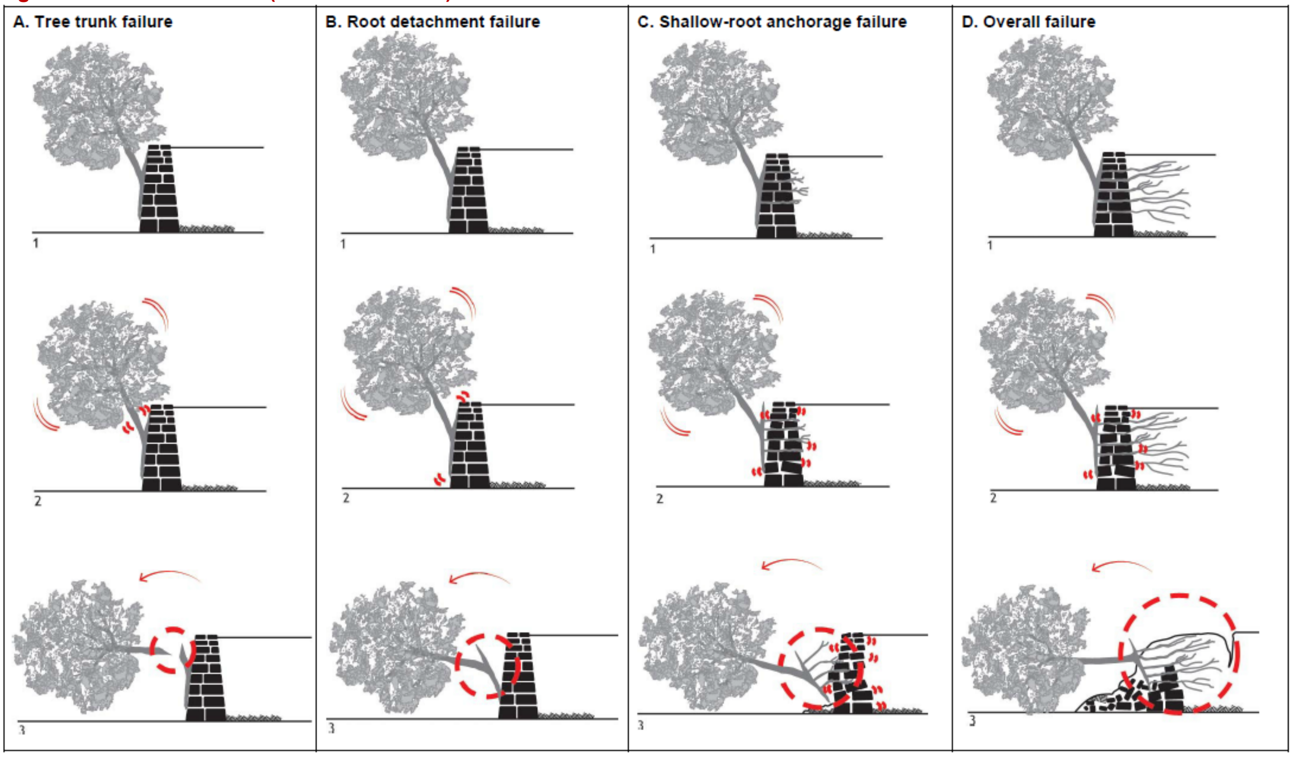


Figure 3 - Location Types of Trees in Confined Space

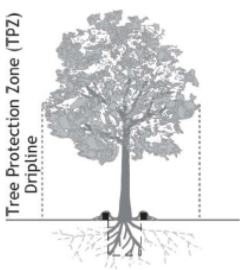
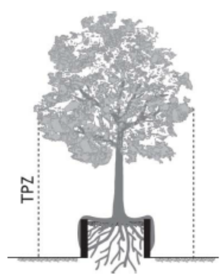
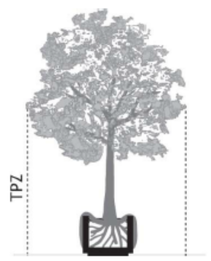
Trees grown in confined space	 (a) Tree Pit	 (b) Small (Raised) Planter	 (c) Planter Box
Structural condition on tree anchorage	• Open bottom planter • Typical tree pit size is around 1.2 m (L) x 1.2 m (W) x 1.0 m (D) • Extent of root spread outside the tree pit is uncertain as most of the surrounding soil is generally compacted or ground surface paved	• Open bottom planter • Sinker root could be developed for tree anchorage • Extent of root spread depends on the planter size and relative size of the tree	• Closed bottom planter • Roots confined within planter box • Tree anchorage depends on the size of planter box and relative size of the tree
Health condition	• Nutrient / water uptake would highly depend on maintenance	• Nutrient / water uptake would highly depend on maintenance	• Nutrient / water uptake would highly depend on maintenance
Attention on tree anchorage	Medium to Low (depending on extent of paving around tree pit)	Medium to Low (depending on the planter size)	High

Figure 4 - Location Types of Trees with Ground Disturbance

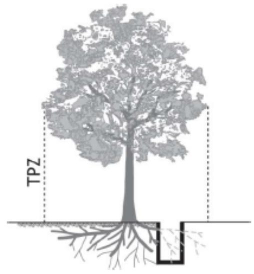
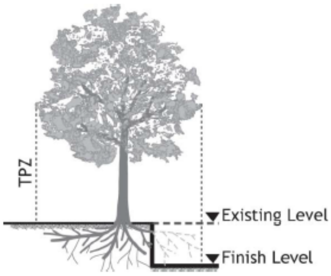
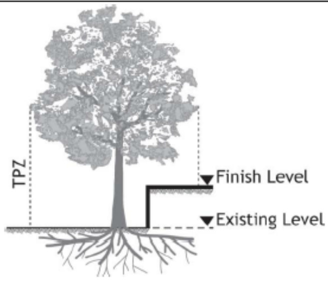
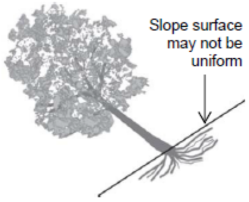
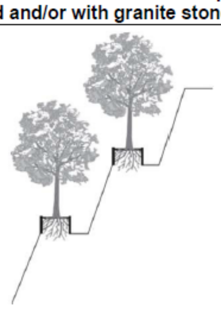
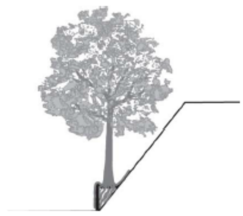
Trees with ground disturbance	 (a) Trenching	 (b) Cutting (lowering of level)	 (c) Filling (raising of level)
Structural condition on tree anchorage	• Poor root anchorage due to imbalanced root system caused by removal of roots within the dripline • No further trenching / cutting of roots should be allowed • Large roots cut from trenching may easily be infected by decay organisms and extended to lower trunk over time	• Poor root anchorage due to imbalanced root system caused by removal of roots within the dripline • No further cutting of roots should be allowed • Large roots cut from lowering of level may easily be infected by decay organisms and extended to lower trunk over time	• Existing root system would become stressed and suffocated, and the tree may eventually die • No soil filling should be allowed within dripline to the trunk and above root flares
Health condition	• Nutrient / water uptake would be affected by the physical root loss • Crown dieback on the trenching side would be obvious in the first year after trenching	• Nutrient / water uptake would be affected by the physical root loss • Crown dieback in the cutting side would be obvious in the first year after cutting	• Tree health may decline over time due to lack of oxygen, inadequate soil aeration and poor drainage • Health decline may not immediately become obvious
Attention on tree anchorage	High	High	Low

Figure 5 - Location Types of Trees on Slopes

	Trees on Slopes (natural or man-made slopes)	Trees on Hard Surfaced Slopes (shotcreted and/or with granite stone facing)		
Trees grown on slopes	Leaning tree with no sign of self-correction 	 (a) Trees in tree rings	 (b) Trees in berm planters	 (c) Trees in toe wall planters
Tree Risk Assessment Considerations (tree leaning and root anchorage)	• Extent of root development on tension side • Defects in roots on tension side • Root anchorage (loosen / cracked / uneven soil within root zone) • Extent of leaning versus height of tree • Sign of increased extent of leaning when compared with previous inspection • Condition of reaction wood on tension side	• Site history (condition of site under hard paved surface) • Extent of roots that are visible on the slope • Conditions of roots that are visible • Position of tree on slope • Extent of leaning / falling zone • Anomalies of slope surface around tree	• Exposed roots spill over planter edge • Aggressive root growth causing damage to planter wall • Refer to items (b) in Figure 3.2 "Trees in Confined Space"	• Exposed roots spill over planter edge • Aggressive root growth causing damage to planter wall • Refer to items (b) or (c) in Figure 3.2 "Trees in Confined Space"
Modes of failure	• Root failure (e.g. root decay, poor attachment)	• Root failure (e.g. root decay, poor attachment, girdling roots)	• Root failure (poor root anchorage, exposed roots, girdling roots)	• Root failure (root decay, poor root anchorage, exposed roots, girdling roots)
Attention on tree anchorage	High	High	Medium	High

Appendix 3 - Requirements for Inspection Officers for Form 1 - Tree Group Inspection and Form 2 - Individual Tree Risk Assessment.

"Inspection Officers" for Form 1 tree group inspection and Form 2 individual tree risk assessment shall fulfil either Section A or B.

A. meet the following minimum requirements on academic, professional and training qualifications as well as work experience:-

Academic Qualifications*	• Certificate / diploma or above qualifications in arboriculture, tree management, tree risk assessment, landscape management up to or above the standard of Level 3 in the Hong Kong Qualifications Framework, or equivalent in an appropriate discipline. Examples of relevant programmes at QF Level 3 or above are listed on GLTMS Website for reference: https://www.greening.gov.hk/en/resource-centre/relevant-organisations-qualification-and-training/index.html.

AND

Professional Qualifications*	• Certified Arborist, Certified Arborist Utility Specialist, Certified Arborist Municipal Specialist or Board Certified Master Arborist of the International Society of Arboriculture; or • Technician Member, Professional Member, Fellow or above qualifications of the Arboricultural Association of the United Kingdom; or • European Tree Worker or European Tree Technician of the European Arboricultural Council; or • General Member of the National Arborists Association of Australia (issued on or before 31 Dec 2010); or • Registered Qualified Arborist, Registered Practicing Arborist, Registered Consulting Arborist, Registered Consulting & Practicing Arborist of Arboriculture Australia; or • Accredited Arborist of the Hong Kong Institute of Landscape Architects; or • equivalent to the above.

AND

Training Qualifications*	• Completed and passed Comprehensive Tree Risk Assessment and Management Training Course with assessment or Refresher Course with assessment organised by the Tree Management Office (TMO); or • Completed and passed equivalent departmental training recognised by the TMO; or • Completed and passed training programmes in tree risk assessment recognised by the TMO as listed on GLTMS Website: https://www.greening.gov.hk/en/resource-centre/relevant-organisations-qualification-and-training/index.html.

AND

Work Experience	• Has at least 3 years of work experience in tree care and is familiar with tree risk assessment /management.

** Field Assistant Grade and Field Officer Grade staff in the Agriculture, Fisheries and Conservation Department and Amenities Assistant Grade and Leisure Services Manager Grade staff in the Leisure and Cultural Services Department who have completed the recognised vocational training offered by the respective departments are considered meeting the minimum requirements on the academic, professional and training qualifications for Inspection Officers.*

B. (i) "Arborist" under the Registration Scheme for Tree Management Personnel maintained by the GLTMS; or

(ii) "Tree Risk Assessor" under the Registration Scheme for Tree Management Personnel maintained by the GLTMS and meets the minimum requirement in Section A above with valid registration.

Tree Risk Assessment Form 1 : Tree Group Inspection
樹木風險評估表格1 : 樹群檢查表

Form 1 Ref. No.: 表格1編號:	

General Information 基本資料

Dept. 部門/ Agency 機構:		Inspection Officer 巡查人員:		Post 職位:	
Project 工程/ Contract No. 合約編號:				File Ref. 檔案編號:	
Date of Inspection 巡查日期:	*(dd/mm/yyyy)*	Last Inspection Date 上次巡查日期:	*(dd/mm/yyyy)*	Inspection Frequency 巡查週期:	

Location Information 位置資料

Masterzone Ref.主區編號:		Subzone Ref. 副區編號:	

English Location 英文地點:		Chinese Location 中文地點:		District 地區:	

Tree Risk Management Zone 樹木風險管理地點類別:	

Location Types
地點類別:
(multiple selections allowed
可選多於一項)

- ☐ Roadside Landscaped Area 路旁綠化地區
- ☐ Public Park/Recreation Venue 公園/康樂場地
- ☐ Planter box 花盆
- ☐ Tree Pit/Tree Ring 樹穴/樹圈
- ☐ Housing Estate 屋邨
- ☐ Central Divider 中央分隔帶
- ☐ Others (please specify) 其他 (請說明):
- ☐ Government Compound 政府建築物
- ☐ Unleased/Unallocated Government Land 未批租/未撥用的政府土地
- ☐ Recreational Site/Facility inside Country Park 郊野公園內康樂用地或設施
- ☐ SIMAR Slopes 系統性鑑辨維修責任的斜坡

SIMAR Slope Ref:

Nearest lamp pole number 最接近的燈柱編號:	

Tree Information 樹木基本資料

The size of a tree group should be defined by location types, such as public park, SIMAR slopes, tree pits, etc. with due consideration given to the limitations of visual tree assessment.
No more than 50 trees shall be included in a Tree Group.
在決定樹群的大小時，應參照地點類別，如公園、系統性鑑辨維修責任的斜坡、樹穴等，並需考慮目測法的局限，每個樹群不可多於50棵樹。

(A) Triage Trees and Trees required Remedial Actions or Form 2 Assessment
分流樹木及需要進行緩減措施 / 表格 2 評估的樹木

TMCP Tree ID 樹木編號	Dept. Tree ID 部門樹木編號	Tree Species 樹種	DBH (mm) 胸徑 (毫米)	Estimated Tree Height (m) 大約樹高 (米)	Estimated Crown Spread (m) 大約樹冠闊度 (米)	Tree Status 樹木類別	Overall Tree Conditions 整體樹木狀況	Triage Colour 分流顏色	Remedial Action / Form 2 Assessment 緩減措施 / 表格2評估	Anticipated Completion Date 預計完成日期 (dd/mm/yyyy)	Reference Coordinates of Tree 樹木參考座標	
											東 X	北 Y

(B) Other Trees (Non-Triage trees - trees do not need further actions)
其他樹木（非分流樹木 - 無需進一步行動的樹木）

Tree Species 樹種	App. Quantity of Trees 大約樹木數量	Range of Tree Height 樹高範圍		Overall Tree Conditions 整體樹木狀況
		Form (m) 由（米）	To (m) 至（米）	

Overall Remarks 整體評語

Sub-total No. of Trees in Table (A): (A) 表樹木數量小結:	0	Sub-total No. of Trees in Table (B): (B) 表樹木數量小結:	0	Total No. of Trees (A + B) : 樹木總數 (A + B):	0

Summary of TRIAGE Trees 分流樹木總結

Black 黑	0	Red 紅	0	Orange 橙	0	Yellow 黃	0	No Triage colouring 無	0

Attached Information 附夾資料

Attachment Type	Attacement File Name	Description

Declaration 聲明

I, the Inspection Officer for the above TRA Form 1, confirm that I have inspected the tree group(s) at the specified date with due diligence, and the information given in the Form(s) is truly reflecting what I observed on site.

本人作為以上樹群檢查表格1的巡查人員，確認本人已在本表格所列日期，謹慎小心完成有關樹群的檢查，而本表格上填入的資料均真確無訛地反映本人在現場觀察所得。

My academic, professional, training records and work experience met the requirements of Inspection Officer specified in the TRAM Guidelines.

本人的學術、專業、培訓紀錄及相關工作經驗均符合「樹木風險評估及管理安排」指引中對巡查人員的要求。

Name of Inspection Officer: ______________________

巡查人員姓名 ***(請以英文正楷書寫)***

 # (If more than one Inspection Officer involved in the same Tree Group Inspection, each Inspection Officer should submit individual Form 1 containing the trees inspected by him/her.
如多於一位巡查人員負責同一樹群檢查，個別巡查人員應將其檢查的樹木以另一表格1填報。)

Date of Form Completion: ______________________

完成表格日期 **(dd/mm/yyyy)**

(If Form 1 is submitted in paper form 若以文本形式遞交表格1)

Signature of Inspection Officer: ______________________

巡查人員簽署：

Appendix 5 - Explanatory Notes for Form 1: Tree Group Inspection

This Form 1 is provided with the *Guidelines for Tree Risk Assessment and Management Arrangement (TRAM Guidelines*) (10th Edition) for tree group inspection. It intends to act as a template for Inspection Officers to collect and record tree information and facilitate a meaningful tree group inspection as well as identification of individual tree(s) under the Triage System for individual tree risk assessment (Form 2) or immediate remedial actions. For individual tree risk assessment, the Inspection Officers should refer to the guidelines for individual tree risk assessment (Form 2) in the TRAM Guidelines.

Box(es) and Space(s) are provided on the Form 1 for Inspection Officers to record/write descriptions and estimated measurements, or check box(es) for selected options, in field investigation. The Inspection Officers are also required to provide their observations, suggestions and/or recommendations on tree remedial actions in space under "Overall Remarks" when necessary. It is not necessary to check every box or to fill in every space provided on this Form. Only information relevant to the tree group inspection should be collected.

Section 1 – General Information

This Section intends to identify the responsible department, the Inspection Officer and a brief history of the tree group inspection.

Form 1 Ref. No.: Reference number of the Form 1 in the format: [XXX]-[20XX]-[000]-[9999]-[0], where

XXX	20XX	000	999	0
First 3 character of department's abbreviated name, i.e. AFC for AFCD, LAN for LandsD, etc.	*Year of TRAM Exercise, i.e. 2019/2020 TRAM Exercise, use 2019.*	*Project code or contract code assigned by departments. If no subdivided project or contract, please input "000"*	*Serial number of Form 1 report in one TRAM Exercise. For each project or contract in the dept., new set of serial number from 0001 to 9999 can be used.*	*Part number of the Form 1 report. If only one Inspection Officer conducted the Form 1 inspection in a tree group, use "0"; If more than one Inspection Officers and more Form 1 reports for one tree group, use "1" for the 1st report and "2" for the second report, and so on.*

Department/Agency: name of the responsible Department or Agency of the tree group inspection.

Inspection Officer: name of the Inspection Officer (to be automatic filled in TMCP system) who met the qualification requirements on academic / professional / training, and work experience as specified in 'Requirements for Inspection Officers' in Appendix 3 of the TRAM Guidelines. The qualifications of Inspection Officer should be vetted by relevant tree maintenance department and a name list of vetted Inspection Officers should be provided to GLTMS/TMCP for verification.

Post: post title of the Inspection Officer in the Department/Agency.

Project/Contract No.: project/contract reference number of the tree inspection works, where applicable.

File Ref.: File reference no. in the Department/Agency that keeps the tree inspection reports, where applicable.

Date of Inspection: date of inspection in the format of dd/mm/yyyy. If the inspection lasts for more than one day, it is the commencement date of the inspection.

Last Inspection Date: date of last inspection of the subject tree group in the format of dd/mm/yyyy. If the inspection lasts for more than one day, it is the commencement date of the inspection. If it is the first time inspection of the subject tree group, please set it to the "Date of Inspection".

Inspection Frequency: The frequency of inspection, i.e. once per 6 months marked as '6 months', once per year marked as '12 months', etc. Mark '***ad hoc'*** if the inspection is on need basis.

Section 2 – Location Information

This Section provides background information of the location of tree group to be inspected.

Masterzone Ref. & **Subzone Ref.**: provides Masterzone reference and Subzone reference, if applicable, of the tree group inspected. Fill in "NIL" in space provided after "Subzone" if no Subzone. Details of the zoning for Masterzone and Subzone are specified in the Tree Management Common Platform (TMCP) manual in the Cyber Manual for Greening (http://devb.host.ccgo.hksarg). The zoning is assigned by the responsible tree maintenance department.

Chinese Location and **English Location**: Chinese and English name of the tree group location, please refer the location/street name to the latest version of "*Hong Kong Guide*" published by the Lands Department.

District: use district categorisation in 18 District Councils.

Tree Risk Management Zone: the category of Tree Risk Management Zone (TRMZ) as specified in the TRAM Guidelines. Select 'Category I', 'Category II' or 'Category III' if the tree group falls into relevant Category zone. The Inspection Officer shall confine the tree group to one TRMZ category. For example, a roadside landscaped area has about 20 metres width with one side along a public road of high pedestrians and/or high traffic flow, but with another side inaccessible by the public or vehicles. According to TRMZ definition, the landscaped area beside the public road of high pedestrians and/or high traffic shall be classified as Cat. I but the rest areas shall be classified as Cat. II/III subject to the fall zone of trees. In this case, the Master Zone would be divided into two Master Zones, or if a single Master Zone should be maintained, the landscaped areas with different TRMZ classification could be divided into two Subzones.

Location Type: check the box for “Location Type” as appropriate; mark SIMAR Slope reference number in the space provided if SIMAR Slope is identified. For trees within a tree ring on a shotcrete slope, check "Tree Pit/ Tree Ring”. Provide location information in space in ‘Others’ if the subject tree group does not fall into the boxes provided. **Check more than one box if the subject tree falls into more than one location type.**

Nearby Utility Post No.: The nearby public utility post number, such as Lamp pole number. Mark the utility on the location map with clear denoted reference number.

Section 3 – Tree Information

Inspection Officer shall define the size of a tree group by location types, such as public park, SIMAR slopes, landscaped area, etc. with due consideration given to the limitations of visual tree assessment. **For easy recognition of tree conditions in a tree group under inspection, the tree group inspected shall not contain more than 50 trees.**

Table (A): Triage Trees and Trees Require Remedial Actions or From 2 Assessment:

Triage Trees and Trees Require Remedial Actions or Form 2 Assessment: Table (A) is designed for trees in the tree group inspected including:

1. Triage Trees, the specific tree categories require Triage Classification including:
   - Dead trees
   - Trees confirmed with Brown Root Rot (BRR) disease infection
   - Old and Valuable Trees (OVTs)
   - Stonewall trees (SWTs)
   - Large trees with an individual trunk(s) DBH ≥ 500mm or overall tree height at 9 metres or above
2. Trees in the tree group that require remedial actions; and
3. Trees in the tree group that require Form 2 assessment.

Individual tree information is required in Table (A).

TMCP ID: A system generated ID to give a unique reference number to trees in the TMCP tree database. Inspection Officers are not required to fill in this TMCP ID.

Departmental Tree ID: the departmental identification number of each tree inspected. If the tree inspected has more than one tree ID, use the latest departmental tree ID.

Tree Species: use the scientific names and the preferred Chinese and English common name (i.e. the first name if more than one name) listed in the *Check List of Hong Kong Plants* (latest version) published by the AFCD.

DBH: Diameter at breast height (DBH). The measurement of DBH shall follow the Practice Notes on measurement of diameter at breast height promulgated by the AFCD. Departments may use Mobile Mapping System (MMS) / Lidar scanning to survey the tree locations and DBH if the site is too large or inaccessible. For use of MMS, please refer to "Tree Management" section in Cyber Manual for Greening.

Estimated Tree Height: estimate the total height of the tree inspected above ground level to top of tree crown, measured in meter (m). For better estimation, making use of clinometer / range pole.

Estimated Crown Spread: estimate the diameter of crown spread in meter (m). For asymmetric tree crown, the longest axis should be measured.

Tree Status: status of the tree inspected, namely

- OVTs
- SWTs
- Large Tree with an individual trunk(s) DBH ≥ 500 mm or overall tree height at 9 metres or above
- Other Trees: trees does not fall within the above four status

BRR Disease infected: Check the box **"BRRD confirmed"** if the tree is confirmed infected by BRRD; Check the box **"BRRD in vicinity"** if BRRD confirmed case occurred within driplines of the tree crown.

Overall Conditions: estimate the overall health and structural conditions of the tree inspected and select an appropriate condition in the following categories:

- **Normal**: tree health and structural conditions are similar to other healthy tree of the same species in the area, for example, leaf size and color, crown density, tree height and crown spread. The growth of the tree inspected is in general vigor in comparison to a healthy tree of the same species in the area and no significant defects were identified.

- **Fair**: Health and structural conditions of the tree inspected is considered not as vigor as a normal tree by comparison to a healthy tree of the same species in the area; plus, either one of the follows:
  (1) one or two health or structural defects were observed in crown, branches, trunk or root zone (i.e. old wounds, cavity with entire defensive wood, etc.),
  (2) minor dieback twigs (less than 5%), or
  (3) signs of pest and/or disease etc., but no actual pest or disease could be identified.

  and such health and structural problem(s) can be mitigated by pruning or other tree treatments, tree failure is not foreseeable.

- **Poor**: Health and structural conditions of the tree inspected are significantly poor than a normal tree of the same species in the area, plus either one of the follows:
  (1) more than 3 significant health or structural defects were observed on crown, branch, trunk or root zone, including large old wounds with signs of decay, large cavities with signs of decay, dead branches, hanging branches, etc.,
  (2) dieback twigs over 25% of total canopy,
  (3) minor pest and/or disease infestations are observed, but not detrimental to overall health and structural conditions of the tree inspected, or
  (4) Tree growth was considered adversely restricted by health or structural defects or other environmental conditions.

  Mitigation measures is considered cannot completely remedies the health and structural defects. Tree failure is expected in the long-run. Removal of the tree is recommended.

- **Very poor**: The tree is considered under a very poor condition if either one of the following is observed:
  (1) many (5 or more) significant health and structural defects are observed, including old wounds with significant decay, large cavity with significant decay, etc., where mitigation measures cannot stop

deterioration of tree health from curing the defects,

(2) fallen leaves or die back twigs over 50% of total canopy (except deciduous trees and semi-deciduous trees), broken of main branches,

(3) large portion of tear off tree barks in main trunk (over 50%), or

(4) severe pest infestation and/or disease infection that existing pest and disease control measures are considered ineffective to the infestation, tree health conditions is continuously deteriorating. These health and structural defects are detrimental to the tree inspected and tree removal is recommended to be conducted as soon as practicable.

- **Dead:** Dead tree. The dead tree shall be removed within 4 weeks after inspection or as soon as practicable. Appropriate warning signs shall be installed and/or condor-off the site shall be arranged when necessary.

Triage Colour: assess the tree under the Triage system in accordance to the TRAM Guidelines, i.e. Black, Red, Orange or Yellow. Fill in the Triage colour category in the space provided. Please note that Triage classification may change in each assessment due to change of tree conditions and mitigations works done. If the tree is “Other Trees” in Zone I or trees in other zoning, no classification under the Triage system is necessary, please mark ‘NIL’.

Remedial Actions/Form 2 Inspection: Fill in the remedial actions or individual tree risk assessment (Form 2) is considered necessary, leave the space empty if no further action is required. If this column is checked, please provide anticipated completion date, tree reference coordinates and reference number of tree photos showing the defects identified or spot of mitigation required in the following columns. Examples of remedial actions include:

- Remove the whole tree;
- Crown reduction to reduce crown load;
- Crown cleaning to remove dead/diseased branches/twigs;
- Crown lifting to remove lower branches;
- Structural pruning to modify tree form;
- Form 2 individual tree risk assessment; or
- Others: please specify in space provided or use separate information sheet.

Anticipated Completion Date: the date that Inspection Officer anticipates the remedial actions or Form 2 assessment should be completed, in the format of dd/mm/yyyy. Consult tree works agent when necessary.

Tree Reference Coordinates: provides reference coordinates of the tree inspected at the tree center by x-axis and y-axis reading (HK1980 Grid Coordinates) up to 3 decimal places for reference in TMCP. The reference coordinates could be a reference location of the tree inspected measured by common GPS instruments or plotted on location plan with estimated reference co-ordinates.

Add Rows: check this box if more row is required.

Delete Rows: check this box to delete row.

Table (B): Other Trees (Non-Triage Trees - trees do not need further actions)

Other Trees (Non-Triage Trees - trees do not need further actions): Table (B) is designed for “Other Trees” in the tree group that do not fall into Table (A): the categories of Triage trees, trees do not need further actions or Form 2 assessment. **Only tree group information is required in Table (B).**

App. Quantity of Trees: Approximated quantity of trees, as far as practicable, in the same species in the tree group falls into the definition of “Other trees”. For tree species cannot be identified during the tree group inspection, mark “unidentified” on the **Tree Species** column. Same tree species may appear in Table (A) and Table (B), please avoid duplicated counting.

Range of Height: the range of tree height in the same species of tree in Table (B). Please mark the tree height from the lowest to the highest in meter.

Overall Remarks: Inspection Officer may provide his/her observations, suggestions and recommendations on tree remedial actions in the space provided under the “Overall Remarks” when necessary. The overall remarks shall also include limitations and restrictions in the site, the need of further assessment on particular tree (individual tree risk assessment by Form 2) in the tree group assessed, as well as other information did not cover in the above-mentioned items.

Sub-total No. of Trees in Table (A): Total number of trees in Table (A).

Sub-total No. of Trees in Table (B): Total number of trees in Table (B).

Total No. of Trees: the total number of trees in the tree group inspected, i.e. total number of trees in Table (A) + Total number of trees in Table (B).

Summary of Triage Trees: give total number of trees of each Triage colour in the tree group inspected.

Attached Information: use this section to attach photos, map, and other information.

Add Tree Photos: provide tree group photos taken on the inspection day. The picture of tree group inspected shall be taken from at least two different directions; individual tree photos should be provided for tree health or structural conditions classified as "Very Poor" and recommended for tree removal; and tree(s) recommended for remedial actions or further assessment (individual tree risk assessment (Form 2)). All photos provided shall follows the photographs requirements set out in Appendix 6 – Photo-taking Guidelines for Tree Risk Assessment specified in TRAM Guidelines. All photographs should be stamped with date and time of photo taken.

Add Map: add tree location map of the tree group assessed. The map shall show the location of the tree group, the relevant land status, major check points (i.e. Lamp pole number, SIMAR slope number, etc.). **All trees listed on Table (A) in the Form 1 report should be marked on the tree location map with the Departmental Tree ID.**

Add Other Information: add other information related to the inspection, i.e. future development project, land sales information, etc., that the Inspection Officer considers necessary further describe the site conditions and the tree group inspected.

Appendix 6 - Photo-taking Guidelines for Tree Risk Assessment

1. General

- All photographs should be illustrated with the dates and time of the photographs were taken.
- The photo records should be coloured photos clearly showing the tree conditions.
- Proper annotations and descriptions should be provided to illustrate the conditions of trees.
- For record of remedial mitigation measures, photos showing the conditions before and after the operations should be taken from similar view angles as far as possible to facilitate comparison.
- All photographs should be taken in a specific manner so as to provide a fair comparison and clear illustration to reflect the change of the tree groups or the individual trees when compared to the relevant and retrievable records.

2. Photo Records in Form 1

2.1 Overall condition

- All trees should be clearly seen in photos record through a photo can cover more than one tree if it can capture the general conditions of individual trees.
- Overall view showing the tree group and its adjacent site conditions.
- Close views of the tree group from different angles clearly showing its condition.
- Views showing site conditions or changes that may have an impact on tree health or structural conditions.
- Views showing the potential impact on targets / sensitivity in case of tree failure.
- Views clearly showing tree health and structural conditions, in particular for stand-alone trees and street trees, should be captured as far as practicable unless tree parts are obscured due to site constraints (such as those on steep slopes or trees in clusters).
- Close-up views clearly showing trees having notable arboricultural defects, disorders or anomalies (if any).

3. Photo Records in Form 2

3.1 Overall Condition

- Overall views showing the tree from different angles, its adjacent site condition and extent of leaning (if applicable).
- Views showing site conditions or changes that may have an impact on tree health or structural conditions.
- Views showing the potential impact on targets / sensitivity in case of tree failure.

3.2 Crown Condition

- Views showing general condition of the crown to illustrate the vigor, foliage density and colour.
- Close up views for the following features (if any):
  - abnormal leaf size with reference scale;
  - dieback twigs;
  - epicormics;
  - signs of pest or disease; and
  - other notable arboricultural defects or disorders.

3.3 Trunk and Branch Conditions

- Views showing general conditions of the trunk(s) and major branches illustrating the structural integrity.
- Close up views for the following features (if any):
  - co-dominant trunks or branches;
  - poor taper;
  - included bark or weak attachment;
  - decay or cavity;
  - cracks or splits;
  - wounds and wound wood development;
  - dead branches or hangers;
  - crook or abrupt bends;
  - crossed branches;
  - heavy lateral limb;
  - lion tailing;
  - bleeding or sap flow;
  - fungal fruiting bodies;

- parasitic plants;
- signs of pests and diseases; and
- other notable arboricultural defects or disorders.

3.4 Lower Trunk / Root Condition

- Stressful site conditions, including construction activities within the tree protection zones and any other activities or restrictions that may damage the root system and the overall structural stability of the trees. Views showing general conditions of the root flare and disturbance that may damage the root zone.
- Close up views of the following features (if any):
  - root rot;
  - exposed roots;
  - girdling roots;
  - cracks or splits;
  - mechanical damage;
  - root-plate movement;
  - soil cracks or other cracks;
  - fruiting bodies;
  - signs of pests and disease; and
  - other notable arboricultural defects or disorders

Tree Risk Assessment Form 2 Individual Tree Risk Assessment
樹木風險評估表格2 個別樹木風險評估

General Information 基本資料

Dept. / Agency 部門 / 機構		Inspection Officer 巡查人員		Post 職位	
Project/Contract No. 工程/合約編號				File Ref. 檔案編號	

Date and Time of Inspection				Last Inspection Date		Inspection Time Spent 是次巡查所用時間	
巡查日期及時間	*(dd/mm/yyyy)*	*(hr)*	*(min)*	上次巡查日期	*(dd/mm/yyyy)*	Inspection Frequency 巡查週期	

Tree Information 樹木資料

TMCP Tree ID TMCP 樹木編號		Dept. Tree ID 部門樹木編號		Tree Species 樹種		Triage Colour 分流顏色	
Tree Height(m) 樹高(米)		Crown Spread(m) 樹冠闊度(米)			No. of Trunk(s) 樹幹數目		

DBH of tree trunk(s)(mm)	1	2	3	4	5	Aggregated DBH (mm)	
每枝主幹胸徑(毫米)						總胸徑(毫米)	

Tree Status 樹木類別	☐ Old and Valuable Tree 古樹名木 (OVT No. 古樹名木登記冊編號:)	☐ Other tree 其他樹木
	☐ Stonewall Tree 石牆樹 (Tree Register No. 樹木登記編號:)	☐ Brown Root Rot Disease Infected 受褐根病感染
	☐ Large Tree(DBH ≥ 500mm or overall height ≥ 9m) 大樹(胸徑≥500毫米或高度≥9米)	☐ Tree in Confined Site 擠迫地點的樹木

Location Information 位置資料

Masterzone Ref. 主區編號				Location (Chinese) 地點 (中文)	
Subzone Ref. 副區編號				Location (English) 地點 (英文)	
Coordinates 座標	X:		Y:		
Tree Risk Management Zone Category 樹木風險管理地區類別				District 地區	

Location Type 地點類別	☐ Roadside landscaped area 路旁綠化地區	☐ Tree pit/Tree ring 樹穴/樹圈	☐ Central divider 中央分隔帶
	☐ Public park or recreation venue 公園或康樂場地	☐ Housing estate 屋邨	☐ Government compound 政府建築物
	☐ Planter box 花盆	☐ SIMAR slopes 系統性鑑辨維修責任的斜坡	
	☐ Recreational site/facility inside country parks 郊野公園內康樂用地或設施		
	☐ Unleased or unallocated government land 未批租或未撥用政府土地		☐ Other 其他
Nearby Utility Post No. 就近公用設施編號:			

Target Assessment 目標物評估
(Please identify no more than five (5) potential Target(s) in the sequence of severity of consequence 請依後果的嚴重性次序選取不多於五個目標物)

Target No. 目標物編號	Target Description 目標物的描述	Target Zone 目標物範圍	Occupancy rate 佔用率	Remove target? 可否移除目標物?	Restrict usage? 可否限制使用?
1					
2					
3					
4					
5					

Site Conditions 場地狀況

Topography 地勢	☐ Flat 平地 ☐ Natural terrain 天然山坡 ☐ Man-made slope 人造斜坡 ☐ Retaining wall 擋土牆 ☐ Stonewall 石牆 ☐ Others 其他:
Site changes 場地改變	☐ None 沒有 ☐ Grade change 地表改變 ☐ Site clearing 場地平整 ☐ Others 其他 ______
Soil conditions 土壤情況	☐ Normal 正常 ☐ Compacted 土壤被擠壓 ☐ Water Logging 積水 ☐ Hard Paved 硬地鋪面 ☐ Others 其他 ______
Soil crack or crack behind lean 土壤裂縫或裂縫於傾斜部位背後 #	○ None 沒有 ○ Yes 有 ______
Restriction within dripline 滴水線範圍內有限制 @	○ None 沒有 ○ <25% ○ 25-50% ○ 51-75% ○ >75%
Tree failure record 樹木倒塌記錄 #	○ None 沒有 ○ Yes 有
Brown Root Rot disease record 褐根病記錄 ✗	○ None 沒有 ○ Yes 有

If these items are checked, further assessment by resistograph or tomograph(#), equipment for tree root detection(@) and/or BRRD/pathogen tests(✗) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)、樹根探測工具(@) 及/或褐根病/病源檢測(✗) 。

Other observations 其他觀察	

General Conditions 總體概況

Tree vigor 茁壯程度	○ Low 低 # ○ Normal 正常 ○ High 高
Lean 傾斜	○ No 沒有 ○ Yes 有 Angle from vertical 傾斜角度 #(> 15°) ☐ ☐ Natural due to phototropism 趨光性 ☐ Self-corrected 已自然修正 ☐ Recent Tilt 新近傾斜# ☐ Response growth 反應生長 ______
Wind exposure 受風情況	○ Protected 受遮擋 ○ Partial 部份 ○ Exposed 暴露 ○ Wind funneling 風洞 ○ Others 其他 ______
Wildlife or nesting site 野生動物或鳥巢	○ None 沒有 ○ Yes 有
Cable or brace 鋼索或支架	○ None 沒有 ○ Yes 有
Pruning history 修剪歷史	☐ Cleaned 清理樹冠 ☐ Thinned 疏減樹冠 ☐ Raised 提升樹冠 ☐ Reduced 縮減樹冠 ☐ Structural pruning 結構修剪 ☐ Topped 削頂 ☐ Lion-tailed 獅尾 ☐ Others 其他

If these items are checked, further assessment by resistograph or tomograph(#) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)。

Other observations 其他觀察	

Crown Conditions 樹冠狀況

Crown density 樹冠密度	○ Normal 正常 ○ Sparse 稀疏 (○ <25% # ○ 25% - <50% # ○ 50% <75%) ☐ Imbalanced crown 樹冠不對稱
Live crown ratio 活冠比	○ <40% # @ ○ 41 - 70% ○ >70% Crown load 樹冠負荷 ○ Normal 正常 ○ Heavy 過重 ○ Declined 衰弱 #@
Foliage 葉片	○ Fallen leaf (Seasonal) 落葉(季節性) ○ Defoliation (Withered) 落葉 (枯萎) ○ Normal 正常 ○ Chlorotic 萎黃 % ○ Necrotic 壞死 %
Leaf size 葉片大小	○ Normal 正常 ○ Smaller than normal 比正常細小
Dieback twigs 枯枝	○ <5% ○ 5 - <25% ○ 25 - 50% ○ >50% ☐ Epicormics 水橫枝 ☐ Hanger 懸吊斷枝 ☐ Pest and disease 病蟲害 ✗ ______ Defoliation Percentage 落葉百分比

If these items are checked, further assessment by resistograph or tomograph(#), equipment for tree root detection(@) and/or BRRD/pathogen tests(✗) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)、樹根探測工具(@) 及/或褐根病/病源檢測(✗) 。

Other observations 其他觀察	

Branch Conditions 樹枝狀況

☐ Co-dominant branches 等勢枝	☐ Included bark 內夾樹皮	☐ Cross branches 疊枝	☐ Crooks or abrupt bends 不常規彎曲	☐ Sap flow 滲液
☐ Cracks or splits 裂縫或裂開	☐ Decay or cavity 腐爛或樹洞 #	☐ Heavy lateral limb 重側枝	☐ Deadwood 枯木	
☐ Canker 潰瘍 ☐ Galls 腫瘤	☐ Burls 節瘤	☐ Wounds or mechanical injury 傷痕或機械破損		
☐ Pest and disease 病蟲害：	☐ Parasitic or epiphytic plants 寄生或附生植物：			
☐ Fungal fruiting bodies 真菌子實體：✗	☐ Response growth 反應生長：			

If these items are checked, further assessment by resistograph or tomograph(#), equipment for tree root detection(@) and/or BRRD/pathogen tests(✗) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)、樹根探測工具(@) 及/或褐根病/病源檢測(✗) 。

Other observations 其他觀察	

Trunk Conditions 主幹狀況

☐ Cavity 樹洞 #(Width of cavity opening over 1/3 of trunk diameter 樹洞洞口闊度大於主幹直徑1/3)	#1	L 長 (mm)	W 闊 (mm)	D 深 (mm)	Direction 方向	Height above ground 離地面高度
	#2	L 長 (mm)	W 闊 (mm)	D 深 (mm)	Direction 方向	Height above ground 離地面高度
	#3	L 長 (mm)	W 闊 (mm)	D 深 (mm)	Direction 方向	Height above ground 離地面高度
	#4	L 長 (mm)	W 闊 (mm)	D 深 (mm)	Direction 方向	Height above ground 離地面高度

☐ Co-dominant stems 等勢幹 #	☐ Included bark 內夾樹皮 #	☐ Poor taper 不良漸尖生長	☐ Crooks or abrupt bends 不常規彎曲
☐ Cracks or splits 裂縫或裂開	☐ Abnormal bark crack 不正常樹皮裂紋	☐ Sap flow 滲液	
☐ Canker 潰瘍 ☐ Galls 腫瘤	☐ Burls 節瘤	☐ Wounds or mechanical injury 傷痕或機械破損	
☐ Pest and disease 病蟲害：	☐ Parasitic or epiphytic plants 寄生或附生植物：		
☐ Fungal fruiting bodies 真菌子實體：✗	☐ Response growth 反應生長：		

If these items are checked, further assessment by resistograph or tomograph(#), equipment for tree root detection(@) and/or BRRD/pathogen tests(✗) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)、樹根探測工具(@) 及/或褐根病/病源檢測(✗) 。

Other observations 其他觀察	

Root Conditions 根部狀況

☐ Root collar not visible 根脊不現	☐ Cracks or splits 裂縫或裂開	☐ Exposed root根部外露	☐ Root rot 根部腐壞 # @
☐ Cut or pruned roots 根部經切割或截根	☐ Trunk girdling 纏繞樹幹	☐ Girdling root 纏繞根	☐ Dead surface roots 表根枯萎
☐ Root-plate movement 根基移位 # @	☐ Wounds or mechanical injury 傷痕或機械破損		
☐ Pest and disease 病蟲害：	☐ Parasitic or epiphytic plants 寄生或附生植物：		
☐ Fungal fruiting bodies 真菌子實體：✗	☐ Response growth 反應生長：		

If these items are checked, further assessment by resistograph or tomograph(#), equipment for tree root detection(@) and/or BRRD/pathogen tests(✗) should be arranged when necessary.
若選擇此項，應視乎情況考慮應用微鑽探、聲納探測(#)、樹根探測工具(@) 及/或褐根病/病源檢測(✗) 。

Other observations 其他觀察	

Risk Categorisation 風險類別 *(Please identify no more than three (3) important Target(s) for no more than three (3) Tree Part 請就不多於三個樹木部份選取不多於三個目標物)*

Target No. 目標物編號	Tree Part 樹木部分	Condition(s) of Concern 關注狀況	Part Size (mm) 部位大小 (毫米)	Fall Distance (m) 下墜距離 (米)	Likelihood 可能性			Consequences 後果	Risk rating* 風險評級* *(Matrix 2: Risk rating matrix 風險評級組合)*
					Failure 倒塌	Impact 影響	Failure and Impact 倒塌並影響 *(Matrix 1 : Likelihood matrix 可能性組合)*		

*For tree obtained "High" or "Extreme" risk rating after assessment, appropriate mitigation measures should be followed.
*當風險評級組合的結果為"高"或"極高"時，需要安排適當的緩減措施。

Matrix 1: Likelihood matrix 可能性組合

Likelihood of Failure 倒塌的可能性	**Likelihood of Impacting Target 影響目標的可能性**			
	Very Low 非常低	**Low 低**	**Medium 中等**	**High 高**
Highly Probable 非常可能	Unlikely 很低機會	Somewhat likely 有機會	Likely 較大機會	Very likely 很大機會
Probable 相當可能	Unlikely 很低機會	Unlikely 很低機會	Somewhat likely 有機會	Likely 較大機會
Possible 有可能	Unlikely 很低機會	Unlikely 很低機會	Unlikely 很低機會	Somewhat likely 有機會
Improbable 不太可能	Unlikely 很低機會	Unlikely 很低機會	Unlikely 很低機會	Unlikely 很低機會

Matrix 2: Risk rating matrix 風險評級組合

Likelihood of Failure and Impact 倒塌並影響的可能性	**Consequences of Failure 倒塌後果**			
	Negligible 微小	**Minor 較小**	**Significant 重大**	**Severe 嚴重**
Very likely 很大機會	Low 低	Moderate 中	High 高	Extreme 極高
Likely 較大機會	Low 低	Moderate 中	High 高	High 高
Somewhat likely 有機會	Low 低	Low 低	Moderate 中	Moderate 中
Unlikely 很低機會	Low 低	Low 低	Low 低	Low 低

* 20 Common Tree Species requiring special attention should be duly considered to be rated at “Probable” or “Highly Probable” depends on the severity of the defects
* 20種需特別注意的常見樹種應視乎缺陷的嚴重性而盡量評為"相當可能"或"非常可能"

Mitigation Measures 緩減措施

Target No. 目標物編號	Tree Part 樹木部分	Mitigation Measures 緩減措施	Anticipated Completion Date 預算完成日期 (dd/mm/yyyy)	Residual Risk* 剩餘風險*

*The level of "Residual Risk" after proposed mitigation measures against "High" or "Extreme" risking rating shall be lowered to "Moderate" or below, otherwise, the proposed mitigation measures shall be reviewed.
*當執行針對"高"或"極高"水平風險評級的緩減措施後，有關的"剩餘風險"水平必需降至"中"或以下。否則，有關的緩減措施需要檢討。

Notes, explanations, descriptions and supplmentary Information 說明、註解、描述及補充資料

Overall tree risk rating 綜合樹木風險	Overall residual risk 綜合剩餘風險		
		Advanced assessment 進一步檢查	○ No 否 ○ Yes 是 Please describe 請描述
		Inspection limitations 檢查限制	☐ None 沒有 ☐ Inaccessible 難以接近 ☐ Climbers 攀緣植物 ☐ Root collar buried 根脊被埋 ☐ Others 其他 ____
		Next inspection date 下次檢查日期	____

Attached Information 附夾資料

Attachment Type	Attachment File Name	Description

Declaration 聲明

I, the Inspection Officer for the above TRA Form 2, confirm that I have inspected the tree(s) at the specified date and time with due diligence, and the information given in the Form(s) is truly reflecting what I observed on site.

本人作為以上個別樹木風險評估(表格2)的巡查人員，確認本人已在本表格所列日期及時間，謹慎小心完成有關樹木的風險評估，而本表格上填入的資料均真確無訛地反映本人在現場觀察所得。

My academic, professional, training records and work experience met the requirements of Inspection Officer (Form 2) in the TRAM Guidelines.

本人的學術、專業、培訓紀錄及相關工作經驗均符合「樹木風險評估及管理安排」指引中對巡查人員的要求。

Name of Inspection Officer:
巡查人員姓名 *(請以英文正楷書寫。)*

Date of Form 2 Completed:
完成表格2日期 *(dd/mm/yyyy)*

(Please sign on the space provided if the Form 2 is submitted in paper form 若以文本形式遞交表格2, 請於以下空位簽名)

Signature of Inspection Officer:
巡查人員簽署

Appendix 8 – Explanatory Notes for Form 2 – Individual Tree Risk Assessment

This Form 2 is provided with the *Guidelines for Tree Risk Assessment and Management Arrangement (TRAM Guidelines)* (10th Edition) and aligns with the latest tree risk assessment methods promulgated by the International Society of Arboriculture (ISA) and other overseas professional organisations. It intends to serve as a template for Inspection Officer to collect and record tree information and facilitate a meaningful individual tree basis risk assessment. For an advanced tree risk assessment, the Inspection Officer or arborist concerned shall submit a separate written report including but not be limited to the detailed assessment results on the risks of the tree or the tree part assessed. For further information on the requirements of the written report, the Inspection Officer may refer to the latest version of the ANSI A300 standards and the ISA Best Management Practice – Tree Risk Assessment or other relevant publications, such as BS 3998:2010 – *Tree Work - Recommendations* by the British Standards Institute.

Box(es) and space(s) are provided in the Form for collation of the right information. Please check the box(es) that reflect the observations. More than one box may be checked. Please also write comments and notes that are not covered elsewhere in the Form or for points that need additional explanation in the space(s) provided or under the “Other Observations” section. *It is not necessary to check every box or to fill in every space provided in this Form*. Only information relevant to the tree risk assessment should be collected.

<u>Section 1 – General Information</u>

This Section records the background information of the responsible department and the Inspection Officer who undertakes the individual tree risk assessment.

Department/Agency: name of the department or agency responsible for the tree risk assessment.

Inspection Officer: name of the Inspection Officer (automatic filled after login) who meets the academic, professional and training qualifications as well as work experience as specified in the ‘Requirements for Inspection Officers’ in the TRAM Guidelines. The qualifications of the Inspection Officer should be vetted by the responsible tree maintenance department and each department shall provide a list of accepted Inspection Officers to Greening, Landscape and Tree Management Section (GLTMS) of the Development Bureau forverification.

Post: post title of the Inspection Officer in the responsible department or agency.

Project/Contract No.: Project/Contract reference number in which the tree risk assessment is undertaken (if applicable).

File Ref.: file reference no. in the responsible department or agency that keeps the tree risk assessment reports, if applicable.

Date and Time of Inspection: date and time of the inspection in the format of dd/mm/yyyy and hr:min. If the inspection lasts for more than one day, the inspection date refers to the commencement date of the inspection.

Last Inspection Date: date of last inspection of the subject tree in the format of dd/mm/yyyy. If the inspection lasts for more than one day, the last inspection date refers to the commencement date of the last inspection. If it is the first-time inspection of the subject tree, please set it to the Date of Inspection.

Inspection Time Spent: the time spent in the field inspection of the subject tree to the nearest 0.5 hour. Travelling time should not be included.

Inspection Frequency: the frequency of inspection, for example, if the subject tree is inspected every six months, please mark '6 months' or if the subject tree is inspected every year, please mark '12 months', etc. Please mark '***ad hoc'*** if the tree risk assessment is undertaken on a need basis.

Section 2 – Tree Information

This Section provides background information of the tree assessed.

TMCP ID: A system generated ID to give a unique reference number to the trees in the new tree database, Tree Management Common Platform (TMCP). Please be alerted that if Inspection Officer input more than one departmental tree ID to an individual tree, different TMCP Tree IDs will be generated, hence, Inspection Officer should be aware of using a unique Departmental Tree ID for an individual tree. If the tree was transferred to other department/third party, original department shall follow **"Tree Transfer"** procedures to update the Departmental Tree ID accordingly.

Departmental Tree ID: the departmental identification number of each tree inspected. Department shall decide a **unique Departmental Tree ID** for an individual tree and ensure all Inspection Officer followed.

Tree Species: the botanical name of the subject tree. Please also include the preferred Chinese common name (generally the first name listed is the preferred common name) listed in the *Check List of Hong Kong Plants* (latest version) published by the Agriculture, Fisheries and Conservation Department (AFCD).

Triage Colour: the classification under the Triage System in the TRAM Guidelines. Please indicate the triage colour in the space provided. Please note that the triage classification may change in each assessment due to a change of the tree conditions and mitigation works completed. If the tree is one of the “Other Trees” in Zone I or one of the trees in other zones, no classification under the Triage System is necessary. Please mark ‘NIL’ in this situation.

Tree Height: estimated height of the subject tree from the existing ground level to the top of the tree crown measured to the nearest meter. For better estimation, please use a clinometer and/or range pole.

Crown Spread: diameter of the spread of the tree crown measured to the nearest meter. For asymmetric tree crown, the crown spread along the longest axis should be measured.

DBH of Tree Trunk: diameter of the tree trunk at breast height (1.3 meter above ground) measured to the nearest millimeter in accordance with AFCD’s Nature Conservation Practice Note No. 2 ‘*Measurement of Diameter at Breast Height (DBH)*’’ (2006 or its latest version). For measurement of trees with multiple trunks, please input the individual trunk diameters in the boxes provided and then calculate the aggregate DBH in accordance with AFCD’s Practice Note No. 2. The tree risk assessment report should include photographic records showing the multiple trunks and each trunk numbered in sequence (i.e. #1, #2…etc.). If there are more than five individual trunks, please provide the individual trunk diameters in a separate sheet but the aggregate DBH should cover all individual trunks.

Tree Status: tree status in the Tree Register. Please indicate whether the subject tree is an Old and Valuable Tree (OVT), a Stonewall Tree (SWT), Large Tree (with an individual trunk(s) DBH ≥ 500 mm or overall height at 9 metres or above), a Brown Root Rot (BRR) disease infected tree or other trees. If applicable, please fill in the OVT Register No. and Tree Register No. for OVT and SWT respectively in the space provided. Please check more than one box if applicable.

<u>Section 3 – Location Information</u>

This Section provides location information of the subject tree.

Masterzone Ref. & **Subzone Ref.**: Masterzone reference number and Subzone reference number in the Tree Management Common Platform (TMCP) for the subject tree. Please fill in "NIL" if there is no Subzone. Details for the zoning of Masterzones and Subzones are specified in the TMCP Manual which can be viewed and/or downloaded from the Cyber Manual for Greening (http://devb.host.ccgo.hksarg). The zones are determined by the responsible department.

Chinese Location and **English Location**: Chinese and English names of the tree location. Please refer to the location/street names in the latest version of the '*Hong Kong Guide*' published by the Lands Department.

District: use district categorisation in 18 District Councils.

Tree Risk Management Zone Category: category of Tree Risk Management Zone as specified in the TRAM Guidelines. Please check the 'Category I' box if the tree falls into Category I zone; check the 'Category II' box if the tree falls into Category II zone; and check the 'Category III' box if the tree falls into Category III zone.

Co-ordinates: x- and y-coordinates of the tree at the centre of the tree trunk according to the HK1980 Grid Coordinates up to 3 decimal places. The coordinates can be measured by common GPS devices.

Location Type: venue or particular area that the subject tree is located. Please mark SIMAR Slope Number in the space provided if the subject tree is within a SIMAR slope. Please check "Others" if none of the venues or areas is applicable. For trees within a tree ring on a shotcrete slope, check "Tree Pit/Tree Ring". Please check more than one box if more than one location type apply, for example, if the tree is growing in a tree pit in a housing estate, please check "Tree Pit" and "Housing Estates", etc. Provide location information in space in 'Others' if the subject tree group does not fall into the boxes provided.

Nearby Utility Reference No.: nearby public utility reference number, such as lamp post number. Please mark the utility on the location map with its reference number clearly indicated.

<u>Section 4 – Target Assessment</u>

This Section provides information on the potential targets affected by the subject tree. One individual tree or a tree part may affect one or more potential targets. The assessment of each potential target facilitates a better assessment of the likely consequence of a potential tree failure.

Target Number: the potential targets in priority according to the severity of consequence. People is always the most critical target with the most severe consequence.

Target Description: brief description of the target identified, for example, ‘pedestrians’, ‘people in leisure/amenity area’, ‘occupied resident house’, ‘cars in carpark’, ‘school’, ‘play area’, ‘low-traffic street’, or ‘high-traffic street’, etc.

Target Zone: location at which the target would likely be present the most. Please check the box if the target would likely be:

- Within dripline – the target is within the dripline of the subject tree; or
- Within 1.5 x Ht. – the target is outside the dripline but within the striking distance, i.e. 1.5 times of the total tree height.

Occupancy Rate: estimated amount of time in a day or a week that the target would likely be present within the Target Zone.

- Rare – the target is not commonly within the Target Zone.
- Occasional – the target is present within the Target Zone infrequently or irregularly.
- Frequent – the target uses or performs activity within the Target Zone for a large portion of a day or a week.
- Constant – the target is present within the Target Zone at nearly all times, 24 hours a day, 7 days a week.

Remove Target: remove the target as far as possible to eliminate the risk. Please check the box ’Yes’ if the target can be removed; otherwise, please check the box ’No’.

Restrict Usage: restrict usage to eliminate the risk if possible. Please check the box “Yes” if access to the Target Zone can be restricted; otherwise, please check the box ‘No’.

Section 5 – Site Conditions

This Section provides background information of the site that may affect the likelihood of tree failure.

Topography: topography of the site where the tree is growing. Please check the box “flat”, “natural terrain”, “man-made slope”, “retaining wall” or “stonewall” where applicable and specify other site observations in the box “Other”. For example, if the tree is a stonewall tree and cracks on the stonewall is observed, more information shall be provided in the “Other” box. Please check more than one box to fully describe the site setting.

Site Changes: site factors affecting the root system of the subject tree or site factors that may affect the wind exposure of the subject tree:

- None – no soil changes observed.
- Grade change – soil was added or removed from the site.
- Site clearing – adjacent tree(s) had been removed or significantly reduced, which may cause the assessed tree to become exposed to wind.
- Others – other necessary information or further description of site change.

Soil Conditions: factors that may affect the health and/or vitality of the tree assessed, or the ability of the assessed tree’s root system to provide sufficient mechanical support.

- Normal – normal soil conditions.
- Compacted – soil is severely compacted, limiting the depth, spread, and distribution of the root system.
- Water logging – water-logged due to poor drainage, high water table, excessive irrigation or assessed tree grows in a low area.
- Others – conditions that has not been covered in the boxes provided or further descriptions of soil conditions is considered necessary.

Soil Crack or Crack behind Lean: Please check the box if soil crack or crack behind lean was observed. Give more descriptions in the space provided when necessary. Root detection and mapping survey should be arranged when necessary to confirm if root system is damaged if resource permit.

Restriction within the Dripline: Please check the box and estimate the percentage restriction observed within the dripline of the tree assessed. Restriction refers to building, pavement, roads, hard landscape features, retaining wall, planter boundary or drainage channels etc. Root detection and mapping survey should be arranged when necessary to confirm if root development is restricted too.

Tree Failure Record: Please check the box if whole-tree failure(s) at the site of the tree assessed was reported in the past 12 months of the site inspection, saving for the trees that have failed during typhoons. Please give more information including the estimated time of the tree failures and the reasons for the failures, etc., if possible. Particular attention shall be drawn if branch failure of the same tree was recorded in the past 6 months.

Brown Root Rot Disease Record: Please check the box if Brown Root Rot Disease (BRRD) infected tree(s) was previously identified within the dripline of the assessed tree (Distribution of BRRD infected tree location can be viewed on TMCP web layer). Please give detailed descriptions including the estimated time of disease identification, treatment applied, etc., if possible. Soil pathogen test, including BRRD, should be conducted if necessary.

Other Observations: Please provide other observations that have not been covered in this Section.

Section 6 - General conditions

This Section provides general conditions of the tree assessed.

Tree Vigor: the overall health conditions of the tree assessed. Please indicate:

- Low – tree growth is restricted or stunted, smaller than normal size, leaf density below average and/or abnormal epicormics. If tree vigor is Low, further checking on trunk internal decay or root system defects/damages occurred by resistograph, tomograph or soil pathogen test should be arranged when necessary.
- Normal – tree growth is in similar size of a typical/average sample tree for its species in the area, leaf conditions and branching show no significant defects. Root growth is in normal conditions, no restriction.
- High – tree is growing well and appears to be of a size above a typical/average sample tree for its species in the area. It is also free from any restriction, diseases or pests infestation.

Lean: angle of the trunk measured from vertical line. Please indicate:

- No – no leaning observed.
- Yes – measure the angle from vertical line and record in the space provided. If the tilt angle is larger than 15 degrees, tree stability shall be assessed.
- Recent Tilt – tilting was first identified in the current inspection or the leaning angle has continued, active leaning by more than five (5) degrees in the past 12 months, root system and trunk decay should be assessed. Root plate lifting, root breaking or soil cracks shall be carefully checked. Root detection and mapping survey should be arranged when necessary to confirm if the tree root grows healthy or restricted, if resource permit.

- Natural due to phototropism – leaning due to phototropism.
- Self-corrected – leaning of tree corrected due to self-correction mechanism.
- Response growth – reaction wood or additional wood has grown to increase the structural strength of the trunk/branches; describes location and extent of response growth observed.

Wind Exposure: factors that affect wind load of the tree assessed.

- Protected – other trees, structures or buildings in the area significantly reduce wind velocity or the exposure of the assessed tree to wind.
- Partial – other trees, structures or buildings near the tree moderately reduce the impact of wind on the assessed tree.
- Exposed – the assessed tree is fully exposed to wind, e.g. standalone tree, tree at the edge of a forest/plantation, etc. If the tree is identified exposed to wind direction, crown loading and imbalance crown shall be assessed and necessary crown reduction shall be considered to reduce crown loading.
- Wind funneling – wind may be 'funneled' or 'tunneled' (by buildings, canyons, large stands of trees) towards the assessed tree so that wind velocity experienced by the assessed tree is increased dramatically. If the tree is identified located at "Wind Funneling" site, crown loading and imbalance crown shall be assessed and necessary crown reduction shall be considered to reduce crown loading. More thorough crown inspection shall also be conducted to remove dead branches or hanging branch on the tree crown.

Wildlife or Nesting Site: wild birds or other wildlife including bats, squirrels, etc. may use the branches or cavity of the assessed tree for nesting. Please indicate:

- None – no nesting activity is observed.
- Yes – nesting activity is observed. Please record on-site observations in the space provided (if available), including the name of the wildlife (if known), quantity, and location of nests, etc.

Cable or Brace: presence of cable or brace installed to provide additional support to the assessed tree. Please indicate:

- None – no cable or brace system was installed.
- Yes – cable or brace system was installed. Please provide more information if possible, including the type of cables or braces, conditions of cables or braces, effectiveness, maintenance requirement, etc., in the space provided.

Pruning History: maintenance/pruning record of the assessed tree in the past 12 months or the latest tree assessment. Please indicate:

- Cleaned – crown cleaning was conducted.
- Thinned – crown thinning was conducted.
- Raised – crown raising was conducted.
- Reduced – crown reduction was conducted.
- Structural pruning – structural pruning was conducted, normally for young trees.
- Topped – inappropriate pruning technique used to reduce tree size; characterized by inter-nodal cuts.
- Lion-tailed – inappropriate pruning practice used to remove an excessive number of inner and/or lower lateral branches.
- Others: give detailed descriptions on the items checked, last pruning date and other pruning records not covered above.

Other Observations: Please provide other observations that have not been covered in this Section.

Section 7 – Crown Conditions

This Section provides information on the crown conditions of the assessed tree.

Crown Density: the branches, foliage and other reproductive parts of a tree forming the tree crown that blocked light visibility or penetration through the crown. Crown density can be estimated by using the crown density – foliage transparency card or electronic densitometers. Please indicate:

- Normal – crown density is similar to a typical/average sample tree for its species in the area.
- Sparse – crown density is lower than a typical/average sample tree for its species in the area that allows a large degree of wind and light penetration. Please estimate the percentage of crown density in <25%, 25% - <50%, or 50% - <75% by comparing to a typical/average sample tree for its species in the area and fill in the space provided. Over 75% is considered "Normal". If crown density is lower than 50%, assessment on root development (by root detection and mapping survey) and trunk decay assessment by resistograph or tomograph should be arranged when necessary to check the reasons of the sparse crown

Imbalanced Crown: Please check the box if the canopy is not uniformly formed. Please counter check the tree stability if the heavy side of the tree crown falls to a busy traffic road, school, playground or gathering place. Crown reduction shall be conducted to reduce crown load and rectify the imbalance crown.

Live Crown Ratio (LCR): the ratio of the height of the live crown to the total height of entire tree [(crown height/tree height) × 100%]. Please check the appropriate box for the estimated range of LCR. If live Crown Ratio is lower than 40%, further assessment on trunk or root internal decay by resistograph or tomograph, or root system defects/damages by equipment for root detection and mapping, should be arranged when necessary to identify cause of low crown ratio. Pruning history shall also be counter-checked to identify if any unnecessary pruning was conducted.

Crown Load: the estimated overall loading at tree crown of the assessed tree. This may vary with the density of foliage and other reproductive parts, canopy architecture, etc.

- Normal – crown load is similar to a typical/average sample tree for its species in the area.
- Heavy – crown load is much higher than a typical/average sample tree for its species in the area. If heavy load of crown is identified, crown reduction shall be considered to reduce crown loading.
- Declined – crown load is lower than a typical/average sample tree for its species in the area. If crown load is identified "declined", assessment on trunk internal decay by resistograph or tomograph, or thorough assessment on root development by equipment for root detection and mapping, should be arranged when necessary, or soil pathogen test as required. Although most of the nutrient deficiency symptoms can be observed by experienced inspection officers, soil nutrient content test should be considered to check if any nutrient deficiency in the planting soil, however, application of fertilizers shall be carefully planned as over fertilization will also damage the root system and the tree health. Departments shall also be aware of the restriction on the application of fertilizers at Water Gathering Ground and Country Parks.

Foliage: an important indicator of tree health based on the comparison with a healthy specimen of the same species in the area. Please indicate:

- Fallen leaf (seasonal) – fallen leaf observed on the tree, check if the tree is a deciduous tree and leaves shed in winter.
- Defoliation (withered) – defoliation observed on the tree, check if the tree is withered and leaves shed before it is dead. Check if internal trunk decay or root system damages caused the defoliation. Soil nutrient content test should be considered to check if any nutrient deficiency in the planting soil, however, application of fertilizers shall be carefully planned as over fertilization will also damage the root system and the tree health. Departments shall also be aware of the restriction on the application of fertilizers at Water Gathering Ground and Country Parks.
- Normal - foliage color is similar to a typical/average sample tree for its

species in the area.

- Chlorotic – leaves become yellowish-green to yellow, estimate the percentage of chlorotic foliage in the canopy and fill in the space provided. Check if the planting site is water-logged or insufficient of water. Soil nutrient content test shall be considered to check if any nutrient deficiency in the planting soil, however, application of fertilizers shall be carefully planned as over fertilization will also damage the root system and the tree health.
- Necrotic – dead leaves remained in the tree crown, estimate the percentage of necrotic in the tree crown and fill in the space provided. Check if the planting site is water- logged or insufficient of water. Check if internal trunk decay or root system damages caused the defoliation. Soil nutrient content test should be considered to check if any nutrient deficiency in the planting soil, however, application of fertilizers shall be carefully planned as over fertilization will also damage the root system and the tree health. Departments shall also be aware of the restriction on the application of fertilizers at Water Gathering Ground and CountryParks.

Leaf Size: size of leaves in the mature part of the assessed tree.

- Normal – leaf size in mature part of the assessed tree is similar to a typical/average sample tree for its species in the area.
- Smaller than normal – leaf size in mature part of the tree is smaller than leaves in a sample species in the area. Soil nutrient content test should be considered to check if any nutrient deficiency in the planting soil, however, application of fertilizers shall be carefully planned as over fertilization will also damage the root system and the tree health. Departments shall also be aware of the restriction on the application of fertilizers at Water Gathering Ground and CountryParks.

Dieback Twigs: progressive death of twigs starting at the tips of shoots or branches. The percentage of dieback twigs can be estimated by comparing the portion of dieback twigs to the entire tree crown. Please indicate:

- <5% – less than 5% of dieback twigs wasobserved.
- 5% – <25% - dieback appeared on about 5% to less than 25 % of canopy
- 25% – 50% - dieback appeared about 25% to 50% of thecanopy
- >50% – dieback extended to over 50% of thecanopy.

If the dieback twigs is more than 25%, assessment on trunk internal decay by resistograph or tomograph, or thorough assessment on root development by equipment for root detection and mapping should be arranged when necessary, or soil pathogen test as required.

Epicormics: Please check the box if epicormics, which are shoots sprouting vigorously from damaged bark/wounds on trunk or branch of a tree, are present.

Extensive growth of epicormics always indicates poor health conditions or wound damages, thorough check of tree health conditions, in particular internal decay at old wounds or cavity, shall be conducted.

Hanger(s): Please check the box if hanger(s), which is a broken part of trunk or branch that remains or hangs up in the tree crown. This hanger may impose high potential risk to the target(s), especially unprotected target(s), present underneath the canopy of the tree. Removal of hanger should be conducted as soon as practicable.

Pest and Disease: Please check the box if pest(s) or disease(s) was observed on the assessed tree. Please try to identify the pest(s) or disease(s) detected on the assessed tree such as Brown Root Rot Disease and decay caused by *Ganoderma* spp. and termites (use termite detector if necessary), for better pest/disease control. If the pests/fungi cannot be identified on site, please collect samples to the TMO for further identification. For *Phauda flammans* infestation, TMO has collected departments' information and created a distribution layer on TMCP map for departments to view.

Other Observations: Please provide other observations that have not been covered in this Section.

Section 8 – Branch Conditions

This Section provides information on the branch conditions of the assessed tree. Please check the appropriate box(es) if the following branch conditions are observed:

Co-dominant Branches: branches of nearly equal diameter arising from a common junction, from apical buds at the tip of the same stem and lacking normal branch union or collar. Co-dominant branches in combination with other defects, such as acute angle attachment, included bark and high aspect ratio, may increase potential of branch failure. Thorough inspection shall be conducted to identify if any other structural defects had been associated with the co-dominant branches. The inspection can be conducted by aerial inspection (tree climbing), binocular or Drone inspection as required.

Included Bark: bark that embedded in a union of two or more branches or between branch and trunk, resulting a weakened structure or source of decay to core wood. Included bark in combination with other defects, such as low live crown ratio, and/or high aspect ratio, may increase risk of branch failure, mitigation measures including pruning of defective branch shall be conducted as far as practicable.

Cross Branches: crossing, rubbing or upright branches that may cause damage to tree bark or resulted in weakened structure. Cross-branching contributes weak point to branch failure, mitigation measures shall be conducted timely to prune the defective branch as far as practicable.

Crooks or Abrupt Bends: abnormal bending of tree branch. The crooks or bends may result in weak point on branch(es), mitigation measures shall be conducted timely to prune the defective branch as far as practicable.

Sap Flow: oozing of liquid that may result from infections or infestations under the bark. The presence of sap flow may or may not be a structural defect or stability weakness. Internal decay assessment shall be considered to check the health and structural conditions of the branch as required.

Cracks or Splits: separation in the wood in either a longitudinal (radial, in the plane of ray cells) or transverse (across the stem) direction. If the conditions of cracks or splits is significant and may affect the structural safety of the branch, mitigation measures including removal of the defective branch shall be arranged as far as practicable.

Decay or Cavity: decay and cavity in a branch may be caused by mechanical injury or fungal damage or wildlife nesting, resulting in weakened structure on the branch. Internal decay assessment shall be conducted to assess the sound wood percentage and the extent of decay. Necessary mitigation measures shall be conducted to remove the defective branch as far as practicable. As tree has self-defense mechanism, no particular treatment, including applying protective reagents/resin or covering the opening of the wound/cavity is required.

Heavy Lateral Limb: leaves clustered at tip of a long branch. Heavy lateral limb (Lion Tail) may contribute high branch failure rate, removal of the Lion-tailed branch or mitigation measures to enhance lateral growth of the Lion-tailed branch shall be considered. Counter check the pruning history is required to identify mal-practice of pruning.

Dead Wood: dead wood may be resulted from poor pruning or remains of hangers. Mitigation measures shall be arranged to remove the dead wood as soon as practicable.

Cankers or Galls or Burls: cankers are localised diseased areas (lesions) on the trunk, branch or even roots; often sunken or discolored; galls are abnormal swellings of tissue caused by pests; may or may not be a defect; burls are outgrowth on the branch; not usually considered a defect. Resistograph or tomograph should be arranged when necessary to identify if any internal decay was caused and the percentage of sound wood remained as far as practicable.

Wound or Mechanical Injury: wound or mechanical injury observed on branch. Wound is an opening that is created when the bark of a live branch is cut, penetrated, damaged, or removed. Please provide more descriptions if necessary. Internal decay assessment shall be conducted to assess the sound wood percentage and the extent of decay if resources permit. Necessary mitigation measures shall be conducted to remove the defective branch as soon as practicable. As tree has self-defense mechanism, no particular treatment, including applying protective reagents/resin or covering the opening of the wound/cavity is required.

Pest and Disease: Please check the box if pest(s) or disease(s) was observed on the assessed tree. Please try to identify the pest(s) or disease(s) detected on the assessed tree such as Brown Root Rot Disease and decay caused by *Ganoderma* spp. and termites (use termite detector if necessary), for better pest/disease control. If the pests/fungi cannot be identified on site, please collect samples the TMO for further identification. Mitigation measures including application of pesticides or fungicides should be considered as appropriate. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Parasitic or Epiphytic Plants: parasitic or epiphytic plants grow on branches. The presence of parasitic or epiphytic plants may or may not affect health or structure of the tree. Please try to identify the parasitic or epiphytic plants observed and provide details in the space provided. Mitigation measures to remove the parasitic or epiphytic plants shall be arranged as appropriate. For removal of Mikania, technical notes issued by the AFCD on removal of Mikania shall be observed.

Fungal Fruiting Bodies: fungal fruiting bodies or mycelia present at decayed part of the assessed tree. Please try to identify the common wood decay fungi such as Brown Root Rot Disease and decay caused by *Ganoderma* spp. as far as possible. Close-up photographs showing the key features of the fungi should be included to aid subsequent identification. Soil pathogen test should be arranged when necessary to identify possible species of pathogenic fungi and appropriate mitigation measures including application of fungicides should be considered when necessary. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Response Growth: reaction wood or additional wood that has grown to increase the structural strength of the branch. Please indicate the location(s) and extent.

Other Observation: Please provide other observations that have not been covered in this Section.

Section 9 – Trunk Conditions

This Section provides information on the trunk conditions of the assessed tree.

Cavity: Please measure and input the dimensions of cavity on tree trunk. The direction of cavity opening and height of cavity (measured at the center of the opening above ground level) should be measured and marked in the space provided. Internal decay assessment shall be conducted to assess the sound wood percentage and the extent of decay. Necessary mitigations measures shall be conducted to remove the defective trunk or the whole tree as soon as practicable. As tree has self-defense mechanism, no particular treatment, including applying protective reagents/resin or covering the opening of the wound/cavity is required.

Please check the appropriate box(es) if the following trunk conditions are observed:

Co-dominant Stems: trunks of nearly equal diameter arising from a common junction and lacking a normal union or collar. Co-dominant stems in combination with other defects, such as acute angle attachment, included bark and high aspect ratio, may increase potential of failure. Thorough inspection shall be conducted to identify if any other structural defects had been associated with the co-dominant stems. The inspection can be conducted by aerial inspection (tree climbing), binocular or Drone inspection as required. If the situation threatened the safety of the tree, removal of the defective stem or the whole tree shall be considered as soon as practicable.

Included Bark: bark that embedded in a union of two or more trunks, causing a weakened structure at the trunk. Included bark in combination with other defects, such as low live crown ratio, and/or high aspect ratio, may increase the likelihood of failure. If the situation threatened the safety of the tree, removal of the defective stem or the whole tree shall be considered as soon as practicable.

Poor Taper: the decrease in diameter over the height of tree trunk. New exposure of poor taper tree may result in higher possibility of failure. Structural stability of the tree with poor taper shall be further assessed. If the tree failure risk rating is “High” or “Extreme”, tree removal shall be considered as soon as practicable.

Crooks or Abrupt Bends: abnormal bending of tree trunk(s), new exposure of trees with crooks or bends may result in weak point on the trunk(s) and is a significant contributor to likelihood of failure. Mitigation measures shall be conducted timely to remove the defective stem or removal the whole tree as far as practicable.

Cracks or Splits: separation in the wood in either a longitudinal (radial, in the plane of ray cells) or transverse (across the stem) direction. If the conditions of cracks or splits is significant and may affect the structural safety of the tree, mitigation measures including removal of the defective stem shall be arranged as far as practicable.

Abnormal Bark Crack: bark cracks may be a common character on tree trunk. It would be useful to compare with other trees of the same species in the area to identify abnormal bark cracks. New exposure of abnormal bark crack may contribute to higher likelihood of failure. Mitigation measures including removal of the defective stem or removal of the whole tree shall be considered.

Sap Flow: oozing of liquid that may result from infections or infestations under the bark. The presence of sap flow may or may not be a structural defect or stability weakness. Resistograph or tomograph should be arranged when necessary to identify if any internal decay was caused and the percentage of sound wood remained if resource permit. If the situation threatened the safety of the tree, removal of the defective part or the whole tree shall be considered as soon as practicable.

Cankers or Galls or Burls: cankers are localised diseased areas (lesion) on the trunk, branch or even roots; often sunken or discolored; Galls are abnormal swellings of tissue caused by pests; may or may not be a defect; Burls are outgrowth on the trunks; not usually considered a defect. Resistograph or tomograph should be arranged when necessary to identify if any internal decay was caused and the percentage of sound wood remained if resource permit.

Wounds or Mechanical Injury: wound or mechanical injury observed on tree trunk. Please give more descriptions if necessary. Internal decay assessment shall be conducted to assess the sound wood percentage and the extent of decay. Necessary mitigation measures shall be conducted to remove the defective part or the whole tree as far as practicable. As tree has self-defense mechanism, no particular treatment, including applying protective reagents/resin or covering the opening of the wound/cavity is required.

Pest and Disease: pest and disease that may significantly affect tree health or stability. Please try to identify the pest or disease detected on the assessed tree, such as termites (use termite detector if necessary), for better pest/disease control. If the pests/fungi cannot be identified on site, please collect samples to the TMO for further identification. Mitigation measures including application of pesticides or fungicides should be considered as required. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Parasitic or Epiphytic Plants: parasitic or epiphytic plants grow on tree trunk(s). The presence of parasitic or epiphytic plants may or may not affect health or structure of the tree. Please try to identify the parasitic or epiphytic plants observed on the tree and fill in the space provided. Mitigation measures to remove the parasitic or epiphytic plants shall be arranged as appropriate. For removal of Mikania, technical notes issued by the AFCD on removal of Mikania shall be observed.

Fungal Fruiting Bodies: fungal fruiting bodies or mycelia present at decayed parts of the tree. Please try to identify common wood decay fungi, such as Brown Root Rot Disease and decay caused by *Ganoderma* spp., as far as possible. Close-up photographs showing the key features of the fungi should be included to aid subsequent identification. Soil pathogen test should be arranged when necessary to identify possible species of pathogenic fungi and appropriate mitigation measure including application of fungicides shall be arranged. If application of fungicides shall be undertaken, prior advice from a qualified pathologist or specialist shall be sought.
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Response Growth: reaction wood or additional wood that has grown to increase the structural strength of the trunk. Please note location(s) and extent.

Other Observation: Please provide other observations that have not been covered in this Section.

<u>Section 10 – Root Conditions</u>

This Section provides information on the root conditions of the tree assessed. Please check the appropriate box(es) if the following root conditions are observed:

Root Collar not Visible: if possible, please determine and note the depth of root collar below ground. Mitigation measures including the removal of top soil to expose the root collar, application mulching to improve soil conditions should be considered

Cracks or Splits: separation in the wood in either a longitudinal (radial, in the plane of ray cells) or transverse (across the root) direction. Mitigation measures including removal of the defective roots is required as soon as practicable.

Root detection and mapping should be arranged when necessary to counter-check the health root distributions if resource permit.

Exposed Root: roots exposed, curling or snaking around a tree. Root exposure may be caused by erosion of top-soil, lack of soil space for root growth or over trampling. Mitigation measures including application of mulching and replacement of top soil should be considered. If the exposed root has damaged the pavement nearby, elevated walkway or other site improvement work shall be considered.

Root Rot: root rot is a common root disease. Please try to identify the type of root rot and provide close-up photographs of the rotted areas for further identification. Mitigation measures including application of fungicides, removal of defective roots or removal of the whole tree should be considered as appropriate. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Cut or Pruned Roots: roots cut or pruned may truncate the transmission path of water and nutrients to the trunk and leaves. Root detection and mapping survey should be arranged when necessary to counter check the distributions of healthy roots. Mitigation measures including application of mulching to reduce compaction should be considered to improve the soil conditions to promote new root development. If the root damages is assessed threatening to the stability of the whole tree, tree removal shall be considered.

Trunk Girdling: roots girdled the tree trunk may cause restriction to trunk growth. Resistograph or tomograph should be arranged when necessary to assess if internal decay and percentage of sound wood remained if resource permit. If the situation has threatened the safety of the whole tree, tree removal shall be considered.

Girdling Root: roots circles the tree base or below surface soil. The root girdling restricted or destructed the development of both trunk and roots, and may cause tree failure in extreme case. Root detection and mapping survey should be arranged when necessary to check the distributions of healthy roots if resource permit. If the root damages is assessed causing defective to the whole tree, tree removal shall be considered.

Dead Surface Roots: dead surface roots may indicate structural instability, check this box if dead surface root is observed. Root detection and mapping survey should be arranged when necessary to counter check the distributions of healthy roots if resource permit. Mitigation measures including application of mulching to improve soil conditions should be considered. If the root damage is assessed causing defective to the whole tree, tree removal shall be considered.

Root-plate Movement: root plate may be affected by strong gust wind or soil erosion; root- plate movement may severely affect the stability of the tree. Mitigation measures including installing staking should be considered to maintain the stability for small trees. If root damage is serious or the tree is unstable after staking, tree removal shall be considered.

Wounds or Mechanical Injury: wounds or mechanical injury observed on the roots, in particular the exposed roots. As tree has self-defense mechanism, no particular treatment, including applying protective reagents/resin or covering the opening of the wound is required. If the root damages is assessed causing defective to the whole tree, tree removal shall be considered.

Pest and Disease: pest and disease that may significantly affect tree health or stability. Please try to identify the pest or disease detected on the assessed tree, such as termites (use termite detector if necessary), for better pest/disease control. If the pests/fungi cannot be identified on site, please collect samples to the TMO for further identification. Mitigation measures including application of pesticides or fungicides should be considered as required. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Parasitic or Epiphytic Plants: parasitic or epiphytic plants grow on roots exposed. The presence of parasitic or epiphytic plants may or may not affect health or structure of the tree. Please try to identify the parasitic or epiphytic plants observed on the tree and provide details in the space provided. Mitigation measures to removal the parasitic or epiphytic plants shall be arranged as appropriate.

Fungal Fruiting Bodies: fungal fruiting bodies or mycelia present at decayed parts of the roots. Please try to identify common wood decay fungi, such as Brown Root Rot Disease and decay caused by *Ganoderma* spp., as far as possible. Close-up photographs showing the key features of the fungi should be included to aid subsequent identification. Soil pathogen test should be arranged when necessary to identify possible species of pathogenic fungi and appropriate mitigation measures including application of fungicides should be arranged when necessary. If application of fungicides is required, prior advice from a qualified pathologist or specialist shall be sought.

Response Growth: reaction wood or additional wood that has grown to increase the structural strength of the roots or root collar. Please note location(s) and extent.

Other Observations: Please provide other observations that have not been covered in this Section.

<u>Section 11 – Risk Categorisation</u>

This Section on risk categorisation follows the tree risk assessment method promulgated by the ISA, and the method is described in the "*Best Management Practice – Tree Risk Assessment*" (2011) published by the ISA.

Target Number: reference number of the targets in priority according to the severity of consequence as given in Section 4 – Target Assessment. **Please list a maximum of three most important targets on each tree part identified.**

Tree Part: the concerned part of the tree. It could be the whole tree, one or more branch(es), main trunk, or root, which might lead to damages of the target(s). A category of tree part may lead to one or more 'Condition(s) of Concern'.

Condition(s) of Concern: the condition(s) of tree or tree part that affect the likelihood of failure and may lead to damages to target, e.g. 'large, dead branch over a car parking space.', 'root plate movement observed at a tree near a residential house', 'trunk decay identified at a tree nearly a children playground' etc.

Part Size: the size of the tree or tree part concerned. Please estimate the diameter of the tree part concerned; if whole tree is concerned, measure the DBH of the tree trunk.

Fall Distance: the fall distance of the tree part or the whole tree against the target concerned. The longer the fall distance, the larger the extent of damage.

Likelihood of Failure and Impact

According to ISA's risk categorisation, 'likelihood of failure and impact' can be selected from a Likelihood Matrix – Likelihood of Failure x Likelihood of Impact, using the Likelihood Matrix table (Matrix 1).

The likelihood of failure can be categorized using the following guidelines:

- Improbable – failure of the tree or tree part concerned is not likely under normal weather conditions and may not fail under extreme weather conditions including red/black rainstorm, typhoon signal No. 8, or extreme winter monsoon, within a specified timeframe. According to the ISA guidelines, the 'specified timeframe' for estimating likelihood of tree failure is between one to five years.

- Possible – failure of the tree or tree part concerned could occur under extreme weather conditions within a specified timeframe but would unlikely fail during normal weather conditions.

- Probable – failure of the tree or tree part concerned is expected under normal weather conditions within the specified timeframe.
  Highly probable – the tree or tree part concerned has started falling or failure is most likely to occur in the near future under normal weather condition. If this situation is encountered, the Inspection Officer is required to take immediate action(s) to protect public safety.

If the species of tree falls with the "List of 20 Common Tree Species Requiring Special Attention" as reported by the TMO before commencement of TRAM Cycle every year, the rating of "Likelihood of Failure" should be duly considered to be rated at "Probable" or "Highly Probable" depends on the severity of the defects. Furthermore, tree defects including hanging branch, severe branch/trunk/root decay, and other major defects and health problems as stated in paragraph 2.4.4 in the TRAM Guidelines were observed, the "Likelihood of Failure" should also be rated at "Probable" or "Highly Probable" depends on the severity of the defects.

Regarding the likelihood of impacting target, it can be categorised in four levels:

- Very low - the chance of a tree or tree part failure impacting the target concerned is very low, for example, a rarely used site, an occasionally used site that is partially protected by shelter/cover/structure, or a rarely used trail, etc.

- Low - it is not likely that a tree or tree part failure will impact the target concerned, for example, an occasionally used site that is fully exposed to the tree concerned, a frequently used site that is partially exposed to the tree concerned, or a constant target that is well protected from the tree concerned.

- Medium - a tree or tree part failed may or may not impact the target, with nearly equal likelihood, for example, a frequently used site that is fully exposed to the tree concerned, a constantly used site that is partially protected from the tree concerned.

- High - A tree or tree part failure will most likely impact the target, for example, a fixed target is fully exposed to the tree concerned, high-use road or walkway adjacent to the tree concerned.

<u>Risk Rating</u>

According to ISA's risk categorisation, the risk rating of a specific tree part to a specified target can be selected from the Risk Rating Matrix – Likelihood of Failure and Impact x Consequence of Failure, by using the Risk Rating Matrix table (Matrix 2).

The consequence of failure can be categorised using the following guidelines:

- Negligible – no personal injury, low value property damage, or minor or no disruption to traffic or human activities will be involved. For example, the tree is located at remote location that almost no human activity or vehicular traffic, the failure of tree very unlikely to cause any human injury or property damages.
- Minor – very minor personal injury may or may not require simple first aid treatment, low to moderate property damage, or small disruptions to traffic or human activities will be involved. For example, the tree or tree part in question is relative small in size or the fall distance is low and the failure of the tree part of the whole tree is less chance to cause serious human injury or big damages to property or disruption to traffic.
- Significant – personal injury may result in hospitalization, moderate to high property damage, or considerable disruption to traffic or human activities will be involved. For example, the tree or tree part is relative large in size or the fall distance is medium, the tree failure may cause minor injury to human or minor damages to property or disrupted certain traffic circulation but would not close total blockage of traffic.
- Severe – serious personal injury or death, high value property damage, or major disruption to traffic and/or important human activities will be involved. For example, the tree or tree part involved is large in size or the fall distance is high, the failure of the tree may cause serious human injury or death, major damages to property or cause total blockage of traffic.

The Risk Rating, after using the Risk Rating Matrix table (Matrix 2), is further categorized into four categories:

- Low - the consequence of failure is "Negligible" or the likelihood of failure and impact is "Unlikely" or the likelihood of failure and impact is "Somewhat Likely" when the consequence of failure is "Minor", the risk rating is "Low". Routine mitigation measures or "No Further Action" shall be applied to maintain the health and structural conditions of the tree assessed.

- Moderate - the consequence of failure is “Minor” when the likelihood of failure and impact is “Likely” or “Very Likely” or the likelihood of failure and impact is “Somewhat Likely” when the consequence of failure is “Significant” of “Severe”, the risk rating is “Moderate”. Routine mitigation measures shall be applied to maintain the health and structural conditions of the tree assessed.

- High - the consequence of failure is “Significant” when the likelihood of failure and impact is “Likely” or “Very Likely” or the likelihood of failure and impact is “Likely” when the consequence of failure is “Severe”, the risk rating is “High”. Mitigation measures shall be applied to alleviate the risk rating of particular target and tree part involved to lower the residual rating to “Moderate” or lower. If the proposed mitigation measure cannot achieve the lowering of risk rating, revised the mitigation measure shall be considered.

- Extreme - the consequence of failure is “Severe” when the likelihood of failure and impact is “Very Likely”, the risk rating is “Extreme”. Timely mitigation measures shall be applied to alleviate the risk rating of particular target and tree part involved to lower the residual rating to “Moderate” or lower as soon as practicable. If the proposed mitigation measures cannot achieve the lowering of risk rating, revised mitigation measure or remove the whole tree shall be considered. Measures to cordon-off the tree location and notice shall be posted around the tree assessed to avoid people passing-by or staying near the tree.

<u>Section 12 – Mitigation Measures</u>

This Section requires the Inspection Officer to make recommendations on mitigation measures based on the results of the tree risk assessment. Mitigation measures should be prioritised according to their urgency in terms of protecting public safety. The residual risk of the tree or individual tree part upon completion of the recommended mitigation measures should be estimated at the time of the inspection to evaluate if the recommended mitigation measures are implemented adequately.

Target No.: reference number of the targets in priority according to the severity of consequence given in Section 4 – Target Assessment.

Tree Part: the target tree or tree part that requires mitigation measures.

Mitigation Measures: the recommended mitigation measures to reduce the tree risk. For each target identified, appropriate mitigation measures shall be applied timely. Inspection Officer shall advise the completion date of the mitigation works after consulting department and tree works agent.

Anticipated Completion Date: the expected completion date of the recommended mitigation measures in the format of dd/mm/yyyy.

Residual Risk: estimated risk level upon completion of the recommended mitigation measures. For trees assessed in “High” or “Extreme” risk rating, appropriate mitigation measure shall be recommended to lower the risk rating to “Moderate” or lower. If the proposed mitigation measures cannot achieve the lowering of risk rating, revised mitigation measure or remove the whole tree shall be considered.

Section 13 – Notes, Explanations, Descriptions and Supplementary Information

Notes, Explanations, Descriptions and Supplementary Information: Please include any conditions or factors or observations that have not been well described elsewhere in the form, including additional notes of the Inspection Officer that are used as the basis for making decisions on the hazard, impact and risk levels in the risk assessment.

Overall Tree Risk Rating: the highest risk rating determined among the different problematic tree parts identified.

Overall Residual Risk: the highest residual risk upon completion of the mitigation measures for all the problematic tree parts identified. For trees assessed “High” or “Extreme” on “Overall Tree Risk Rating”, appropriate mitigation measures shall be recommended to lower the “Overall Residual Risk” rating to “Moderate” or lower. If the proposed mitigation measures cannot achieve the lowering of risk rating, revised mitigation measures or remove the whole tree shall be considered.

Advanced Assessment: The Inspection Officer needs to advise if advanced assessments for the tree concerned is required. Please check the box ‘Yes’ if required and provide detail of the advanced assessments recommended, including but not be limited to:

- Drill resistance (resistograph);
- Sonic tomography;

- Aerial inspection by tree climbing or Drone;
- Equipment for root detection and mapping; or
- Slope/stonewall stability analysis, etc.

Inspection Limitations: the possible limitations of the tree risk assessment. Additional information may be provided in the space 'Others'.

Attached Information: Please provide photos, map, measurements, drawings, figures, etc. relevant to the assessment.

Add Site Plan: relevant site plan should be uploaded. The site plan should show the location of the tree and targets concerned, the dripline, Target Zone boundary and relevant land status information.

Add Tree Photo: relevant photos including but not be limited to site photos, whole tree photos in different directions, close-up photos showing the defects with illustrations and denotes should be uploaded. All photos provided shall follows the photograph requirements set out in Appendix 6 – Photo-taking Guidelines for Tree Risk Assessment specified in the TRAM Guidelines. All photographs should be stamped with date and time at which the photo is taken.

Add Other Information: other relevant information that would help describe, illustrate and/or explain the tree risk assessment, mitigation measures and others should be included

References:

Agriculture, Fisheries and Conservation Department, 2006, Nature Conservation Practice Note No. 2 - Measurement of Diameter at Breast Height (DBH), Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region, China.

ANIS A300 (Part 9) – 2017 Tree Risk Assessment a. Tree Failure, Tree Care Industry Association, Inc., USA.

British Standards Institution, 2010, “BSI Standards Publication: Tree Work – Recommendations”, British Standards Institution, UK.

Costello, L.P., Perry, E.J., Matheny, N.P., Henry, J.M., Geisel, P.M., 2003, Abiotic Disorders of Landscape Plants – A Diagnostic Guide, University of California, Agriculture and Natural Resources, USA.

Dunster, J. A., Smiley, E. T., Matheny, N. and Lilly, 2017, Tree Risk Assessment Manual, International Society of Arboriculture, USA.

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Lonsdale, D., 2017, Principles of Tree Hazard Assessment and Management (7th ed.), Arboriculture Association, UK.

Shigo, A.L. 2008, A New Tree Biology and Dictionary (11th ed.), Shigo and Trees, Associated., USA.

Smiley, E. T., Matheny, N. and Lilly, S., 2017, “Best Management Practice: Tree Risk Assessment” (Second Edition), International Society of Arboriculture, USA.

APPENDIX 5 - Examples of Common Tree Defects

APPENDIX 5 - COMMON TREE DEFECTS

1.0 Recognising Tree Defects

Trees are living organisms that undergo their normal lifecycles. No tree is absolutely "safe". Trees may exhibit defects in their health and structural conditions as they grow and age. Recognising the nature and severity of the defects and their implications in tree stability contributes an important part to any tree inspection and risk assessment. Proper mitigation measures to reduce tree hazards can only be made with proper diagnosis of tree problems.

2.0 Common Tree Defects

Healthy trees are exemplified by full crowns, vigorous branches, and healthy, full-sized leaves. However, green foliage in the crown does not ensure that the tree is safe. Trees in good health condition may exhibit structural defects such as hollow trunks, etc. Dead trees should be removed as soon as they are identified.

Common tree defects include wood decay, cracks, weak branch unions, cankers, root problems, poor tree structure, and dead wood. The same type of problems can be seen at different parts of a tree which may constitute different degrees of tree hazards. Therefore it is important to understand signs and symptoms associated with different types of defects during tree inspection.

The 'Pictorial Guide for Tree Maintenance to Reduce Tree Risks' (www.greening.gov.hk/filemanager/content/pdf/tree_care/PictorialGuideForTreeMaintenanceToReduceTreeRisk(eng).pdf) issued by the GLTMS provides illustrated examples to the identification and proposed mitigation of the various tree defects. Examples of common tree defects are illustrated in Photo 2.1 to 2.10.

Photo 2.1 - Severe leaning

Photo 2.2 - Extensive dieback twigs

Photo 2.3 - Codominant stems with crack/decay

Photo 2.4 - V-shaped Crotch with cracks/split

Photo 2.5 - Severely cut/damaged roots

Photo 2.6 - Fungal fruiting bodies at root

Photo 2.7 - Brown root rot disease

Photo 2.8 - Wood decay/cavity at basal area/root flare

Photo 2.9 - Root-plate movement

Photo 2.10 – Sign of termites

APPENDIX 6 - Guidelines on Arboriculture Occupational Safety and Health

Guidelines on Arboriculture Occupational Safety and Health

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU

December 2012

<u>CONTENTS</u>

1.0 Introduction

1.1 Risk is inherent in all forms of works and tree work is no exception. A culture of safety and health is essential in any organization. This should permeate all levels of the organization and be established and maintained through training, qualifications, procedures, etc. Under **Section 6(1) of the Occupational Safety and Health Ordinance**, "*Every employer must, so far as reasonably practicable, ensure the safety and health at work of all the employer's employees.*" Employer covers both the employer of a company and of a service contract.

1.2 Tree work includes pruning, tree removal, cabling, bracing, guying, cavity treatment and/or other arboricultural treatment to be undertaken at ground or elevated level. Tree work, if not properly carried out with adequate safety measures, can be hazardous for those engaged in it and for people and property in the vicinity of the work.

1.3 Provision of a safe system of work is essential and tree work should be undertaken by trained and experienced personnel. A suitable and safe method should be adopted and adequate occupational safety and health measures should be implemented in carrying out the tree work. Such information, instruction, training and supervision as may be necessary to ensure, so far as reasonably practicable, the safety and health at work of the employer's employees should also be provided.

2.0 Provision of a Safe System of Work

2.1 A safe system of work is a formal procedure which results from systematic examination of a task in order to identify all the hazards. It defines safe methods to ensure that hazards are eliminated or risk minimized.

2.2 Where hazards cannot be eliminated and some elements of risk remain, a safe system of work should be developed and put in place before commencement of tree work.

2.3 Employers responsible for tree work should provide and maintain safety system of work to ensure the safety and health of the employees/workers involved in tree work. This requires the employers to assess the task, identify the hazards, define safe methods, implement the system and monitor the system.

2.4 Reference should be made to the Labour Department's prevailing guidelines on occupational safety and health including "Safe System of Work" and "Five Steps to Information, Instruction and Training" (http://www.labour.gov.hk/eng/public/index.htm).

3.0 Team Work

3.1 Tree work is a team work which should be carried out by trained and experienced personnel. The employer should assign a Tree Work Supervisor who is competent to supervise the tree work to ensure that the work is carried out in accordance with good arboricultural practice and adequate occupational safety and health measures, including procedures as laid down in the safe system of work.

3.2 Workers participating in tree work operations should receive relevant training for the assigned tasks to be performed. As a general rule of thumb, tree work operations should not be performed alone by a Tree Worker and effective communication should be maintained between members of the team. The team should include Tree Work Supervisor and Tree Workers who have met the requirements as detailed in Annex I.

4.0 Adoption of a Suitable and Safe Method

4.1 The Tree Work Supervisor should assess the task, identify the potential hazards, evaluate the risks and formulate the most appropriate and safe method to carry out the tree work. Risk assessment on the potential hazards, method to be adopted and relevant occupational safety and health measures to be implemented should be prepared and properly documented and communicated to all personnel involved in the tree work.

4.2 Wherever practicable, the work should be carried out from ground level. This may be achieved by using suitable job method such as using extending equipment or tools to perform the work from ground level.

4.3 If it is inevitable to work at height, appropriate access equipment such as elevating work platforms, scaffolds, podium steps or ladders should be used as safe means of access. Also, elevating work platforms and scaffolds should be used to provide safe means of support when work is being carried out.

4.4 In situations where the use of the above means are not reasonably practicable, other alternative means, such as the use of rope access system, can be considered. The Tree Work Supervisor should confirm the appropriateness of the method if rope access is adopted. The aerial tree work by climbing should be carried out by Tree Workers satisfying the requirements in Annex I(C) (i.e. Tree Worker (Tree Climbing)). Relevant safety practices/instructions and devices in accordance with recognized standards should apply (please refer to paragraph 5.6 below).

4.5 Before carrying out the tree work on site, risk assessment on the potential hazards, method adopted, occupational safety and health measures should be properly documented and communicated to all personnel involved in the tree work.

5.0 <u>Occupational Safety and Health Measures</u>

5.1 General

5.1.1 Compliance with the relevant prevailing occupational safety and health requirements and guidelines as promulgated by Labour Department is essential. The following paragraphs introduce the general occupational safety and health measures, which are not exhaustive, associated with tree work for reference. All Tree Workers should receive relevant training for the required skills in carrying out tree work. The Tree Work Supervisor should formulate specific occupational safety and health measures to suit the operation.

5.1.2 When tree work is to be conducted at or near public area, the Tree Work Supervisor should assess potential hazards to the public. Appropriate measures, such as provision of warning signs, temporary fencing and/or guarding, should be adopted when there is a potential risk affecting the public.

5.2 Good Communication

5.2.1 Good communication should be maintained between Tree Workers and Tree Work Supervisor involved in the tree work so that each one is well aware of the duty, work arrangement, potential hazards, occupational health and safety measures and progress of the operation. A job briefing should be provided before tree work begins to facilitate good communication in carrying out the tree work on site.

5.3 Personal Protective Equipment (PPE)

5.3.1 Tree Workers should wear appropriate clothing and footwear. Loose-fitting clothing and slippers should not be allowed. The PPE includes, but is not limited to, head protection (helmets), reflective vests, protective gloves, sturdy boots, chainsaw-resistant chaps, safety goggles and hearing protection. They should comply with relevant standards to suit the work required.

5.3.2 Suitable and adequate PPE should be provided for use by Tree Workers involved in carrying out tree work. They should also be trained in the proper use, care and maintenance of PPE.

5.3.3 The employer should implement a monitoring system to ensure proper use of the PPE by the workers. Proper maintenance programme of the PPE so provided by the employer should be in place to ensure that the PPE is kept in a serviceable state as well as a safe-to-use manner.

5.4 Traffic Flow

5.4.1 For tree work to be performed in area with traffic flow, Temporary Traffic Arrangement (TTA) has to be instituted to protect the safety of the public as well as the Tree Workers. Adequate lighting, signing and guarding complying with the requirements of "Code of Practice for the Lighting, Signing and Guarding of Road Works" issued by Highways Department should be provided (http://www.hyd.gov.hk/eng/public/publications/index.htm).

5.5 Underground Utilities

5.5.1 Underground utilities include gas pipes, electrical cables, cables for telephones, water pipes, drainage and sewerage pipes buried underground. Tree work, such as planting or removal of tree stump, may cause damage to underground utilities which in turn poses hazards. The presence of underground utilities should be checked and identified on site with adequate precautions if the required excavation or stump removal work, particularly removal of large deep-rooted stump along public pavement, may affect the underground utilities.

5.5.2 When working in the vicinity of utilities, hand tools should be used with due care. Relevant utility companies should be contacted for precautionary protection measures.

5.6 Work at Height

5.6.1 If work at height is required, a safe access, egress and working condition to prevent fall from height, including steep slope, should be provided. The following publications and the prevailing guidelines issued by the Labour Department are relevant (http://www.labour.gov.hk/eng/public/index.htm).

- ♦ "Safety at Work – A Guide to Ladders and Elevated Working Platforms"
- ♦ "Guidance Notes on Safe Use of Power-operated Elevating Work Platforms"

- “Code of Practice for Metal Scaffolding Safety”
- “Code of Practice for Bamboo Scaffolding Safety”
- “Guidance Notes on Classification and Use of Safety Belts and their Anchorage System”

Other relevant references include:

- “2011 Best Practice Guidelines for Safety and Health in Tree Work Part one: Arboriculture” New Zealand: The New Zealand Arboricultural Association: 2011.
- “A Guide to Good Climbing Practice” UK: The Arboricultural Association: 2005.
- “AFAG 401 Tree-climbing operations” UK: The Health and Safety Executive.
- “American National Standard for Arboricultural Operations – Safety Requirement (ANSI® Z133.1-2006)”. Champaign: International Society of Arboriculture: 2006.

5.7 Falling Objects

5.7.1 Falling objects may include materials, tools, debris and/or cut tree parts falling from height. Loose tools should be carried in tool bags and properly secured. Throwing of large cut tree parts from height should be avoided as far as possible. Where a working platform is used, the working platform should be fully boarded and toe-boards alongside the edge of working platform should be installed.

5.7.2 Where members of the public may be present within the tree work area, measures to ensure their safety should be instituted e.g. cordoning off the work area with suitable barriers, erecting appropriate warning signs and arranging Tree Workers to guard the work area.

5.8 Manual or Mechanical Handling

5.8.1 To reduce the hazards associated with lifting or delivery of tree parts, large tree parts should be cut into smaller manageable sizes. The size of tree parts should be determined by the Tree Work Supervisor to avoid overloading, taking into account the working load of the equipment, machinery and environmental condition e.g. strong wind.

5.8.2 Tree parts, particularly sizable pieces, should be secured properly before cutting and delivery. Care should be taken for possible physical damage to the Tree Worker caused by swinging of tree parts during operation.

5.9 Impact with Overhead Obstacles or Tree Parts

5.9.1 Overhead obstacles should be identified, particularly overhead electrical lines and apparatus. Adequate safety precautions, including keeping safe clearance from overhead obstacles should be adopted in carrying out tree work. When elevating work platform is in use, the travelling route should be within the vision of the operator of the platform.

5.9.2 In tree felling operations, the tree can split upward from the back cut (known as "barber chair") which may hit the Tree Worker standing directly behind the tree. The Tree Worker should stand to one side of the tree when making the back cut and plan for an escape route on either side 45^{o} opposite to the direction of fall. Adequate steps should also be taken to prevent tree trunk from rolling on sloping site when the branches are removed to minimize hazards to the Tree Worker.

5.10 Electrical Hazards

5.10.1 Tree Workers should receive relevant training in handling electrical hazards. Electrical hazards should be identified before performing tree work. These include the existence of overhead power lines, underground cables or electrical apparatus and the use of electrical tools. A safe working distance from overhead electrical line or electrical apparatus should be maintained when carrying out tree work. Reference should be made to the "Code of Practice on Working near Electricity Supply Lines" issued by the Electrical and Mechanical Services Department.

5.11 Use of Equipment

5.11.1 All equipment, including hand tools or machinery, should be inspected prior to operation and should be properly and regularly maintained. The equipment should be fit for the purposes and should comply with relevant standards with evidence of conformity.

5.11.2 Tree Workers should use all equipment in correct posture. They should receive relevant training in the use of hand tools and mechanical equipment, such as pole pruner and chainsaw, so that hazards associated with the use of them can be minimized.

5.12 Heat-Related Disorders

5.12.1 Heat-related disorders include heat stroke, heat cramps and heat exhaustion. They are associated with working under prolonged and/or high environmental heat exposure which results in overheating and dehydration.

5.12.2 As precautionary measures, wearing of suitable clothing to facilitate heat dissipation and provision of adequate drinking water and rest breaks to Tree Workers are required. Training on the awareness of heat-related disorders and associated first aid procedures should be provided to all personnel involved in tree work.

5.13 Application of Chemicals

5.13.1 Application of chemicals, such as fungicides and insecticides, is a common practice in tree care operations. The chemicals should be properly labeled and stored in a cool, dry and well-ventilated place away from direct sunlight and dampness. Dosages and application methods as recommended by the manufacturers should be followed. Disposal of chemicals should follow an approved hazardous waste management procedure.

5.13.2 The intake of chemicals can be made through direct contact, inhalation and/or ingestion. Tree Workers should wear suitable protective clothing, gloves, goggles or face shields to prevent direct contact with chemicals. Properly fitted respirators should be worn to protect Tree Workers from inhaling harmful chemicals. Eating or smoking should not be allowed during chemical applications and before cleansing procedures have completed after chemical applications.

5.13.3 Tree Workers should also take note of the surroundings and minimize harms to the public caused by inhaling or contacting chemicals. This includes guarding the site with warning notices and paying attention to the wind direction during spraying to avoid spreading chemicals. If required, warning notices should be posted to keep people and their domestic animals off the site after application of chemicals.

5.14 Inclement Weather

5.14.1 This includes poor weather conditions, such as strong wind, thunderstorm and heavy rainstorm, which adversely affect the safe operation of tree work. With the exception of emergency work performed by well-trained Tree Workers having adopted necessary safety precautions, no tree work should be carried out during inclement weather.

5.15 Hazards associated with Plants and Animals

5.15.1 These hazards include bites by snakes or insects (such as mosquitoes, bees and Red Imported Fire Ants) and direct contact with poisonous plants. Training should be provided for identification of hazardous plants and animals and the associated treatment.

5.15.2 Tree Workers should wear suitable clothing and gloves to minimize skin exposure to insect bites and scratches by poisonous plants. They should apply insect repellant to exposed skin when required. If severe reactions upon bites or contact with poisonous plants are observed, prompt medical treatment should be sought.

5.16 Fire Precautions

5.16.1 Fire may result from improper use of gasoline-powered equipment. Smoking should be prohibited when handling flammable liquid. Trucks transporting tree work equipment should be equipped with fire extinguishers and Tree Workers should be trained to use fire extinguishers in case of fire to reduce the risk of personal injury and spread of fire to other wooded area.

5.17 First-aid and Emergency Procedures

5.17.1 Procedures covering emergency arrangements, rescue and first aid procedures should be formulated and well-communicated to the Tree Workers by the Tree Work Supervisor. Emergency drills should be regularly conducted, with the performance properly recorded and reviewed. First-aid kits with appropriate medical and rescue contents should be provided and maintained.

5.17.2 For tree climbing operations, a minimum of two Tree Workers must be present and one of them should be stationed on the ground, competent and equipped to perform aerial rescue without delay.

Annex I

Requirements of Tree Work Supervisor and Tree Workers

A) Tree Work Supervisor

A Tree Work Supervisor is a person who has:

Training	**(a)** received relevant training in occupational safety and health relating to tree work operation covering, hazard identification, risk assessment and supervision, and
	(b) (i) completed training in tree work operations provided by trainers with practical experience and expertise recognized by the employer; or (ii) completed training or vocational assessment in tree work operations offered by recognised institutions or industry organisations; or (iii) be a Certified Arborist of the International Society of Arboriculture, Registered Arborist (Level 3 or above) of Arboriculture Australia, Technician Member or above of the Arboriculture Association of the United Kingdom or the Accredited Arboricultural Practitioner of the Hong Kong Institute of Landscape Architects, those having taken the Professional Diploma Programme in Arboriculture of the Chinese University of Hong Kong or equivalent or above, and
Work Experience	**(c)** with at least 2 years work experience in tree care.

Notes:

a) Training in tree work operations provided by trainers with practical experience and expertise recognized by the employer include in-house training provided by government departments.

b) Examples of recognized institutions or industry organizations include Occupational Safety and Health Council, Vocational Training Council and Construction Industry Council.

c) The employer may appoint two persons to cover for the above requirements in (1) arboricultural and (2) occupational safety and health aspects separately if necessary. Each of them should have at least 2 years relevant work experience. However, they should work together to address the occupational safety and health issues associated with tree work.

B) Tree Worker

A Tree Worker is a person who has:

Training	**(a)** received basic training in occupational safety and health relating to tree work operation; and
	(b) (i) completed relevant job/task specific training in tree work operations by trainers with practical experience and expertise recognized by the employer; or (ii) completed relevant job/task specific training or vocational assessment in tree work operations by recognized institutions or industry organisations; and
Work Experience	**(c)** with at least 1 year work experience in tree care if aerial tree work is involved.

C) Tree Worker (Tree Climbing)

A Tree worker (Tree Climbing) is a person who has:

Training	**(a)** received basic training in occupational safety and health relating to tree work operation; and
	(b) (i) completed training in tree work operations (including tree climbing (rope access), use of chainsaw and aerial rescue) by trainers with practical experience and expertise recognized by the employer; or (ii) completed training or vocational assessment in tree work operations (including tree climbing (rope access), use of chainsaw and aerial rescue) by recognized institutions or industry organisations; or (iii) be a “Certified Tree Worker Climber Specialist” of the International Society of Arboriculture, those having taken Professional Diploma Programme in Arboriculture of the Chinese University of Hong Kong or equivalent or above; and
Work Experience	**(c)** with at least 1 year work experience in tree care.

Notes:

a) Training in tree work operations provided by trainers with practical experience and expertise recognized by the employer include in-house training provided by government departments.

b) Examples of recognized institutions or industry organizations include Occupational Safety and Health Council, Vocational Training Council and Construction Industry Council.

APPENDIX 7 - Sample of Master List of Document and Record on Tree Works

APPENDIX 7 – SAMPLE OF MASTER LIST OF DOCUMENT AND RECORD ON TREE WORKS

List of Document and Record on Tree Works

1. Site boundary plan shown on the lease documents and/or the Deed of Mutual Covenant
2. Tree inventory
3. Records of tree maintenance work
4. Tree Risk Assessment Report
   - Records of Tree Group Inspection Form (Form 1)
   - Records of Individual Tree Risk Assessment Form (Form 2)
   - Records of mitigation measures
5. Other tree inspection report (if any)

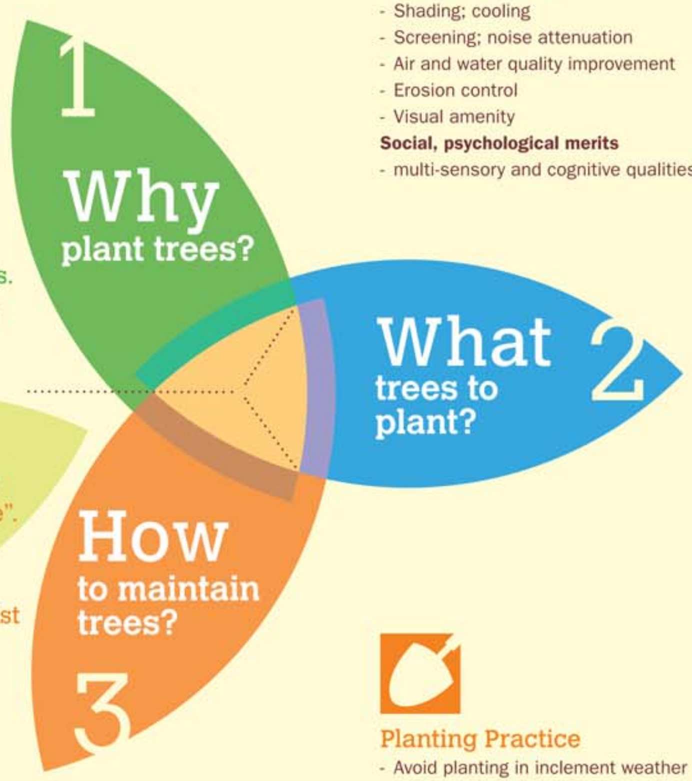
APPENDIX 8 - Right Tree Right Place Quick Reference Guide

2015 | Newsletter
10 | Greening, Landscape and Tree Management Section

RIGHT TREE RIGHT PLACE

Trees come in all shapes and sizes and will change dramatically over their lifetimes. Careful planning and selection are essential for a tree's long term success.

The purpose of this guide is to demonstrate the crucial considerations for establishing the "right tree in the right place". Please seek further advice from a Registered Landscape Architect, qualified horticulturist and landscape contractor.



Space

Above ground
- Adequate clearance to adjacent buildings, structures, roads and other mature trees

Below ground
- Adequate clearance from underground utilities for root growth and anchorage

Design

- Create a sense of place and belonging
- Forms; colours; textures; scale
- Safety In Design (SID)
- Maximise sustainability
- Minimise maintenance

Function

Enhance biodiversity
- Maximise plant mix

Create points of interest
- Seasonal interest of foliage and flowers
- Spectacular tree form
- Fragrance

Enhance environment
- Shading; cooling
- Screening; noise attenuation
- Air and water quality improvement
- Erosion control
- Visual amenity

Social, psychological merits
- multi-sensory and cognitive qualities

Choose Species

- Native or exotic
- Evergreen or deciduous
- Fast-growing or slow-growing
- Avoid potentially invasive
- Able to withstand site conditions (wind, drought, salt and shade)
- Not susceptible to disease and pest infestation

Look for Biological Features

- Visual character
- Caution potential impacts to human (toxicity, pollenosis)
- Life cycle
- Avoid intrinsic tree failure characteristics

Maximise Plant Mix

- Maximise biodiversity
- Showcase native habitat
- Enhance landscape connectivity
- Check tree form and shape
- Allow space for crown, height and root growth

Soil

- Insist only quality soil mix
- Provide correct soil volume for root growth
- Ensure aerated soil (no excessive compaction)
- Assess pH value for species selection
- Adjust to correct nutrient content
- Allow proper drainage

Planting Stock

Buy young
- the trees will grow better

Buy quality
- quality tree stock establish themselves more quickly and require less maintenance in the long run

Planting Practice

- Avoid planting in inclement weather
- Proper preparation of tree pit
- Proper planting depth
- Correct pit size for rootball establishment
- Remove all plastic containers/ rootball wrappings
- Backfill in layers and firm up to remove air pockets
- Apply mulching to keep soil moisture and suppress weed growth
- Appropriate watering after planting
- Regular check up of guy support system if installed

Management and Maintenance

- Qualified professionals to assess and maintain your trees
- Undertake Tree Risk Management and mitigation measures to maximise tree safety

Quick Reference Guide

香港特別行政區政府
發展局
Development Bureau
The Government of the Hong Kong Special Administrative Region

APPENDIX 9 - Select and Plant Good Specimens

Select and plant good specimens

Photo 1 Specimens with good form and structure with sufficient root ball size without girdling roots

Photo 2 Example of the poor quality root ball

- Only accept and plant good specimens that fulfil the contract specifications

Specimens with good health and structure have the following characteristics:

- Central leader with good taper (except multi stem species)
- Good spacing of scaffolding branches (Diagram 1)
- Free of co-dominant stems
- Balanced canopy and normal foliage
- Good live-crown ratio (Diagram 2)
- Sufficient rootball size
- Free of root defects e.g. circling roots, kinked roots, girdling roots
- Free of large wound / cavity / split / crack
- Free of pest / disease
- Free of structural defect

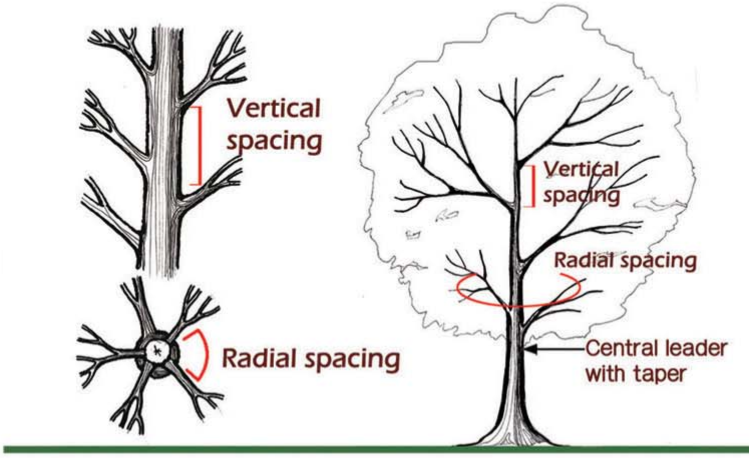


Diagram 1: Scaffold branches require proper vertical and radial spacing on the trunk.

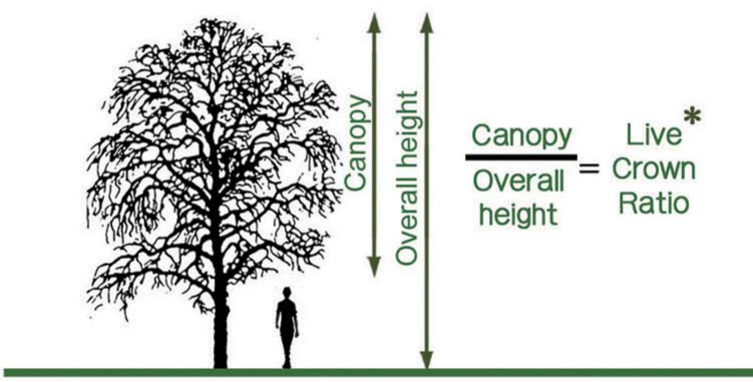


Diagram 2: The live crown ratio* should be more than 60%

APPENDIX 10 - Proper Planting Practice - Provide Adequate Growing Space for Future Growth of Canopy

Proper Planting Practice

Provide Adequate Growing Space For Future Growth Of Canopy

Photo 1 & 2 Trees planted too close for instant greening effect will lead to poor health and structure of trees in the long run

Photo 3 & 4 Trees planted with adequate spacing will develop better form and structure

The Importance of Adequate Growing Space

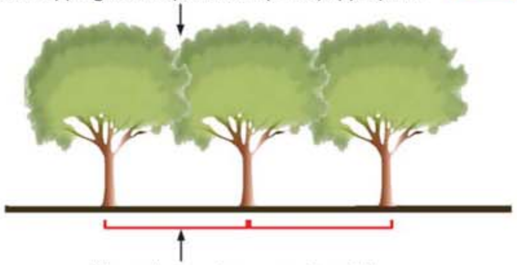
Adequate growing space is required for roots to anchor and obtain water, oxygen, and nutrients; and also for the crown to develop proper structure. In general landscape planting, trees planted too close will result in poor health and structure [1].

When allocating space for trees, the mature form, height and crown spread of the trees as well as the purpose of the planting should be taken into consideration.

In a spacious location, trees are best to be planted to allow the full width of the mature canopy. However, trees are very often used to achieve certain purposes such as to screen a view or achieve a desirable shade etc. Flexibility should therefore be allowed for some overlapping of tree canopies to an extent that is appropriate for the situation.

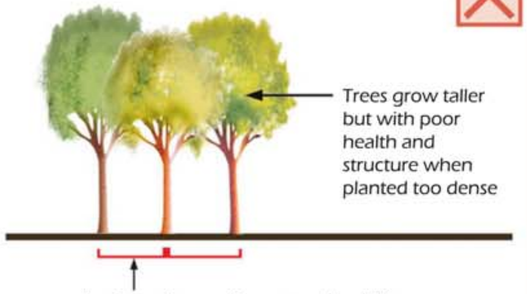
Adequate Spacing

Provided that the extent of overlapping will not adversely affect the tree structure, partial overlapping of canopies is acceptable/appropriate



Adequate growing space should be provided for future growth of canopy

Narrow Spacing



Inadequate growing space should be avoided for future growth of canopy

Narrow spacing may lead to:

- significant crown competition
- poor structure as trees cannot develop to full form or well developed taper
- susceptibility to wind or sun damage if one or more trees in the same stand die
- more disease and insect problems
- more long term stress related problem

1 Trees, however, may be planted closely together in forestry plantation to achieve the desired vegetation coverage quickly during the early afforestation stage, or in specially designed urban landscape setting to establish the initial greening effect. This type of planting should be supported with a proper maintenance plan for thinning/removal of overcrowded trees for the long term benefit of tree health and structure.

References:

Gilman, Edward F., Trees for Urban and Suburban Landscapes, Delmar Publishers, U.S., 1997

Urban, James, Up By Roots, International Society of Arboriculture, U.S., 2008

Whitcomb, Carl E., Establishment and Maintenance of Landscape Plants II, Lacebark Inc.

Greening, Landscape and Tree Management Section
Development Bureau

APPENDIX 11 - Proper Planting Practice - Provide Sufficient Growing Space Between Trees and Adjacent Buildings / Structures

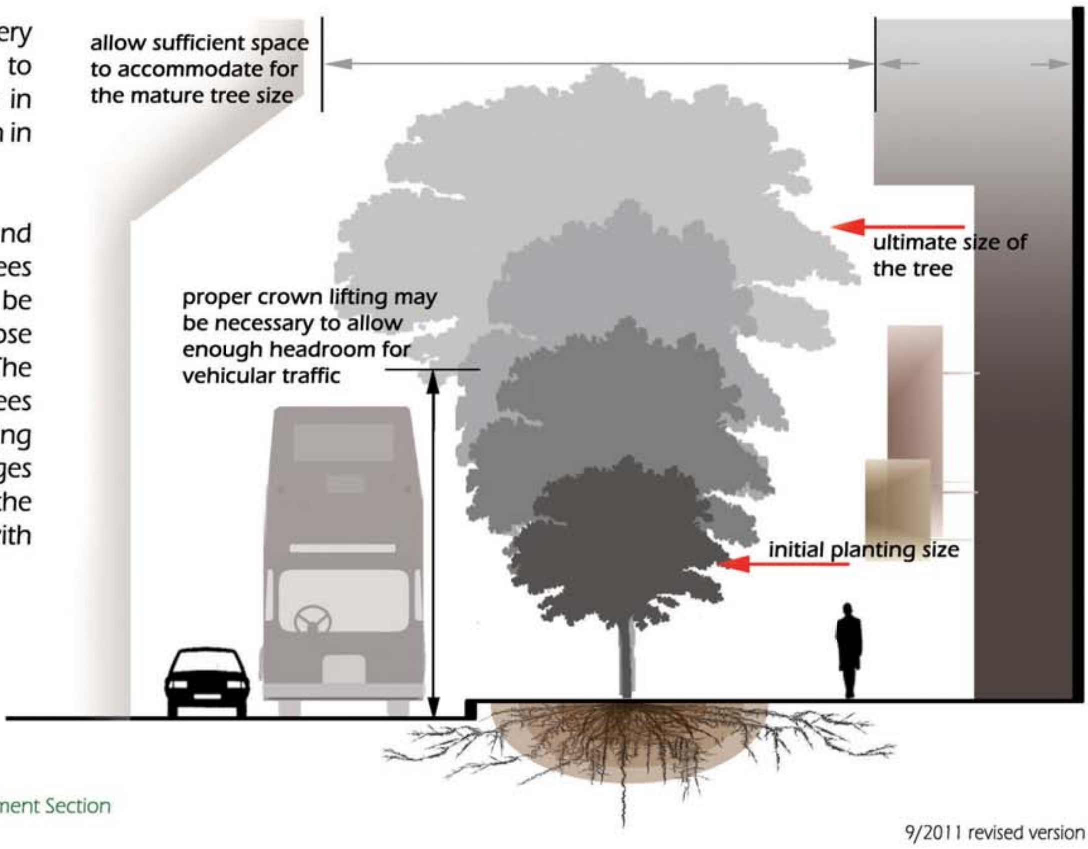
Provide Sufficient Growing Space Between Trees and Adjacent Buildings/Structures

Photo 1 Trees planted too close to buildings/structures will result in imbalance form and poor health.

Photo 2 Deformed tree form is a result of planting tree too near to adjacent structure.

Trees become larger in size every year. Trees planted too close to buildings/structures will result in imbalance form and poor health in the long run.

Sufficient growing space and adequate distance between trees and adjacent structures should be allowed. Avoid planting too close to buildings and structures. The mature height and spread of trees should be considered during design and implementation stages to ensure that in the long run the trees will not be in conflict with adjacent buildings/ structures.



APPENDIX 12 - Proper Planting Practice - Keep Sufficient Space Clear of Vegetation at the Base of Trees

Proper Planting Practice

Keep Sufficient Space Clear of Vegetation at the Base of Trees

1. In the design, installation and maintenance of vegetation cover, try to keep the area around the base of tree trunk clear of vegetation or excessive soil/mulch fill (i.e. fill above the level of tree root collar) where practicable, to avoid adverse impact on tree growth and hindrance to tree inspection.

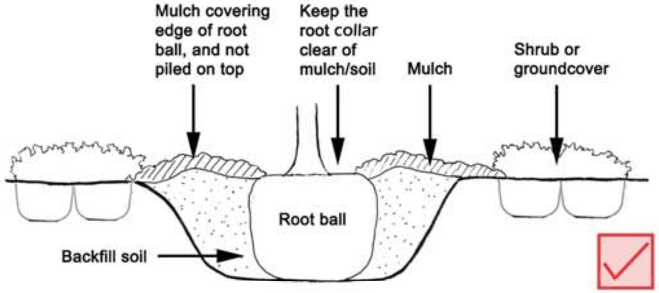


Figure 1 Keep the root collar clear of mulch/soil/other plants.

Photo 1 Keep sufficient space at the base of trees clear of dense vegetation. Apply mulching beyond root collar; and where space allows, extensive application of mulching at root zone is recommended in particular for large trees.

Photo 2 Dense vegetation obstructs thorough tree inspection at the lower trunk and root zone.

Photo 3 Constant replacement of annuals disturb tree roots.

2. How far should the area around the base of tree trunk be cleared of vegetation or excessive soil/mulch fill?

- The edge of the clearance zone is recommended to be around 150 mm – 300 mm from the tree trunk, depending on the size of the tree and its root flare as well as the actual site condition.
- There may be cases where clearance of vegetation around the base of tree trunk is not appropriate, such as on slopes where vegetation clearance will lead to soil erosion and may disturb the natural succession process of slope vegetation cover. Selective cutting back of undergrowth to facilitate tree inspection may be necessary in this situation.
- Professional judgment is essential in deciding the actual size of the clearance zone and how clearance should be carried out.

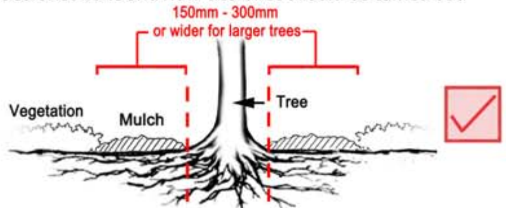


Figure 2 Keep a 'Vegetation-clear' zone at the base of tree.

Photo 4 Annuals or shrubs planted under trees compete with trees for space, air, water and nutrients.

Photo 5 Soil piling above the root collar would lead to suffocation of roots and decay at the lower trunk/ root collar.

Photo 6 Moist environment created by dense ground vegetation promotes fungal growth around trunk base / root collar.

3. Disadvantages of having vegetation or excessive soil/mulch fill at the area around of the base of tree trunk –

- Adverse impact on tree growth
  - Undergrowth (shrubs/ground covers/grass) will compete with trees in the uptake of soil water and nutrient.
  - Undergrowth that requires frequent replacement (such as seasonal flowering plants and annuals) will result in constant disturbance and damage to tree roots.
  - Undergrowth may require more frequent watering (such as ground covers and grass), which together with the dense vegetation cover creates moist environment that promotes fungal diseases at the base of tree trunk.
  - Excessive soil/mulch fill will reduce oxygen supply to tree roots, resulting in suffocation and decay of tree roots.
- Hindrance to tree inspection
  - Dense undergrowth or excessive soil/mulch fill will obscure the base of tree trunk, making any defects at this part of the tree not readily discernible during tree inspection.

References:

Harris, R.W., Clark, J.R., & Matheny, N.P., *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines*, 4th edition, Prentice Hall, Upper Saddle River, NJ, 2004

Watson, Gary W. and Himelick E.B., *Best Management Practices - Tree Planting*, International Society of Arboriculture, U.S., 2005.

Watson, Gary W. and Himelick E.B., *Principles and Practices of Planting Trees and Shrubs*, International Society of Arboriculture, U.S., 1997.

APPENDIX 13 - Proper Planting Practice – Do not Plant too Deep

Proper Planting Practice

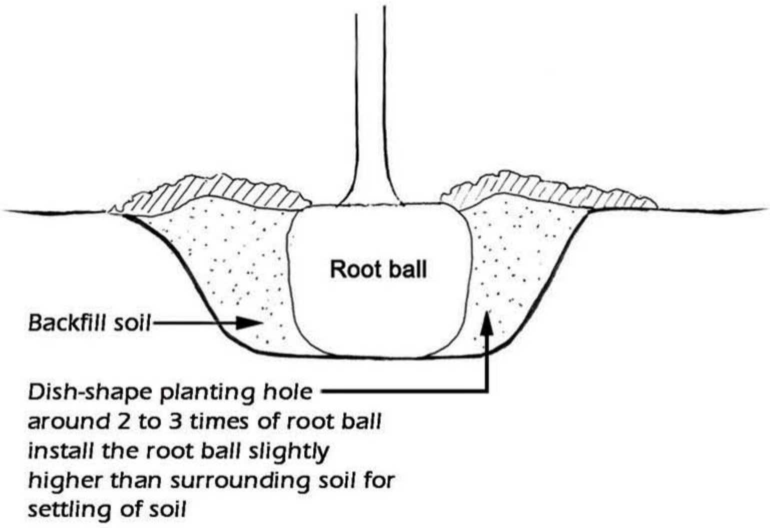
Do Not Plant Too Deep

Photo 1 A tree planted at correct soil level with visible root flare.

Photo 2 When a tree is planted too deep, the root flare is not visible.

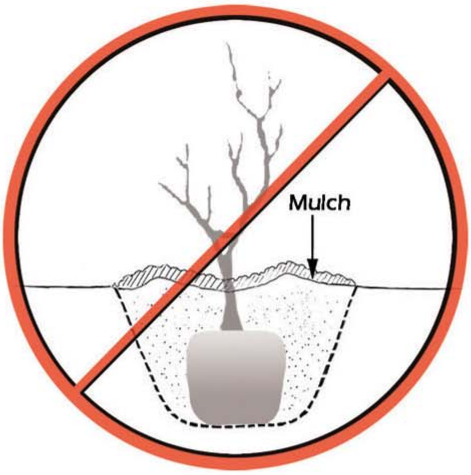
Plant at correct soil level:

Trees should not be planted too deep or too shallow. Plant trees at the correct soil level so that the root flare is visible. When the trunk emerges from the soil like a lamp post without seeing the root flare, it is likely that the tree has been planted too deep.



Disadvantages of planting trees too deep:

- If trees are planted too deep, they would decline over time due to the lack of oxygen for the root system.
- Girdling roots may appear which will restrict the growth of both trunk and roots.
- Decay at the lower trunk or root flare may not be detected easily. The moisture of soil will easily lead to decay in the lower trunk.



Do not plant too deep

APPENDIX 14 - Proper Planting Practice – Staking and Guying

Proper Planting Practice

Staking and Guying of Trees

Staking or guying tree can be an important step to successful tree planting and initial establishment. However, this step has to be carried out properly to achieve desirable result and not to cause more harm than good to the public and the trees.

When should we stake trees?

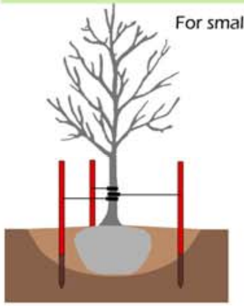
Good trees with sizable root balls (usually with underground guying system) may not require staking. Staking to be used when necessary, e.g. on exposed windy site.

Important notes about staking and guying trees

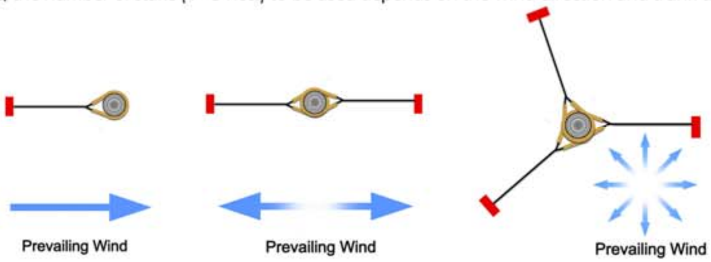
- Staking and guying should not stay too long and should be removed in general after establishment period.
- Do not drive stakes through root ball because this may damage roots.
- The stakes/guys ties should be inspected and adjusted regularly to avoid girdling of tree trunk.
- Avoid placing stakes or guying anchors outside planting bed as much as possible because they may become a tripping hazard to passers-by.

How to stake/guy a newly planted/transplanted tree?

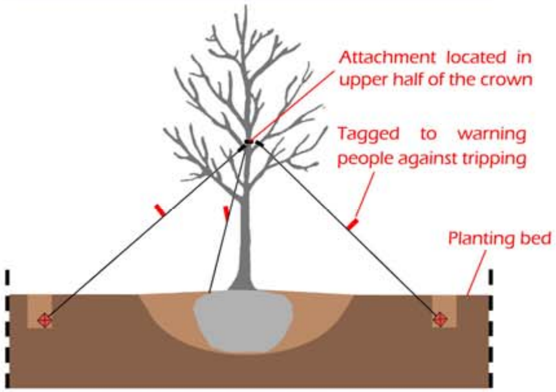
1. Staking Method



For small trees, the number of stake (1 - 3 nos.) to be used depends on the wind direction and trunk diameters.

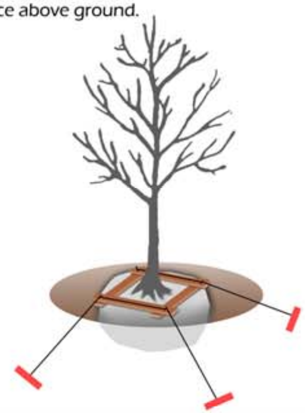


2. Tree-to-Ground Guying

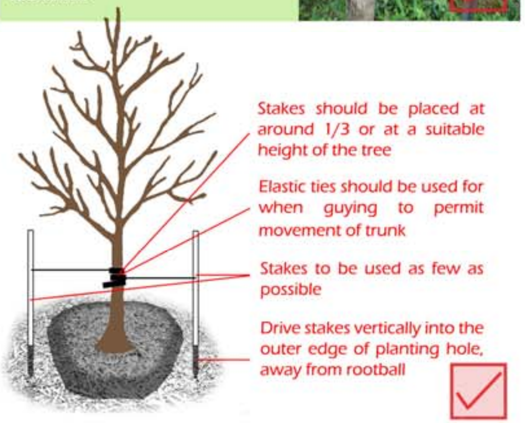


3. Underground Tree Guying

Provide support for trees without interfering with traffic or appearance above ground.



Myths	Facts
The higher the stakes are attached to the tree, the more stable is the support to the tree.	Stakes should be placed at around 1/3 or at a suitable height of the tree to allow some trunk movement.
The more support is installed; the more stable is the tree.	Support should be used as few as possible. As staking/guying may restrict trunk movement, limits the development of the trunk and the root system, and therefore weakens the tree's stability in the long run.
The tree should be tied very tightly.	Some flexibility should be allowed because slight movement in wind encourages root growth and trunk taper development.
Tree grille can prevent toppling of tree.	Tree grille is used to protect trees from root compaction only and would not provide structural support of tree. Tree grille may girdle the trunk if centre hole is too small.



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Smiley, E.T., and Lilly, S., *Best Management Practices - Tree Support Systems: Cabling, Bracing, Guying, and Propping (Revised)*, International Society of Arboriculture, U.S., 2005.

Watson, Gary W. and Himelick E.B., *Principles and Practices of Planting Trees and Shrubs*, International Society of Arboriculture, U.S., 1997.

Whitcomb, Carl E., *Establishment and Maintenance of Landscape Plants II*, Lacebark, Inc., 2006

APPENDIX 15 - Management Guidelines for Mature Trees

Management Guidelines for Mature Trees

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU

December 2014

<u>CONTENTS</u>

1.0 Introduction

1.1 Mature trees, in particular those with good health and structure, are important assets to a city. They constitute key natural components of urban ecosystems and contribute to many aspects, including that of environmental improvement, aesthetic enhancement, ecological and biodiversity enrichment, and economic, social and health benefits (Jim and Zhang, 2013). Mature trees are of particular value, and proper care is required to preserve these valuable landscape assets.

1.2 Tree biology is dynamic, changing as a tree ages (Clark, 1983). Mature trees are those being close to maximum height and exhibiting reduced shoot elongation (either as decreased elongation or a reduced number of flushes per year) (Clark and Matheny, 1991). When trees age, they become slower in growth as they approach maximum age, and become more vulnerable to disease, wind and other causes of death (Goff and West, 1975). Understanding the biology of mature trees is thus an integral component for developing proper tree management strategies and programmes.

1.3 The "Management Guidelines for Mature Trees" (Guidelines) serve as a reference for the management departments responsible for regular maintenance of trees with a view to promoting the health and structural stability of mature trees and optimising their longevity. Due to large quantity of trees in the territory, the Guidelines are focusing on mature trees with individual trunk(s) over 750mm DBH (Diameter at Breast Height[1]) growing in areas with intensive use (i.e. Category I zone under tree risk assessment) and Old and Valuable Trees (OVTs). It is necessary for managerial staff to disseminate the message in the Guidelines to staff at frontline and supervisory levels and also contractors and consultants for successful implementation.

2.0 Biological Aspects for Mature Trees

2.1 At maturity, the degree of apical control frequently lessens and a rounded crown results. Mature trees generally possess sound structure, even though inherent structural problems and numerous internal compartments may

[1] The measurement of DBH should follow Nature Conservation Practice Note No. 2 issued by the Agriculture, Fisheries and Conservation Department.

be present. They appear healthy and vigorous and may persist in this condition for long period of time; indeed, for much of their life span (Clark and Matheny, 1991).

2.2 Trees obtain energy through photosynthesis for biological functions. Surplus energy is stored in reserve to overcome periods of stress when energy production cannot meet demand. Young trees have a high photosynthetic area to biomass ratio and generate surplus of energy as reserve which facilitate rapid growth and tolerate change or stress. Mature trees have a lower ratio and most of the energy produced by the leaves is used for maintenance of existing tissues, defence against pests and diseases and reproduction through seeds and fruits but less for growth. The reserve for stored energy in mature trees is minimal when comparing with young plants and their ability to tolerate change or stress is therefore low.

2.3 Urban trees are often confronted with a lot of environmental stresses such as compaction, lack of nutrients, damage by construction and roadwork activities, etc. In the changing environment like Hong Kong, the main predisposing causes of their decline were related to root damage and soil disturbance (Jim, 2005). **Table 1** highlights the patterns of death in landscape trees. The damage on trees is cumulative and irreversible. Trees have to alter their growth patterns and relocate their resources in order to establish the internal balance with the environment. For mature trees, they are in a delicate balance with their environment and exposure to multiple or chronic stress will aggravate the health problem leading to decline due to limited energy reserve. The characteristics of mature and declining trees are listed in **Table 2**. Therefore, it is important to maintain a stable environment around mature trees to prevent or minimise stress and avoid entering the mortality spiral, where a series of sequential events result in death (Clark and Matheny, 1991). Degradation of growth space or disturbance adversely affecting the growing

Structure failure	Branch, crown and stem failure, uprooting, decay, girdling
Environmental degradation	
Acute	Flooding, fire, vandalism, construction injury, drought, high or low temperature
Chronic	Soil toxicity, soil compaction, air pollution, restricted growing space, low fertility, severe pruning
Parasitic invasion	Insect, fungus, bacterium, virus, mycoplasma-like organism, parasitic plant

Table 1 – Patterns of death in landscape trees (Clark and Matheny, 1991)

conditions of mature trees should be avoided as far as practicable.

Character	**Mature tree**	**Declining tree**
Shoot elongation -		
extent	normal for species	greatly reduced
pattern	normal for species	single flush only
Crown form	normal - some loss of apical control	stag-headed, dieback
Foliage development	normal	reduced size and density
Foliage retention (evergreens)	normal	poor
Presence of epicormic shoots	generally absent	present
Compartmentalization response	normal for species	reduced
Wound-wood formation	normal for species	inhibited/reduced
Integrity of bark	strong	weak
Susceptibility to parasites	normal for species	increased
Reproductive behaviour	normal, may be cyclic	may produce stress crops
Stress response	normal	reduced
Fall colouration	normal	premature

Table 2 – Characteristics of mature and declining trees (Clark and Matheny, 1991)

2.4 To delay the transition from maturity to decline and death, tree management programmes should be proactive rather than reactive and treatment should be applied preventively to maintain tree health rather than remedial once decline begins (Fraedrich, 1999).

3.0 Management Strategies of Mature Trees

3.1 A stable tree structure can reduce the incident of tree failure. Causing wounds on mature trees will demand tree’s extra resource for defence. Wounds are also vulnerable to decay and entry of pathogens which will adversely affect both tree health and structure.

3.2 Site disturbance and unfavourable growing condition will create constraints on resource availability and induce stress on mature trees. These will weaken tree health and make them more susceptible to disease problems. The disease problems will draw mature trees’ scarce resource for defence and the result can lead to irreversible tree decline and death. For site disturbance involving excavation or compaction within root zone, it may cause damage to structural roots which will adversely affect tree’s stability.

3.3 Mature trees have limited ability to recover from stress and damage, proactive and preventive measures are the critical elements in the formulation of management strategies for mature trees. The goal of arboricultural management should aim at creating a stable crown structure, minimise detrimental disturbance and to minimise parasite infection so that the onset of decline and the entry into the mortality spiral will be delayed to enhance longevity (Clark and Matheny, 1991). The key practices to enhance longevity are listed in **Table 3**. Based on the biological characteristics of mature trees, the key management strategies are:

- to maintain a stable tree structure by reducing the chance of damage due to tree failure, and
- to promote tree health by minimising stress through the provision of a stable and favourable growing environment.

Promotion of a stable environment	Plant the right plant in the right place Irrigate according to species requirement Maintain existing/adequate drainage Monitor and maintain soil fertility Develop a pest management programme Minimise soil compaction Minimise grade and other soil change
Development of stable structure	Plant material with well-developed structure (root and crown) Develop early crown training programme Prune to natural targets Minimise mechanical injury

Table 3 – Arboricultural practices that enhance longevity (Clark and Matheny, 1991)

4.0 Tree Inspection

4.1 Regular tree inspection is an essential means in proactive tree management to identify changes in tree conditions and site disturbance which may be corrected before irreversible decline occurs. It should be a continuous and long-term monitoring process rather than a one-off exercise. It is recommended that detailed tree inspection for mature trees with individual trunk(s) over 750mm DBH growing in areas within Category I tree risk zone should be conducted at least annually. For OVTs, inspection should be conducted at least at least twice a year to cover changes over wet and dry seasons. Supplementary inspection should also be conducted in situations when the trees require close monitoring due to health or structural problems or after severe inclement weather in order to identify the need for remedial measures.

4.2 A standard report format to record all findings during inspection covering the assessment on tree health and structural conditions as well as site information is required. The use of "Form 2" under the "*Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis*" issued by the Greening, Landscape and Tree Management Section, the Development Bureau (GLTMS) for inspection of these large mature trees is recommended. Inspection should be conducted by staff with relevant training, qualification and work experience as specified in the guidelines.

4.3 During inspection of mature trees, particular attention should be drawn to the following aspects for a systematic and thorough checking of tree conditions:

4.3.1 Cross checking with the previous inspection and maintenance records to identify any significant changes requiring attention that should be recorded. For monitoring of major structural defects such as cavities, cracks and decayed or damaged areas developed on mature trees, physical measurement on their dimensions should be conducted, preferably fixed reference points should be set to facilitate long-term monitoring.

Photo 1 - Conduct sounding test by a mallet to assist in estimating the presence of internal decay

4.3.2 Sounding test in trunk and/or accessible scaffold limbs should be performed to assist in identifying the presence of internal decay. If severe decay is suspected, additional assessments such as tomographic and/or resistographic testing should be performed to evaluate more accurately the extent of decay and monitor the change in the remaining sound wood over time.

4.3.3 Root collar inspection should be conducted to identify defects which will adversely affect structural stability. Hand tools, if required, should be used with care to excavate soil to check for suspected decay and damage in tree roots. Sufficient space clear of vegetation at the base of trees should be maintained as dense vegetation obstructs thorough tree inspection at the lower trunk and root zone. Constant replacements of annuals/seasonal flowers disturb tree roots and create a moist environment which promote decay and therefore should be avoided. For details, please refer to *"Proper Planting Practice – Keep Sufficient Space Clear of Vegetation at the Base of Trees"* promulgated by the GLTMS.

Photo 2 – Maintain sufficient space clear of vegetation at the base of trees

Photo 3 - Dense planting around trunk base should be avoided as it will affect root collar inspection and cause soil disturbance within root zone during horticultural maintenance

4.3.4 For mature trees with tree supporting system installed, the need for adjusting the hardware and stability condition should be checked.

4.3.5 For trees in areas with frequent use and suspected structural defects which may be difficult to inspect at ground level, it is recommended that aerial inspection should be conducted to assess the structural conditions and the need of mitigation measures.

4.3.6 Site disturbances, e.g. cutting of roots, compaction and construction works, etc., should be identified to facilitate assessment of the extent of damage and the need of remedial measures.

4.3.7 The need of soil and/or foliar tests for the mature trees would be necessary to evaluate any fertility/soil problems, especially when there have been changes of site conditions after the construction activities in the vicinity.

5.0 Tree Maintenance

5.1 The maintenance operations should be carried out by trained personnel under supervision in accordance with good arboricultural practices. In line with the management strategies for mature trees, the following paragraphs outline the major tree maintenance operations.

5.2 Arboricultural Practices

5.2.1 Trees growing in urban areas are usually exposed to harsh man-made environment and the adoption of appropriate arboricultural practices, e.g. pruning, irrigation and fertilisation, would ameliorate the growing conditions and reduce stress to facilitate healthy establishment of trees. However, improper arboricultural practices can also induce stress and cause decline in tree health. Knowledge of proper arboricultural practices is important to avoid unnecessary tree damage and promote tree health. An optimal management programme should begin early in the life of the tree for creating a continuum of stability. While the long term programme of tree care are beneficial, the application of arboricultural practices to mature trees that have not had such care represents a change in their environment. As such these arboricultural practices may be a stress on the trees, the tree management personnel has to assess the pros and cons of each practice before application (Clark and Matheny, 1991).

5.2.2 Pruning

5.2.2.1 Pruning is the most common maintenance operation in tree care. Pruning for mature trees are quite different than those used for young trees. Structural pruning for young trees can eliminate many future problems associated with problematic branching and poor branch structure. It is generally more efficient to prune trees early and with small cuts than to delay pruning until trees

Photo 4 - Formation of woundwood over large pruning wound is difficult and it will lead to decay aged and have serious structural problems (Gilman, 2012). For the general guidance on proper pruning, please refer to *"General Guidelines on Tree Pruning" and "Do's and Don'ts in Pruning"* promulgated by the GLTMS.

5.2.2.2 No trees should be pruned without first establishing clearly defined objectives (Gilman and Bisson, 2007). Pruning of mature trees must be done judiciously. For pruning large and mature trees, the focus should be on ensuring human safety and passage, minimising limb failure and total tree failure near targets and maintaining tree health and vigor. Crown cleaning should be conducted to remove dead, dying, diseased and broken branches and the living tissues should be kept intact in order to maximise the retention of energy producing surface and limit the extent of wounding. For trees suffering from stress or in declining conditions, it is crucial to refrain from removing any live foliage because they need as much sugar-generating capacity as possible (Gilman, 2011).

Photo 5 - Improper pruning caused by excessive removal on inner branches results in over lifting of crowns and lion-tailing.

5.2.2.3 Lion-tailing shifts the centre of gravity higher where wind speed is greater, and creates substantially weakened branches that may break easily in storms or simply under their own weight (Gilman, 2012). This will also hinder the development of proper branch taper and weaken the tree structure. For situations which have justified objectives for selective crown thinning or reduction involving live branches, pruning should be concentrated on branch ends and lion-tailing should be avoided.

5.2.2.4 Removal of too many live branches in a single operation can deplete energy reserve and induce physiological stress on mature trees which should be avoided as far as possible. Extent of live branch removal should be minimised as far as practicable. For old and weak trees, the pruning percentage of live branches should be reduced. Splitting of pruning works into sessions separated by months or years to reduce the impact on mature trees should also be considered.

5.2.2.5 For the mature trees that suffer from damage due to storms or previous improper pruning treatments, crown restoration should be carried out by sprouts management which involves selective removal, reduction and retention of sprouts for development into permanent branches (Gilman and Partin, 2007). This may require several pruning cycles and years to train the sprouts into new branches to restore the tree structure.

5.2.3 Irrigation

5.2.3.1 Water is essential for plant physiological functions. Over irrigation, however, can encourage root rot infections and cause root suffocation. Water requirements for individual trees vary by species, age and environmental conditions. Maintaining suitable amount of water in soil to avoid moisture stress is crucial for tree growth.

5.2.3.2 In general, mature trees growing in natural setting, such as hillside, have established extensive root system and therefore artificial irrigation may not be necessary. However, in urban areas, water availability in confined planting space is generally limited and as a result irrigation may be required as supplemental water source to promote tree growth and prevent moisture stress during droughts. In such situation, tensiometer or other soil moisture sensors can be used to monitor the soil moisture content and the need of irrigation to facilitate development of watering schedule for mature trees.

Photo 6 - Tensiometer installed in root zone to monitor soil moisture

5.2.3.3 Irrigation, if required, should be applied on root zone for thorough infiltration of water into the soil. Watering at lower trunk or trunk flare should be avoided as it encourages fungal growth and root collar diseases which will adversely affect the health and stability of mature trees.

5.2.3.4 Irrigation without adequate drainage is equally detrimental to tree health and provision of adequate drainage is essential. Where soil becomes persistently waterlogged due to improper drainage, it should be corrected by installing drainage pipes or trenching with care to reduce root damage.

5.2.4 Fertilisation

5.2.4.1 Nutrients are substances required by plants for growth and metabolic functions. These nutrients are normally present in sufficient quantities in a natural habitat. However, in an urban environment, topsoil rich in organic matters is frequently removed which disrupts the return of nutrients to soil. Imported soil may not have sufficient nutrients and the activity of beneficial soil microorganisms is limited. Fertilisation should be considered for trees growing in urban setting with poor health due to nutrient stress.

5.2.4.2 However, incorrect application of fertilisers may increase susceptibility to pests and diseases and result in tree decline. To determine the need of fertilisation and nutrient problems, soil test and/or foliar analysis should be considered to determine the nutrient deficiency. In selecting a suitable fertiliser, soil pH should also be considered as it will affect availability of nutrients.

5.2.5 Mulching

5.2.5.1 Mulches are materials placed on soil and the use of organic mulches made from plant matters such as wood chips or shredded bark is preferred. Mulching can reduce environmental stress by providing trees with a more

Photo 7 - Provision of a layer of organic mulch in the root zone can improve the rooting environment for trees moderate root environment to improve root growth. It can improve moisture retention, suppress weed, encourage growth of beneficial soil organisms, relieve soil compaction and release nutrients to soil.

5.2.5.2 For proactive mature tree management, application of mulching in the root zone on flat or gentle area to create a favourable rooting environment is encouraged. The mulched area is recommended to extend over as much of the root system as possible which can be allowed by other site usage requirements. Piling of mulches against trunk base is inappropriate as it will increase the vulnerability of root collar diseases.

5.2.6 Pest and Disease Management

5.2.6.1 Pests are organisms which adversely affect tree health, structure and appearance resulting in damage or nuisance. Examples include insects, ticks, spiders, fungi, bacteria, viruses, snails, rodents, weeds and parasitic vines. Pest problems are usually associated with other primary causes such as environmental or cultural factors. Therefore, accurate diagnosis is fundamental to address pest problems.

5.2.6.2 Parasitic invasion including that of insect, fungus, virus, bacterium, parasitic plant may cause death of a mature tree. Integrated Pest Management (IPM) approach combining both preventive and control tactics through physical, biological, cultural and chemical methods should be employed to minimise adverse impact to plant health.

5.2.6.3 Attention should be drawn to pest, e.g. termite, which may affect structural stability causing tree failure. Prompt treatment to eradicate such pest problem is required and this may involve the use of registered pesticides approved by the Agriculture, Fisheries and Conservation Department (AFCD) in the link: http://www.afcd.gov.hk/english/quarantine/qua_pesticide/qua_pes_pes/qua_pes_pes.html. The application methods for registered pesticides should follow recommendations from the manufacturers.

5.2.6.4 Invasive and parasitic plants such as Mikania (*Mikania micrantha*) and Dodder (*Cuscuta* spp.) should be removed (please refer to the approaches to control Mikania as recommended by AFCD in the link: https://www.afcd.gov.hk/english/conservation/con_flo/About_Mikania/about_mikania.html#c). Generally, other non-parasitic epiphytic plants growing on trees can be retained unless they cause overloading of tree crowns or excessive moisture leading to decay.

5.2.6.5 *Phellinus noxius* is an aggressive fungal pathogen that causes Brown Root Rot (BRR) disease. It is highly pathogenic and infectious which will cause root decay and may lead to tree collapse. When a tree management department identifies typical signs and symptoms of BRR disease infection, a report for the suspected case should be made promptly to the Tree Management Office of the GLTMS. As BRR disease may spread to adjacent plants, special care and treatment on trees infected with BRR disease should be undertaken in accordance with "*Guidelines on Brown Root Rot Disease*" issued by the GLTMS.

5.2.7 Aerial Roots Management

5.2.7.1 Chinese banyan (*Ficus microcarpa*) is one of the most common mature tree species found in Hong Kong. They have the ability to develop an extensive aerial root system to capture water and nutrients from the surroundings to become lignified that give support to the tree.

Photo 8 - Installation of guiding tubes to facilitate development of lignified aerial roots to the ground for additional supports

5.2.7.2 One of the best management treatments for the mature banyan is to make use of this growing characteristic to improve stability of the trees. For details of various treatments of aerial roots to improve the structural stability, please refer to the "*Management Guidelines for Stonewall Trees*" issued by the GLTMS.

5.3 Mitigation Measures

5.3.1 It is not uncommon for mature trees to have health and structural defects due to aging as well as impacts from the natural and man-made environment. As mature trees have limited ability to recover when declining, timely mitigation measures would be necessary.

5.3.2 Continuous monitoring is also required to determine the effectiveness of the remedial measures and the need for additional or alternative treatments. The following paragraphs outline the key remedial measures applicable for mature trees.

5.3.3 Minimise Compaction and Grade Changes

5.3.3.1 Prevention against damage to trees is the best mitigation measure. It is important to protect the growing space both above and below ground from degradation. Soil compaction and grade change around the tree should be minimised in order to protect the root zone. To balance the need of development and the preservation of trees, adequate tree protection measures should be implemented to prevent tree damage, particularly before and during construction activities. These include the provision of Tree Protection Zone (TPZ) and erection of a robust protection fence to protect from disturbance, at the onset of construction. It is important to note that the planning for proper tree protection starts early in the initial planning and design stage and implements through detailed documentation process and subsequently through careful supervision during construction. The requirements of TPZ are detailed in ETWB TC(W) No. 29/2004 ‘*Registration of Old and Valuable Trees, and Guidelines for the Preservation*’ and DEVB TC(W) No. 10/2013 ‘*Tree Preservation*’ and ‘*Management Guidelines for Stonewall Trees*’.

Photo 9 - Excavation within tree protection zone will cause significant damage to root system

5.3.3.2 Construction traffic within TPZ should be avoided by careful site planning for alternatives. For temporary traffic within TPZ which cannot be avoided, adequate protection against compaction should be provided e.g. use of plywood sheet over thick mulching on top of soil to reduce localised compaction.

5.3.3.3 Grade changes within TPZ should be avoided by proper site planning and design. Open trenching and excavation within TPZ should be avoided. Alignment of underground utility should be diverted away from TPZ. Alternative construction methods, e.g. micro-tunnelling underneath root zone, should be proactively considered wherever applicable to minimise the impact if adjustment of the alignment is not practical. Further information on "*Tree Protection Measures*" and "*Tree Care during Construction*" etc. are available in the http://www.trees.gov.hk.

5.3.3.4 Sufficient space for tree growth is necessary for the long term health and stability of trees. Growing trees in open soil and planting area should be given priority instead of in a tree pit, where space is available. For situations where tree pits are necessary, they should be large enough to support the long term growth of trees. Adjacent paving design is also important for providing a desirable environment for tree growth, keeping the tree in good health condition, and avoiding future maintenance problems. In general, a tree should not be surrounded by concrete around the root collar, and sufficient space should be allowed at the base of trees. Permeable paving which allows penetration of air and water in general is recommended. Please refer to the "Guideline on Pavement Renovation Works and Tree Stability" issued by the GLTMS for more information.

5.3.4 Tree Support Systems

5.3.4.1 Tree support systems involve the installation of hardware in trees to offer supplemental supports by limiting the movement of limbs or trunks, providing additional supports for trees. A properly installed tree support system can reduce the risk of tree failure and extend the lifespan of a tree.

5.3.4.2 For large mature trees, the combination of pruning operations and installation of tree support systems may mitigate the risk of failure. The contact points between the supporting system and tree parts should be designed to minimise damage to the bark.

5.3.5 Soil Improvement

Photo 10 - Improvement by enlargement of planting area around a mature tree has been carried out at the above site

5.3.5.1 Soil compaction is one of the most common problems accountable for the decline of urban mature trees. Compacted soil imposes physical resistance to root growth, reduces soil oxygen level and inhibits water retention which are detrimental to root growth. Similar to other stresses, it is easier to avoid compaction with proper design and protection during construction than to correct it after occurrence.

5.3.5.2 Increasing the area of permeable surface and proper soil cultivation can help to enhance water and air movement to the roots and alleviate stress induced by compaction. For mature trees growing in confined pits or planters surrounded with concrete paving or structures, consideration can be given to enlarge the planting areas to improve growing conditions. In carrying out the improvement works, precautionary measures should follow the "*Guideline on Pavement Renovation Works and Tree Stability*" issued by the GLTMS.

5.3.5.3 Soil cultivation is a measure that can mitigate the impact of compacted soil. This can be done manually by hand tools to increase pore spaces. Other methods include the use of equipment such as air spade.

5.3.6 Decay and Cavity Treatments

5.3.6.1 Most mature trees grow in association with some degrees of decay and wounds. Application of wound dressing is not recommended as it cannot facilitate wound closure and may encourage accumulation of moisture which will cause decay. Exposed wood should preferably be left untreated, particularly if it is stable and in good condition. Partial removal of decayed wood may be beneficial to minimise food source for development of wood-rotting fungi.

5.3.6.2 The best remedial measure is to improve the growing conditions for mature trees to encourage woundwood and new wood formation to compensate for the weakened structure due to decay.

5.3.7 Tree Removal

5.3.7.1 Tree removal should be the last resort when there is no practical alternative to cure the tree or to reduce the risk of tree failure to an acceptable level. When a tree poses imminent danger to life and property, felling the tree should be carried out in a timely manner to address public safety.

5.3.7.2 Since old trees have cultural and emotional attachment to the community, communication with the public to explain the tree conditions and measures adopted before removal would be desirable. This can address the public concerns and provide an opportunity to present the tree problems from the professional side so that a mutual understanding on the required tree works can be achieved.

5.3.7.3 If tree removal is considered appropriate, replacement planting of suitable species to suit the site conditions should be considered to restore the greenery. The procedure for tree removal should follow '*Development Bureau Technical Circular (Works) No. 10/2013 – Tree Preservation*'. For removal of OVTs, the procedure in ETWB TC(W) No. 29/2004 '*Registration of Old and Valuable Trees, and Guidelines for the Preservation*' should be followed.

6.0 Record and Monitoring

6.1 The maintenance records should be properly documented. The reports for maintenance operations should contain information such as date of operation, party and/or person responsible for maintenance works, relevant tree information, operation details (e.g. dosage and materials), photographic records showing the trees before and after treatment, preferably from the same view angle.

6.2 The inspection and maintenance records are essential to facilitate monitoring of tree condition, determining the effectiveness of treatment and formulating alternative follow up measures. For trees requiring continuous monitoring due to health or structural concern, they should be uploaded to the Tree Register in order to facilitate community-wide surveillance.

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APPENDIX 16 - Management Guidelines for Stonewall Trees

Management Guidelines for Stonewall Trees

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION
DEVELOPMENT BUREAU

December 2013

CONTENTS

1.0 Introduction

1.1 Stonewall trees are unique landscape, ecological and amenity features in our city. Since the founding of the city in the 1840s, there has been acute demand of land for urban growth. To overcome the hilly terrain with limited flat land for development, stone retaining walls of various types were built by traditional Chinese masonry techniques to provide horizontal platforms and stabilise disturbed terrain. With the sub-tropical climate, the presence of plant species usually *Ficus* spp. with strangler growing habit, joints between the stonewall blocks, the soil behind the walls and ground water seepage have permitted plant growth and stonewall trees have established on vertical surfaces on the stone retaining walls. These unique trees enrich the urban ecology and offer greenery to ameliorate the congested urban environment in Hong Kong.

1.2 Few cities in the world have so many stone retaining walls with spontaneous vegetation in an urban setting (Jim, 2010). The traditional craft in masonry wall construction is no longer present and there is no new stone wall constructed by traditional craftsmanship thus making stonewall trees unique heritage that deserve and require proper management.

1.3 Tree species with strangler growing habit are able to secure a strong grip on vertical wall surface and adapt to such harsh growing environment. These include *Ficus microcarpa, F. subpisocarpa (F. superba* var. *japonica), F. hispida and F. virens* which constitute the majority of stonewall tree species as they can fit into the vertical habitat for successful establishment on stone walls to become sizable landscape features. Other common species include *Celtis sinensis* and *Broussonetia papyrifera* (Jim, 1998).

1.4 Wall trees growing on stone walls are natural-cum-cultural assets and special preservation measures are required. The “Management Guidelines for Stonewall Trees” (Guidelines) serve as a reference for tree management departments in the management of stonewall trees with a view to promoting their health and structure, minimising their risk of failure and optimising their longevity.

2.0 Definition of Stonewall Trees

2.1 A stonewall tree is defined as a tree growing on a stone retaining wall satisfying the following criteria.

a) Wall Trees

"*A wall tree should have most of its roots spreading on or penetrating through the wall face, and with the trunk base situated within the confines of a wall. A tree overhanging above a wall but not physically attached to it, and a tree with trunk base and most roots located outside a wall's boundaries, did not qualify*." (Jim, 1998).

b) Stone Retaining Walls

Stone retaining walls consist of rubble walls composed of stones of regular or irregular size and shape and tied face walls with well shaped blocks. Free-standing walls, concrete walls or concrete walls with a stone veneer are excluded. Maintenance departments should check with the Geotechnical Engineering Office (GEO) to verify the structure of stone retaining walls if in doubt.

3.0 Growing Habit of Stonewall Trees

3.1 Geotechnical works relating to the stability of stone walls are not covered in the Guidelines. Reference should be made to "Geotechnical Manual for Slopes", "Technical Guidelines on Landscape Treatment for Slopes", "GEO Report No. 257 – Study on Masonry Walls with Trees" and other relevant documents published by Civil Engineering and Development Department.

Stabilisation treatment of walls, if required, should be sympathetic to growth of trees, and less damaging method, e.g. recessed soil nail installation, should be adopted.

3.2 Stone retaining walls provide vertical growing environment for establishment of stonewall trees. Seeds of stonewall tree species are brought to wall surfaces by frugivorous birds or bats. Relying on limited moisture available on the wall surfaces, these seeds germinate and extend their roots to explore openings or joints on stone walls and penetrate through the walls to secure their footings and absorb water and nutrients from the aft-soil (i.e. soil behind retaining walls) to sustain their growth. The ecology of stone walls is unique and where stability of the walls is not affected, small plants (e.g. saplings, climbers, ferns, native herbaceous) should be kept intact.

3.3 Roots developed on the wall surfaces also extend their colonies by sending absorbing roots to reach the soil at toe or crest of the walls to capture more water and nutrients for growth. The surface roots also fuse together at intersections to form a distinctive root network enhancing the grip on the walls. For species with aerial roots, these roots provide additional support to improve stability of stonewall trees when lignified, particularly if they can reach the soil to become prop-like supports.

Photo No. 1 – Distinctive root network on retaining wall surface

4.0 Review of Stonewall Tree Failure Cases

4.1 Based on available tree failure records from the maintenance departments, it is found that the main mode of failure associated with stonewall trees is uprooting during adverse weather conditions, e.g. typhoons. Most of the tree failure cases did not involve damage to the stone retaining walls and only a few cases caused localised damage.

4.2 The tree failure cases involve detachment of the roots from the wall surfaces and breakage of the roots penetrated into the walls on the tension side and rupture of the surface roots near the trunk base on the compression side. In general, it is observed that the fallen stonewall trees had only several root ingress points on the walls but the strength of root anchorage could afford establishment of sizable stonewall trees. Although the root anchorage was strong, failure would occur when excessive static and wind loads were transferred from the stems and canopies during adverse weather conditions.

5.0 Management Strategies of Stonewall Trees

5.1 The stability of trees on stone walls depends on the static and wind loads on the trunk, branches and crown as well as the strength of root anchorage (Chan, 2000). The management strategies of stonewall trees are formulated to focus on the integrity of the tree structure and root anchorage to reduce the risk of tree failure and promote tree health.

5.2 The key management strategies are:

- ♦ to maintain a balanced crown architecture and branch structure which enhance stability; and
- ♦ to improve root anchorage and strengthen support.

6.0 Inspection of Stonewall Trees

6.1 Regular tree inspection is essential to monitor the tree condition and identify the required maintenance measures. Inspection should be conducted by staff with relevant training and work experience.

6.2 Periodic inspection should be conducted to suit the maintenance requirements and in line with tree risk assessment requirements of the Tree Management Office (TMO). Supplementary inspection after inclement weather to identify the extent of damage and need of remedial works is required. Inspection frequency should be increased when the stonewall trees require close monitoring due to health or structural concerns.

6.3 Thorough inspection of the entire stonewall tree and its surroundings, with particular focus on the following aspects, in line with the management strategies is required. These include, but are not limited to, the identification of:

- ♦ structural defects, such as broken or dead branches, decay, cavities, splits, cracks, weak attachments, included bark, cross branching, hangers and deformed growth requiring remedial treatment;
- ♦ overgrown, weak and defective branches, scaffold limbs with poor taper requiring end weight reduction;
- ♦ the need of selective thinning of epicormic growth to improve branch structure;
- ♦ serious leaning or imbalance crown requiring pruning to rectify the form;
- ♦ the need of pruning to maintain a reasonable crown size and balanced architecture as well as branch structure taking into account the strength of

root anchorage to enhance stability;

- detachment of root anchorage and damage or decay of roots attached to the stone retaining wall, particularly those surface roots with visible entry points to the stone wall;
- aerial roots requiring guiding to provide potential lignified support;
- symptoms and signs of plant disorders such as fungal fruiting body and termite trails;
- adequacy of clearance to traffic and adjacent property;
- the need for provision or adjustment of installed tree support systems;
- damage or displacement of masonry blocks on the stone retaining wall requiring referral to a geotechnical engineer for follow up checking;
- recent changes to its surroundings such as trenches, grade changes, compaction, construction and demolition activities which may weaken root anchorage and increase exposure of the tree to wind;
- opportunities for providing enlarged planting areas at toe or crest of the stone retaining wall; and
- opportunities for guiding roots to soil.

6.4 Further investigation of the structural conditions by resistographic and tomographic instruments should be conducted if required. Monitoring of movement on stone walls should be considered if stability of the stone walls is a concern upon inspection by a geotechnical engineer.

7.0 Maintenance of Stonewall Trees

7.1 Maintenance operations should be carried out in accordance with the recommendations arising from the inspections. The operations should be carried out by trained personnel under supervision of trained and experienced supervisors with good knowledge in respect of the care of stonewall trees to ensure that maintenance operations can be carried out properly and safely in accordance with the proper arboricultural practices.

7.2 The following paragraphs outline the key measures in the maintenance of stonewall trees. These include preventive measures to promote tree health and structure, and remedial treatments of tree defects to reduce potential risks.

7.3 Pruning

7.3.1 Pruning should be carried out in accordance with the proper pruning practices promulgated by the TMO, for example, "General Guidelines on Tree Pruning" in the website http://www.trees.gov.hk and reference can be made to the international standards and best practices such as the standards promulgated by American National Standards Institute, the British Standards Institution, the International Society of Arboriculture, and Arboricultural Association. Prune only when necessary. The extent of pruning and size of pruning wounds should be minimised as far as practicable to any reduce stress to the stonewall trees and the vulnerability to pest and disease attack from pruning wounds. It is recommended that no more than 25% of the live crown, if justified, should be pruned in any one year. Large pruning wounds and removal of large branches should be avoided. Malpractices such as topping, lion tailing, excessive pruning should not be performed. The amount, location and method of pruning should be prescribed by a trained tree management professional and implemented by a worker/contractor with appropriate skills.

7.3.2 Remove Defective Branches

Dead, diseased or broken branches should be removed as appropriate to address structural and health concerns. Defective branches with weakened mechanical strength and other defects due to advanced decay, cavity formation, and crack development at critical junctures and cross branching should be removed. Stubs should also be removed in order to avoid decay spreading to the parent stems or branches.

7.3.3 Reduce Excessive Branch End Weight

An appropriate amount of end weight should be removed where necessary to reduce the load and abate the risk of failure under the following circumstances: overgrown branches and poor taper, branches suffering from decay or cavity at critical points with reduced load-bearing capacity, truncated branches due to improper heading cut, or long, heavy and upright epicormic branches developed at or near the cut wounds with decay.

7.3.4 Rectify Imbalance Tree Crown

Low leaning angle is common in stonewall trees because of the vertical habitat and the presence of physical obstacles at the back of the walls. The natural leaning and "imbalanced" crown of stonewall trees to suit their growing habit against a vertical wall should not be directly compared to that of trees growing on ground. As a reference for stonewall trees, due to their special habitat, tilting reaching beyond 40^{o} would be considered as heavy lean that deserve close attention (Jim, 2012). Reduction pruning to shorten severe leaning branches should be considered in order to rectify the imbalanced tree crown and improve stability if necessary.

7.3.5 Maintain Optimal Size of Tree Crown

Static load and wind load to stonewall trees are proportional to the frontal area of tree crown. For stonewall trees with large tree crowns but limited root attachment and support, the force transferring from the crown to the root anchorage during windy conditions is large and the risk of uprooting of stonewall trees would increase, especially if the stonewall trees are located at exposed locations (Chan, 2000). Reduction pruning should be performed to reduce the size of tree crown when necessary to avoid excessive loading to root anchorage.

7.3.6 Provide Adequate Clearance from Road Traffic and Properties

7.3.6.1 Mechanical damage by moving vehicles can cause severe impacts to stonewall trees protruding from stone retaining walls along the roadside. A stonewall tree may fail if hit by a heavy vehicle. Low and overhanging branches affecting traffic flow should be appropriately pruned to provide adequate clearance. In general, a head room clearance of 5.5m is required for public roads. Warning signs or markings should be provided, if required, for tree parts which are close to traffic corridors.

7.3.6.2 For branches that are very close to properties or structures, reduction pruning to provide adequate clearance should be carried out to prevent branches from hitting and damaging adjacent properties in windy conditions.

7.4 Utilise Aerial Roots as Lignified Support

7.4.1 Stonewall tree species with aerial roots that capture water and nutrients from the surroundings have the potential to develop and provide additional lignified support. Therefore, aerial roots should be retained whenever practicable and trimming of them should be the last resort.

7.4.2 The best treatment is to allow aerial roots to reach the soil at ground to become upright lignified support for stonewall trees. If no soil is located underneath the aerial roots, opening up of paving to allow aerial roots to anchor at the ground with soil should be considered. At the same time, it would be necessary to consider the adequate strength of the whole root system to support the increased canopy size and the proportionate growth of the aerial roots to form a prop-like support. Guide tubes or ushering ropes can be used to facilitate aerial roots to reach the ground/soil quickly. If these measures are not feasible, aerial roots can be guided and ushered along branches by ropes made of degradable materials to locations for landing and anchorage. Where soil is not available in the vicinity, aerial roots can be ushered along branches to the main stems or scaffold branches to form lignified support to reinforce the branch structure. Aerial roots should be retained whenever practicable. Trimming, cutting or twisting around branches should not be allowed. Keeping joints of masonry walls unsealed is important for the root growth.

Photo No. 2 – Lignified aerial roots forming natural prop-like supports to improve stability of stonewall tree

Photo No. 3 – An example of guiding aerial roots by plastic tubes filled with planting medium

Photo No. 4 – Aerial roots ushered along branches to the main stems or scaffold branches to form lignified support

Photo No. 5 – Aerial roots forming lignified support to strength the branch structure

7.5 Protect Root Anchorage from Damage

7.5.1 The lignified roots on stone walls are vital for root anchorage. Damage or decay of these roots, particularly those structural roots near the trunk base and those having penetrated into the walls, would weaken the root anchorage and stability of stonewall trees.

7.5.2 Damage to these roots should be avoided and treatment on exposed wounds, such as fungicide, should be promptly applied for effective control against decay or infection. Removal of the joint filler embedding the roots growing on the retaining walls to relieve the roots from girdling should be considered. Where soil nails have to be installed in slope stabilisation works, they should be carefully located to minimise damage to the root anchorage. During construction, tree protection zones (TPZs) should be provided to cater for the roots behind and in front of the stone retaining walls.

7.6 Create Rooting Areas at Toe and Crest of Retaining Walls

Paved areas should be opened up where practicable by creating rooting areas at toe and crest of retaining walls, as it can improve water and nutrient supply and thus encourage root growth which will as a result provide extra physical support to the stonewall trees. Therefore, there should be no sealing of joints unnecessarily and in particular, at the toe of walls.

Photo No. 6 – Provision of rooting areas at the toe of the retaining wall

Photo No. 7 – Provision of rooting areas at the crest of the retaining wall

7.7 Install Tree Support System

Tree support system, which in general includes cabling, bracing, propping and guying, should be installed as appropriate taking into account the tree dynamics and practicality of installing these systems.

7.8 Integrated Pest Management (IPM)

7.8.1 Pest problems should be addressed by IPM through appropriate physical, biological, cultural or chemical methods.

7.8.2 If signs and symptoms of the Brown Root Rot (BRR) disease infection are identified, a report should be made to the TMO. Special treatment on trees infected with the BRR disease should be carried out in accordance with the prevailing guidelines promulgated by the TMO such as the "Guidelines on

Brown Root Rot Disease” which is available at www.trees.gov.hk.

7.9 Protection of Stonewall Trees during Construction

7.9.1 TPZs during construction should cover the entire wall structure, the stonewall trees, exposed roots and adequate volume of undisturbed aft-soil. The TPZ, where practicable, should consist of (a) the back root protection zone (i.e. area behind the wall), (b) the front root protection zone (i.e. area in front of the wall), and (c) stem protection zone. A tree specialist with good knowledge and experience on stonewall trees preservation should advise on the extent of the TPZ.

7.9.2 Cordon hoarding should be erected around the TPZ and construction activities that are harmful to stonewall trees must be prohibited unless adequate protection arrangements agreed by the tree specialist are put in place. The implementation of tree protection measures should be closely monitored on site throughout the construction period.

7.9.3 Damage to stems and roots of stonewall trees should be avoided during the upgrading of masonry walls through appropriate design measures and close supervision during construction.

7.10 Tree Removal

7.10.1 In a situation where there is a high risk of tree failure that threatens public safety and no appropriate remedial measures are available, the tree should be removed in a timely manner to reduce the risk to an acceptable level.

7.10.2 Removal of stonewall trees should follow proper procedures. The

TMO should be notified beforehand and the removal operation should be properly documented with photo records and provided for the TMO's reference.

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APPENDIX 17 - Guidelines on Tree Pruning

Guidelines on Tree Pruning

Greening, Landscape and Tree Management Section
Development Bureau

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Contents

Introduction

This guidance document presents a recommended standard of good practice for tree pruning in Hong Kong that helps sustain healthy development of our precious tree assets. Trees provide a lot of benefits to human beings, wildlife and the environment, in particular in densely populated cities like Hong Kong. Trees help to suppress adverse impact from climate change and heat island effect; provide screening effect against noise and pollutants; improve amenity and aesthetic value in the city; provide food source and habitats to wildlife and promote biodiversity in urban environment; and improve air quality by producing oxygen and absorbing greenhouse gases such as carbon dioxide, etc. Nevertheless, trees in urban environment interfere with human lives and urban development at the same time. As they become bigger and older, trees occupy more space on pavements and the roadsides; interfere with underground utilities; block scenery views of residents; and create hygienic concerns due to fallen flowers, fruits and leaves. Tree failures that occur due to extreme weather, poor tree health or poor structural conditions also threaten human lives and result in property damage.

In order to maximise the benefits and minimise the hazards associated with trees in our city, well-developed urban forest and well-planned tree management have become more important. Urban trees should be continuously cared for throughout their life span through measures such as proper irrigation, mulching, fertilisation and appropriate mitigation measures, such as pruning and provision of supporting system. Amongst the various mitigation measures, tree pruning is essential in every tree maintenance and risk management scheme. Tree pruning is a practice of removing specific portions of a tree to achieve long-term maintenance of good tree health, structural integrity, aesthetics and safety of public and properties. Appropriate pruning parameters (e.g. pruning type, pruning time and pruning extent) should be carefully determined according to different pruning objectives, tree species and tree conditions, etc. Given its significance in ensuring good health and structure of trees, thereby, protecting public safety, pruning work should follow a set of good working procedures, standards, and safety guidance, and be performed by registered personnel with adequate knowledge and skills in tree pruning and work supervision.

This guidance document cross-references relevant local and international standards, guidance and publications and those published by the

Greening, Landscape and Tree Management Section (the GLTMS) of the Development Bureau. Tree management personnel should make reference to this guidance document when planning and conducting tree pruning, in conjunction with other local and international standards, guidance and publications listed in the "Reference" section as appropriate. This guidance document provides guidance on good tree pruning practice, and its recommendations are not intended to be mandatory. It is recognised that experienced practitioners may wish to adopt alternative methods to those recommended herein. Practitioners are encouraged to comment at any time to the GLTMS on the contents of this guidance document, so that improvement can be made to future editions.

Part 1. Overall Management

1.1. Objectives

In tree risk management, tree pruning is one of the most commonly used risk mitigation measures. Before carrying out tree pruning, the objectives of the pruning work should be clearly defined to prevent any unnecessary or excessive pruning. The most common objectives of tree pruning are divided into the following categories:

(a) Reducing Risk and Nuisance to Public

(i) Upon identification of potential tree failure risks, it is important to reduce or eliminate the risks as soon as possible. Regular and appropriate tree pruning is an effective mitigation measure to reduce tree failure risks and maintain a safe urban environment.

(ii) As they grow bigger, roadside trees may obscure the sight of pedestrians and motorists; physically obstruct vehicular accesses, road signs, lampposts and power lines; and leave insufficient headroom for pedestrians, vehicles and double-decked buses, etc. Roadside trees require regular pruning in order to provide adequate clearance to road users.

(iii) Trees planted next to buildings or premises may cause disturbance or nuisance to occupiers due to overgrown tree crowns towards the structures. Tree pruning to remove overgrown branches, reduce crown size or uplift tree canopy can reduce tree failure risks and nuisance caused.

(b) Maintaining or Improving Tree Health, Form and Structure

(i) As trees grow towards maturity, the number of dead and diseased tree parts start to accumulate. By removing weak and undesirable branches, shoots/sprouts and trunks, food reserve and water supply can be allocated to healthier parts of the trees while encouraging further tree development and recovery.

(ii) Appropriate tree pruning can prevent invasion of pests and diseases. By removing dead or infected tree parts and by thinning the dense crown, spreading and harbourage of pathogens within the same tree or to adjacent trees can be prevented or eliminated.

(iii) Proper tree pruning removes overcrowded leaves, twigs and branches. This allows more sunlight penetrating to the inner and lower part of canopies and increase photosynthesis rate of trees. Better air circulation within tree crowns can avoid excessive moisture inside the crowns, where is favourable to fungal infection. Besides, when competing branches are reduced or selectively removed, dominant leaders and scaffolding branches would be developed and tree structures can be improved.

(iv) Better tree form with strong and balanced framework can be trained by early tree pruning. Pruning at young tree stage can significantly reduce the need and cost of pruning in upcoming tree lifespan. Poor and declining tree health and structure should be mitigated as early as possible.

(v) Regular tree pruning can help developing good and stable tree structures particularly for those with poor and unstable root system, and those growing on locations with severely restricted rooting area, insufficient soil mass and precipitous slope, etc.

(vi) Urban development and construction may change the original tree growing conditions. Sufficient pruning can help the retained and transplanted trees conform to their new environment by controlling their growth rate and changing their tree forms.

(c) Enhancing Resistance to Inclement Weather

(i) Pruning is one of the best precaution measures of tree failure during extreme weather condition. Crown reduction and crown thinning can reduce wind resistance of trees and minimise the potential of tree failure by reducing tree height and crown loading.

(ii) The survival rates of well-pruned urban trees are generally higher than unpruned trees under inclement weather. Proper tree pruning can protect trees from damage and failure under strong wind and heavy rain and reduce tree failure risks to public and properties.

(iii) Structural pruning (also called formative pruning) during young tree stage can help to establish a healthier urban forest in the future with lower wind resistance and lower tree failure rate during typhoon season. Tree growth can be directed to develop and maintain good structures including single dominant leader, strong branch attachment and balanced tree crown. In the meantime, structural pruning also serve as correction of bad structural issues such as multiple stems, included bark and lion-tailing.

(d) <u>Improving Aesthetics and Urban Environment</u>

(i) Formative pruning can help to maintain trees in their most desirable form and appearance, in particular when conducting in nursery stage or young tree stage. Nursery trees may be regularly pruned to control their form, foliage density and size to fulfil specific landscape objectives and constraints at planting site.

(ii) A tree treated by proper pruning can create a more pleasant living environment. By providing a satisfying amount of shading from trees, this can change the microclimate under the tree and reduce the temperature. Sufficient vegetation coverage can also reduce urban heat island effect.

(iii) Trees play an essential role in urban landscape by serving as greenery enhancement and unsightly view screening. Appropriate tree pruning including crown thinning, reduction and raising can create more desirable views in urban areas.

1.2. Work Plan

Before conducting tree pruning work, it is highly recommended that a pruning plan should be prepared by Inspection Officer in advance. By listing out the important components in a pruning plan, Inspection Officer can manage the workflow of pruning work systematically, identify the required personnel and equipment and address any associated risks and constraints during pruning work. The objectives of the pruning should be clearly conveyed to the Tree Work Supervisors and Tree Workers involved as well as other professional personnel such as the architect/engineer/supervising officer of a contract, and project/resident landscape architect, etc.

When planning the pruning work, the decision and recommendation made in the latest tree inspection report should be taken into consideration. The pruning plan should also take into account the site conditions of the pruning work as well as weather condition on the proposed works. A sample pruning plan is provided in Appendix A for reference. Inspection Officer may suitably amend the sample plan to comply with its own tree management requirements and should include but not be limited to the following considerations.

(a) Assessing Potential Risks of Pruning Work

All risks associated with the pruning work should be assessed and appropriate safety measures should be implemented to alleviate or mitigate the potential risks. Tree Work Supervisors and Tree Workers should be alerted to all potential hazards prior to the pruning work. The potential risks of the pruning work may be associated with the following factors:

(i) Use of pruning tools, e.g. hand saw and chainsaw;

(ii) Work at height, e.g. tree climbing and use of elevated platform;

(iii) Condition and stability of trees, e.g. leaning, cracks, decay, fungal fruiting bodies and root-plate movement;

(iv) Impact of one tree part on lower tree parts and site conditions during pruning work, e.g. fallen branch or whole tree failure;

(v) Weather conditions, e.g. strong wind, heavy rain, very hot weather;

(vi) Health issues related to tree work, e.g. allergic reaction and heat stroke;

(vii) Site conditions that may affect tree stability, e.g. soil erosion, stability of adjacent stonewall or retaining structure, recent site changes due to construction, grade change, site clearing;

(viii) Electrical hazards, e.g. underground utilities and overhead cables;

(ix) Adjacent structure, e.g. buildings, highway structure, lamppost and signboard;

(x) Traffic conditions, e.g. vehicles, double-decker buses, heavy trucks and railways; and

(xi) Wildlife and habitats on tree, e.g. bird nests, snakes, ants and beehives.

(b) Scheduling Pruning Work

When setting up the schedule of pruning work, the following categories should be considered:

(i) Management Factors
(1) Issuance of tree work contracts;
(2) Pruning objectives;
(3) Work programme of building and construction;
(4) Mobilisation of Tree Workers;
(5) Mobilisation of necessary equipment and machineries; and
(6) Site accessibilities and limitations.

(ii) Tree Factors
(1) Tree growing, flowering and dormant seasons;
(2) Likelihood of tree failure;
(3) Actual pruning procedures; and
(4) Pruning interval.

In case the tree work cannot be completed in one operation, phased work plan should be prepared where appropriate. For pruning of more than 25% of the total live foliage, the elapsed time should be at least six months to one year between two pruning work operations.

(c) Managing site operations

The responsible department should, as far as practicable, provide and maintain a safety system of work to ensure safety and health of Tree Workers. Tree pruning work should be conducted with well-organised site management to prevent or reduce adverse impacts on trees to be pruned, adjacent trees, site users and surrounding environment. Some of the necessary measures are listed as below:

(i) If the pruning site is situated within or close to an area with high intensity of use such as crowded street, public parks, expressway, railway, construction site and car park, a risk assessment should be undertaken prior to the commencement of tree work to identify potential hazards, and recommend and implement necessary mitigation measures.

(ii) When conducting tree pruning work, Tree Worker should be fully aware of the potential risks to public safety. Proper notice and cordoning-off of the pruning site may be necessary to restrict unauthorised entry.

(iii) Tree Worker should pay attention to the adjacent buildings, utilities and properties around the site and take necessary procedures to avoid any damage that may arise from the pruning work.

(iv) Cleaning and disposal of tree debris from the working site should be completed after each operation to restore the site as soon as practicable.

Other measures on managing site conditions are given in Part 4.5

Occupational Safety and Health and Part 4.6 Cleaning and Disposal.

(d) Avoiding Transmission of Pests and Pathogens

Pests and diseases sometimes may spread from one tree to another through pruning equipment and tools. Therefore, any equipment and tools used in pruning trees should be kept clean and sterilised regularly before and after operations. If tree pruning work is carried out on trees infected by pests and diseases, particular attention should be drawn to avoid transmission of pathogens from the infected trees to other trees and sites nearby.

When pruning a tree infected with Brown Root Rot Disease (BRRD), particular precaution measures on pruning equipment and the removed tree parts should be undertaken. For trees on government land, responsible tree maintenance departments should report the suspected BRRD cases to the GLTMS and take prompt remedial measures in accordance with the "Guidelines for Tree Risk Assessment and Management Arrangement and Manual on the Management of Brown Root Rot Disease" promulgated by the GLTMS.

(e) Protecting Wildlife and Habitat

Before undertaking pruning work, the concerned trees and working sites should be comprehensively inspected to identify any presence of wildlife and habitat within the site. The potential risks and adverse impacts of pruning work to protected and rare animals, plants and their associated habitats should be carefully assessed and prevented by the following measures:

(i) Active nesting, breeding and roosting of any protected wild animals, including birds, bats and squirrels on trees and adjoining ground should be identified and should not be interfered with.

(ii) Remove, destroy or wilfully disturb nests or eggs of any protected wild animal are prohibited.

(iii) Rare or endangered tree species, such as *Aquilaria sinensis*; and rare or endangered plants on trees or adjoining ground, such as orchids should be protected and preserved as far as practicable.

(iv) Contamination and disruption of soil, water source and wildlife habitats caused by pruning work are strictly prohibited.

(v) Schedule of pruning works at or near egretries (i.e. breeding locations of egrets or herons) should take into account the breeding season of egrets or herons (i.e. March to August).

If the pruning work would interfere with or have adverse impacts on wildlife and habitats, when necessary, further advice/assistance should be sought from relevant government departments and/or other relevant parties, such as the Agriculture, Fisheries and Conservation Department. If emergency tree pruning is necessary due to the presence of imminent danger to public safety but the pruning work may interfere with wildlife and habitat, relevant government departments should first be contacted for further advice/assistance on wildlife protection. Ordinance in relation to wildlife conservation and protection are specified as below:

(i) Country Parks Ordinance (Cap. 208);

(ii) Forests and Countryside Ordinance (Cap. 96) and Forestry Regulations (Cap. 96A);

(iii) Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586); and

(iv) Wild Animals Protection Ordinance (Cap. 170).

1.3. Timing

The best time for pruning throughout a year should be carefully determined. During different times of pruning, trees may have different degrees of response, which vary with tree species, life stages as well as growing seasons.

(a) Pruning Cycle

The pruning cycle refers to the time interval between each pruning exercise. Pruning work should be arranged according to an appropriate pruning cycle (i.e. at appropriate time interval) such that the pruning work would not pose significant health and structural problems to the trees.

(i) There is no single pruning cycle that fits all types of trees and situations. Every individual tree or tree group needs to be assessed and evaluated individually to determine an appropriate pruning cycle.

(ii) Pruning cycle can be bi-annually, annually, or even every two to three years depending on the pruning objectives, site conditions, tree species characteristics, tree life stages, health conditions and environmental constraints of trees etc.

(iii) Sufficient time between consecutive pruning work should be provided for the tree to recover from pruning stress and to complete wound closure. The larger the pruning extent and cuts, the longer the recovery time is required and longer elapsed time between pruning exercises should be scheduled.

(iv) Pruning cycle in the nursery stage is an exception, which depends on the actual needs for structural pruning. Young trees in nursery stage may require two to five times more frequent pruning exercises than mature trees to direct their growth and structural development. Pruning cycle of nursery trees is not applicable for general maintenance of mature trees.

(b) Pruning Time throughout Seasons

The best time for individual tree pruning varies between different tree species and pruning objectives. Seasonal factors and tree characteristics should be taken into account when deciding the pruning schedule around the year. The recommendations of tree pruning during different seasons are described below.

(i) All time in a year
Crown cleaning can be undertaken to remove defective branches anytime as practicable. Structural pruning can be conducted in any season to remove branches of no more than 25% of total live foliage.

(ii) Late winter to early spring
Tree pruning should be minimised during growing season to prevent removal of new leaves and buds. As food reserves are depleted during spring growth, pruning may adversely affect tree vitality.

(iii) Late spring to summer
Tree growth can be directed effectively with summer pruning by slowing down the seasonal growth of trunks or branches. Foliage abnormalities such as sparse, wilted, and absent of foliage on dead, deteriorating branches; and excessive growth of new foliage, which may lead to heavy lateral limbs can be easily spotted for pruning when foliage density reach maximum during growing season, especially for deciduous trees. However, excessive crown reduction should be avoided to prevent large area of previously shaded tissues damaged by sunburn. If the tree is storm-damaged, it is better to conduct restorative pruning as soon as practicable.

(iv) Late-summer
Live branch pruning can be carried out following the seasonal growth so that tree development would not be affected, i.e. when all new leaves become mature and the colour turns stable.

(v) <u>Autumn</u>

Autumn is not a good time for pruning. Dormancy of deciduous trees may be delayed and it is the time of sporulation of many decay fungi. New shoot growth stimulated by pruning cut may easily deteriorate when temperatures drop.

(vi) <u>Winter</u>

In Hong Kong, under sub-tropical region climate, pruning during winter is always more preferable than during other seasons of the year. In winter season, trees are less likely to be infected by fungi and pests when most of them are dormant or inactive. Moderate to heavy cut can stimulate cambial activities, in particular for evergreen trees, which have faster compartmentalisation abilities in the coming growing season. Pruning of deciduous trees after shedding leaves in dormant season is also more preferable as the following spring growth can be stimulated.

1.4. Dosage

Pruning dose refers to the estimated percentage of live foliage to be removed from an entire tree as compared to the amount of existing foliage prior to pruning. The pruning dose should be carefully determined with the following considerations:

(a) The pruning objectives and pruning time as discussed above.

(b) Not more than 25% of the total live foliage should be removed from a healthy, vigorous tree within an annual growing season. Over-pruning may lead to a stressed tree with health decline; excessive water sprout development; irreversible structural damage; reduced tolerance to pests and diseases; and/or sunburn bark tissue.

(c) For trees with significant health defects or at senescence stage, the pruning dose should not be more than 10% of the total live foliage.

(d) The percentage and distribution of live foliage to be removed should be adjusted according to the tree species, tree health, growing stage, tolerance to pruning and site conditions.

(e) When conducting crown reduction or thinning, sufficient healthy branches should be retained to sustain the growth and recovery of parent stems or remaining branches.

(f) In general, young or healthy trees have greater tolerance to pruning work; better recovery abilities from live branch removal; and less adverse effects on tree wounds than mature or unhealthy trees. Old or stressed trees are more vulnerable to infection caused by pathogens and excessive pruning work.

(g) In some cases, a larger pruning dose may be warranted. More than 25% of total live foliage sometimes needs to be removed to mitigate a significant structural defect. The pruning objectives, rationale, potential severity of defects and mitigation measures should be carefully assessed and evaluated prior to the operation.

(h) According to the Development Bureau Technical Circular (Works) No. 4/2020 – Tree Preservation, the excessive tree pruning proposal should be submitted in a Tree Preservation and Removal Proposal (TPRP) to the responsible Tree Works Vetting Panel (TWVP) for approval when necessary. If excessive crown, limb or root pruning is required for trees to be retained or transplanted, the pruning proposal with justifications, method statements and supervision requirements of the pruning work must be approved by the responsible TWVP.

Part 2. Best Practice

2.1. Types

The common types of pruning being used to achieve different pruning objectives as discussed in Part 1 are set out below:

(a) Formative Pruning / Structural Pruning

(i) Definition
Selective pruning of the lateral branches of a tree so as to develop a desirable tree form with a strong and straight trunk, a well-balanced crown with properly spaced scaffolding branches and a clear central leader.

(ii) Techniques and Applications
It is typically used in young trees during their nursery stage and early stage after planting. Formative pruning should aim at reducing the development of tree structural weaknesses while encouraging young trees to accommodate the growing constraints, such as obstructions from adjacent roads and utilities. Details of formative pruning are further discussed in Part 3.1 - Pruning Young Trees.

(b) Crown Lifting / Crown Raising

(i) Definition
Selective pruning to remove or shorten lower branches to increase vertical clearance from ground level (Figure 1).

(ii) Techniques and Applications
Lower branches heavily shaded by branches above may tend to grow downward and outward to absorb more sunlight. These branches should be shortened or removed to provide adequate headroom clearance and prevent development of undesirable overgrown branches. Removal of lower branches should preferably be not more than 15% of the live crown height and the remaining live crown should make up at least two-third of the

tree height, except for young trees undergoing formative pruning. Crown lifting is applied primarily to prune lower and overhanging branches obstructing adjacent buildings, pedestrians, vehicular traffic flow and other utilities.

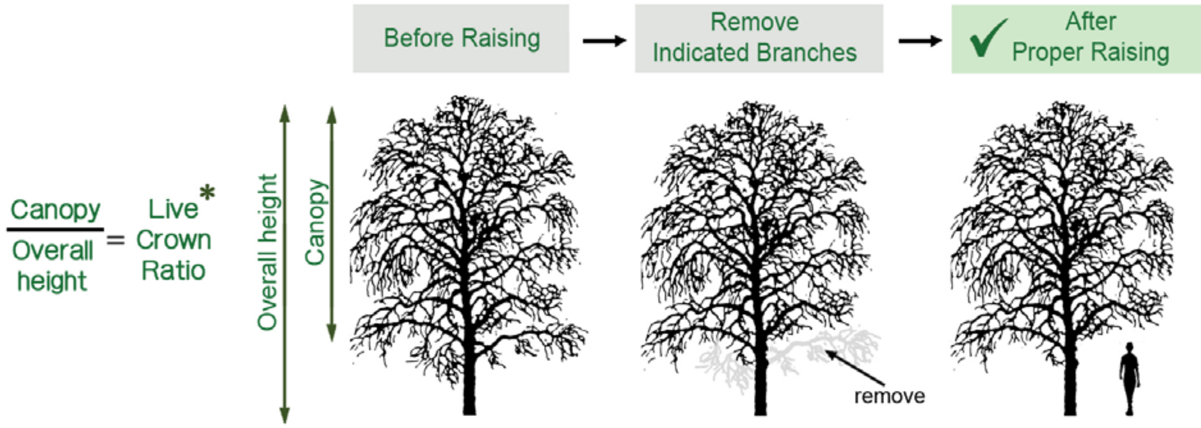

Figure 1. Illustration of proper crown lifting/crown raising practice

(c) Crown Reduction

(i) Definition

Selective pruning to reduce the overall tree height and/or spread of the crown, while maintaining a well-balanced and natural form and shape (Figure 2).

(ii) Techniques and Applications

The tree characteristics as well as its health conditions should be carefully assessed in advance. Crown reduction should be avoided for old or stressed trees. The purpose is to control the development of tree shape, crown size and length of branches in order to reduce tree failure potential and prevent obstruction of the adjacent utilities. Branches with excessive loading, overextended length or severe structural defects such as included bark, crack and cavity can be shortened or removed to minimise the likelihood of failure.

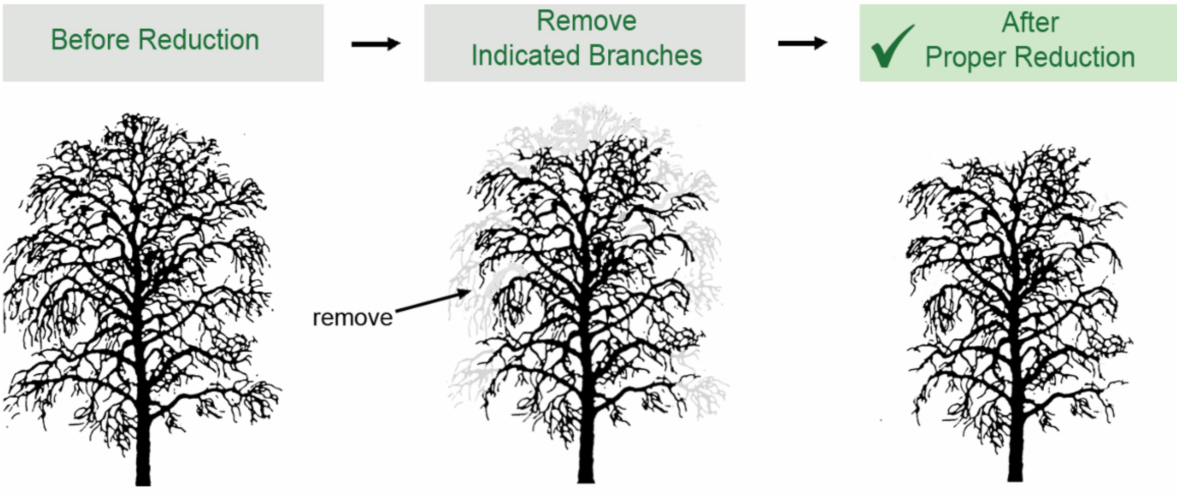

Figure 2. Illustration of proper crown reduction practice

(d) Crown Thinning

(i) Definition

Selective pruning to remove weak, thin, crossing branches and branches growing inward to reduce the foliage density (Figure 3).

(ii) Techniques and Applications

Crown thinning would maintain an even distribution of foliage with a well-spaced and balanced branch structure while not affecting the overall height and spread of trees. By reducing the crown density, wind loading on trees would decrease while sunlight penetration and air circulation within the crown would increase. Crossing branches and branches that raise close together should be selectively pruned to provide more growing space for remaining ones. If the objective is to reduce overall loading of the tree canopy, crown reduction should be considered instead of crown thinning. Over-thinning may result in excessive water sprout development and lion-tailing that increase the likelihood of failure.

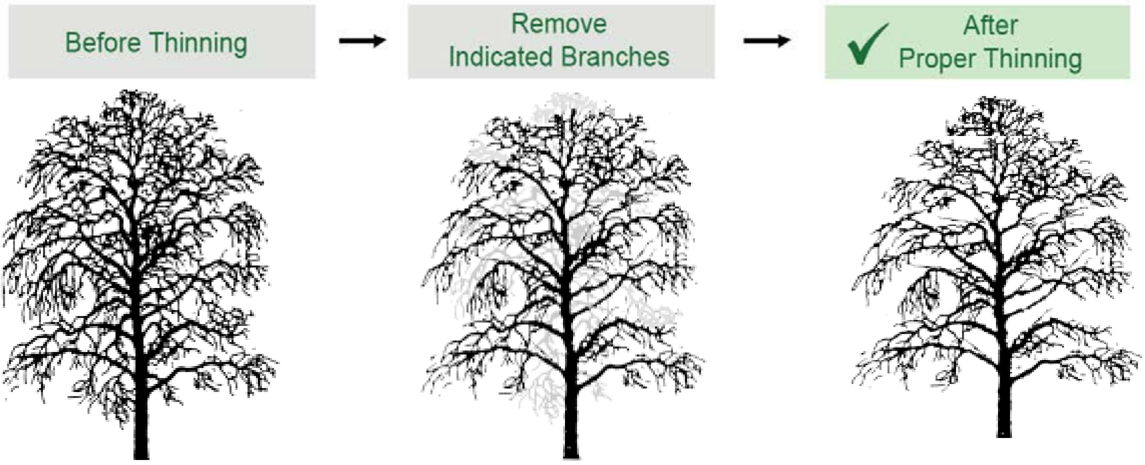

Figure 3. Illustration of proper crown thinning practice

(e) Crown Cleaning

(i) Definition
Selective pruning to remove dead, withered, damaged, broken or diseased branches, twigs and stems from trees (Figure 4).

(ii) Techniques and Applications
Crown cleaning can be accomplished at any time of the year. The objectives are to reduce tree failure risks and improve tree health and appearance by removal of defective parts from trees. The amount of tree materials to be removed and the number and diameter of pruning cut(s) should be kept minimal. Parasitic plants and foreign materials such as dodder, mistletoe, *Mikania micrantha*, nails, angle irons and wound dressing should be removed from trees as far as practicable.

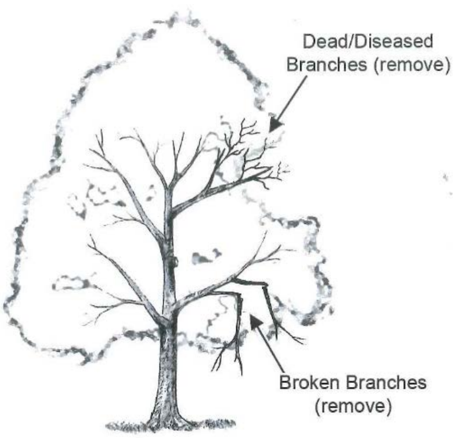

Figure 4. Illustration of possible defective tree parts requiring crown cleaning

(f) Restorative Pruning

(i) Definition

Selective pruning to remove damaged, crossing and dead branches to restore tree health and structure to a better and more natural condition.

(ii) Techniques and Applications

Restorative pruning aims at prolonging the life expectancy of damaged trees. It is generally applied to trees that have lost their natural tree form and structural integrity due to storm damage, poor pruning practices and severe mechanical damage, etc. By conducting a series of pruning throughout the years, tree health and structure can be restored while the tree growth and production of epicormics can be managed. Details of restorative pruning would be mentioned in Part 3.4 - Pruning Storm-damaged Trees.

2.2. Techniques

Pruning work should be completed by proper techniques and with good qualities. Some recommendations for pruning practices are listed below for reference:

(a) Pruning should be performed by registered Tree Workers and under proper supervision by registered Tree Work Supervisors with expertise in horticulture, arboriculture and tree care to ensure that it is done safely and properly. Details of the qualification requirements for Tree Work Supervisors and Tree Workers are given in the "List of Minimum Personnel Requirements for Landscape Works, Tree Management Works and Vegetation Maintenance Contracts" promulgated by the GLTMS.

(b) Over-pruning would adversely affect the healthy growth of trees. A good practice is that removal of crown should be limited to not more than 25% of total live foliage in each pruning work. Also, the crown should be kept in a well-balanced and natural form and appearance after pruning as far as practicable.

(c) Selective pruning should be conducted to prune a tree branch by branch or layer by layer to achieve pruning objectives. Appropriate types of pruning and pruning cut should be determined according to pruning objectives.

   (i) Removal cut (thinning cut) refers to a cut to remove a branch at the union with parent branch or trunk.

   (ii) Reduction cut (lateral cut, cutting to a lateral, drop-crotch cut) refers to a cut to shorten the length of a branch by removing one of a branch of codominant branches or multiple branches while the remaining lateral branch is at least one-third the diameter of the pruned branch.

   (iii) Heading cut (topping) refers to a cut to shorten the length of a branch by pruning in the middle of the branch or by pruning back to a lateral branch which is less than one-third the diameter of the pruned branch. This practice is considered to be inappropriate pruning as the pruned trees would be extremely damaged. It should never be used for reducing tree height or crown size. However, in exceptional circumstances, heading cut might be applied as a temporary measure to mitigate tree risk. For example, only the damaged part of a large branch will be removed instead of removing the whole branch which will leave a large pruning cut on the trunk. The headed branch should be followed-up by frequent monitoring and subsequent pruning in the coming years.

(d) The diameter of a branch removed should generally be not more than one-third of the diameter of the remaining branch or parent stem. The branch cutting should be as small as possible resulting in a relatively smaller area for wound closure.

(e) Pruning work should adopt the practice of "3-Point Cut" (Figure 5) and "Natural target pruning" (Figure 6) techniques, which are very efficient and least damaging ways to remove branches. These techniques can avoid bark tearing and unnecessary wounding caused by pruning cuts and allow the tree to compartmentalise the wound as quickly as possible.

(i) Through the "3-Point Cut" technique, a branch is removed in three sequential cuts:

(1) The first cut should be an undercut on target branch at some distance away from the parent branch or stem. It is made to prevent causing bark tearing and cracks close to the trunk or parent stem when the branch is fell;

(2) The second cut should be a top cut undertaken slightly further out than the first cut to remove the outer part of the target branch and a stub would be left; and

(3) The final cut should be a cut just adjacent to but not within the branch collar or branch bark ridge to remove the remaining stub without bark tearing.

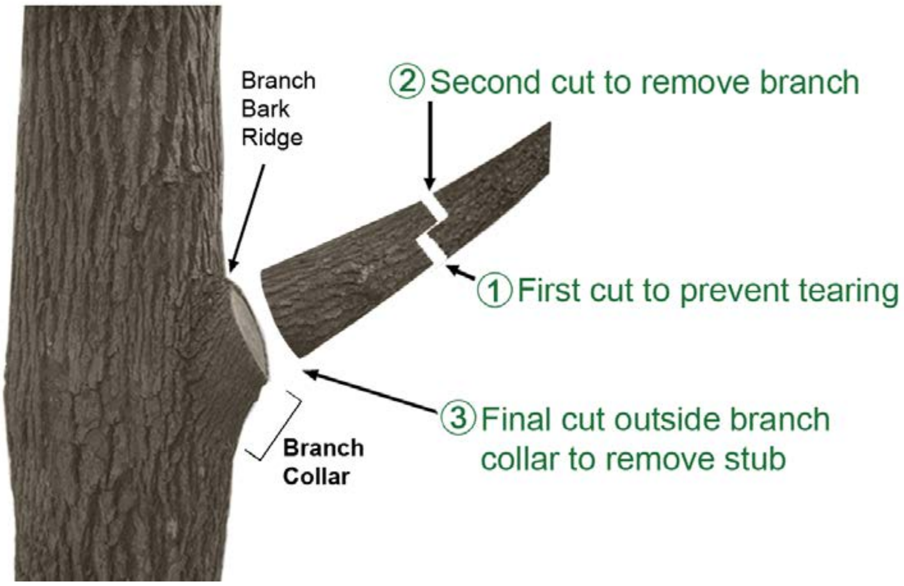

Figure 5. Illustration of "3-Point Cut" procedures

(ii) Natural target pruning refers to making cut at a proper location without damaging the branch bark ridge and branch collar.

(1) If branch collar is visible, the final cut should be made just outside the edge of branch collar;

(2) If there is no visible branch collar but just branch bark ridge, the final cut should be made just outside the branch bark ridge and cutline should not be parallel to the parent branch; or

(3) If neither branch collar nor branch bark ridge is visible, the final cut should be made just outside the basal flare of the branch and cutline should not be parallel to the parent branch.

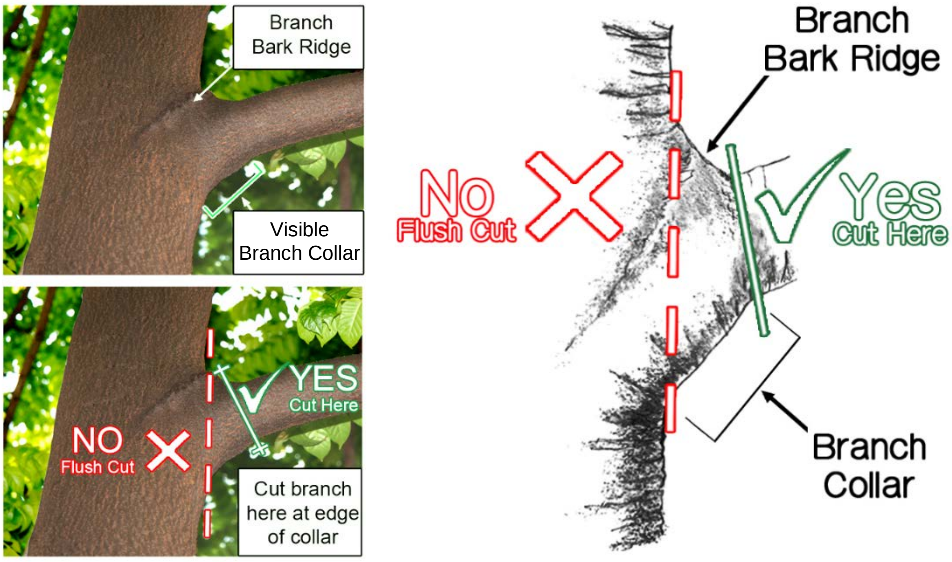

Figure 6. Illustration of "Natural target pruning"

(f) Tree Workers should use appropriate and sharp tools to produce smooth and clean cuts to facilitate better wound closure.

(g) When removing a branch with narrow or V-shaped angle at branch union, the pruning cut should be started from the underside or the outside of the target branch in order to facilitate the pruning operations and to prevent damage to the remaining branch or trunk.

2.3. Malpractices

Trees treated with poor and wrong pruning practises may resulted in irreversible health decline and structural failure. Appendix B – Adverse Effect of Malpractices in Pruning provides more details. Poor tree health and structure can result in failures that lead to casualties or property damage. Some common structural defects caused by malpractices in pruning are summarised as follow (Figures 7 to 15):

Figure 7. Topping

Removal of main stem at its apical end and always involves removal of a large portion of stem and branches.

Figure 8. Lion-tailing

Removal of interior branches, leaving a cluster of small branches and foliage at the end of a branch.

Figure 9. Over-lifting

Excessive removal of lower branches of a tree and results in a very low live-crown-ratio.

Figure 10. Flush Cut

Cutting into the branch collar that may damage the branch collar and trunk tissue.

Figure 11. Stub Remaining

A large portion of stub remains if the location of pruning cut is far beyond the branch collar.

Figure 12. Large Pruning Cut

Cutting outside of the branch collar exposing a large area of heartwood.

Figure 13. Bark Tearing

Unnecessary tearing of tree bark and expose a large area of living tissue caused by improper pruning.

Figure 14. Jagged Wound

Pruning wound with rough surface and torn edges resulting from poor pruning techniques.

Figure 15. Wound Dressing

Any paint or material that being placed on wound.

Part 3. Pruning Scenarios

3.1. Pruning Young Trees

Young tree stage, a period with the most rapid growth rate in a tree's lifespan, is a critical period to conduct formative pruning, which is known as tree structural training. This practice is a special type of pruning which allows tree accommodating the future planting site constraints. By undergoing proper formative pruning, the major framework and growing direction of young trees can be established. In general, formative pruning should be completed either in the nursery stage, or during or right after the planting stage. The major steps of formative pruning are described below.

(a) Developing Dominant Central Leader

Tree structure is much stronger and stable with a dominant leader extending well upwards in the crown. The leader may or may not be straight depending on its genetic code as well as in response to its growing environment. During the nursery or young stage, subordination pruning is critical for central leader and tree form establishment. The size of a branch relative to the trunk or parent branch is known as branch aspect ratio, which is an important parameter to determine the central leader. Key steps of subordination pruning to develop a dominant leader are:

(i) Identify single stem that would make the best leader (e.g. more vertical stem, the largest stem or the highest stem);

(ii) Determine which stems are competing with the best leader (e.g. upright branches with large branch aspect ratio); and

(iii) Decide the location of reduction cut and remove those competing stems.

(b) Identifying Permanent Lower Branches

Permanent and temporary branches should be classified and pruned differently for structural development. Identifying the lowest permanent branches in the permanent canopy would facilitate the management of lower temporary branches. Branches that have originated below the lowest permanent branches are temporary branches while those above become permanent branches in the crown. Key steps to identify and maintain the lowest permanent branches:

(i) Treat all the branches as temporary branches for young and recently planted trees that may not be tall enough yet to have any permanent branches;

(ii) Determine the height of the lowest permanent branch based on the development of desirable tree form and headroom clearance requirements for future site use;

(iii) Remove long, horizontal and large branches below the lowest permanent branches; and

(iv) Leave short, lateral, and small diameter branches unpruned during the nursery stage.

(c) Maintaining Small Branch Aspect Ratio

Branches with small branch aspect ratio (e.g. less than 50%) are more strongly secured to the trunk than branches with large branch aspect ratio. When branches are much smaller in diameter than the trunk (e.g. 30% smaller), a natural branch protection zone may develop within the branch basal area and extend inside the trunk. This zone is rich in chemicals that inhibits spread of decay from the pruning wound into the trunk tissue. Keeping branch diameter less than half the trunk diameter ensures that the branch collar and branch protection zone would remain intact. Key steps to maintain strong branch attachments are:

(i) Identify and maintain branches with sizes less than one half the diameter of the trunk or parent stem (branch aspect ratio less than 50%);

(ii) Maintain a single branch and remove other branches that raises at one location; and

(iii) Select and remove branches with bark inclusion in the attachment.

(d) <u>Suppressing or Removing Branches with Bad Attachments</u>

Included bark is a structural defect that causes weak union between branch and trunk. Inclusions on codominant, large, and long branches are the greatest concern. The mechanical stress from heavy static loading and weak union support are more likely to cause branch failure. Growth of branches with included bark should be suppressed to minimise the chance of breakage. Key steps to suppress and remove branches with bad attachments are:

(i) Identify branches with bad attachment such as with narrow or V-shaped angle, with included bark, crossed with adjacent branches or trunk;

(ii) Select branch with the largest diameter to be pruned first within the identified branches; and

(iii) Remove or suppress the growth of branch with bad attachments by removal or reduction cuts.

(e) <u>Spacing Main Branches along Central Leader</u>

Branches spaced along and around trunk are better connected to the trunk than those clustered together and originate from one location. When several branches raise at one point on the trunk, there is not enough space for trunk tissue to wrap around the branch base for better branch attachment. Key steps to space main branches along central leader are:

(i) Identify and selectively prune branches whose branch attachments are touching or nearly touching at the same vertical point as moving up, down or around the central stem;

(ii) Select the larger and lower branches to be pruned for improving vertical spacing;

(iii) Try to maintain evenly spaced intervals between lateral branches; and

(iv) Do not remove any branch directly above or adjacent to another branch that has already been removed.

3.2. Pruning Trees Adjacent to Utilities

When trees are growing under the following circumstances, directional pruning should be applied to reduce or remove lateral or over-extended branches growing towards the utilities. Tree growth would be directed away from and prevent any interfering and obstruction to public, adjacent infrastructure, utilities, traffic and lines-of-sight.

Although topping maybe a wide-spread practice in provision of sufficient clearance from utilities, it is considered as an unacceptable tree pruning practice. Topping stimulates the growth of water sprouts that have similar growing direction towards utilities as the original branches. Continuous topping can increase failure risks, deplete tree food reserves, increase susceptibility to pests and diseases and disfigure tree forms. On the contrary, directional pruning by reduction cut back to lateral branches is more preferable for utility pruning. Tree pruning should be minimised as far as possible to reduce stresses on trees while obtaining adequate clearance from utilities.

(a) Adjacent to Roads and Railways

Tree parts over-extended towards roads may probably be hit by moving vehicles and severe mechanical damage can be caused by large vehicles. Lower and over-extended branches may obstruct the vision of drivers, potentially causing traffic accidents. Roadside trees should be pruned regularly to provide sufficient headroom over roads and railways. Requirements on headroom for different traffic users are laid down in the Structures Design Manual for Highways and Railways.

(b) Adjacent to Pedestrian Streets and Cycling Tracks

Trees with lower branches and drooping branches may hinder pathways of pedestrians and cyclers. Those tree crowns should be lifted to provide sufficient headroom over pedestrian streets and cycling tracks. Regular tree pruning should be conducted to protect road users from fallen defective branches. Twigs/branches with failure potential should be removed as soon as possible. General requirements on headroom for different traffic users are laid down in the Structures Design Manual for Highways and Railways.

(c) Adjacent to Building Structures

When trees grow tall or wide enough, they may interfere with building structures nearby. To direct the growth of branches which is very close to properties, reduction pruning should be carried out to provide sufficient clearance from adjacent building structures and prevent branches from interfering with and damaging adjacent properties in windy conditions. Trees growing close to buildings may act as bridges for pests and animals to gain access to residential and commercial properties. By keeping branches away from buildings, hygienic and security problems can be prevented.

(d) Under Overhead Cables

In order to ensure safe and reliable electricity to the city, interlacement between trees and overhead energised lines should be prevented. Trees in the proximity of overhead cables should be pruned regularly to maintain an acceptable clearance and avoid contacts with conductors. Over-extended branches should be trimmed to provide sufficient distance away from overhead cables.

(e) Adjacent to Lampposts and Signboards

Over-extended and over-crowned trees may obstruct lampposts and signboards on streets. Sufficient lighting and clear traffic signage is essential to the safety and convenience of road users. Branches blocking lampposts and signboards should be pruned to maintain visibility and clearance of road conditions.

3.3. Pruning Before Wet Season

Tree failure incidents frequently occur during and after rainy and typhoon season and may result in casualties and/or severe damage to properties. Weak and stressed trees are usually more vulnerable to strong wind and heavy rain while trees with good health and structure generally have higher storm tolerance and pose less failure risk to the public. Proper tree management should identify and mitigate any potential tree failure hazards before wet season.

(a) Regular Tree Inspection and Tree Risk Assessment

Tree inspection should be arranged prior to wet season, particular in areas of high pedestrian and vehicular traffic flow. Tree health and structural conditions should be monitored and maintained in good condition. Regular tree risk assessment should be undertaken in order to identify any tree with particular concerns or growing under specific environmental constraints which can be significantly damaged by typhoons and rainstorms. Trees that require regular inspection include but not limited to the following:

(i) Damaged, diseased, deteriorating or dead trees;

(ii) Trees with significant defects or poor structures such as severely leaning, asymmetric tree crown, poor taper, co-dominant trunks or branches with included bark, lion-tailing, decay, crack, cavity, fungal fruiting bodies and girdling root;

(iii) Tree species with brittle wood structure (e.g. *Delonix regia*, *Aleurites moluccana*, *Senna siamea*);

(iv) Trees with dense canopies and heavy crown loading;

(v) Trees highly exposed to wind or their neighbouring trees are recently removed;

(vi) Trees growing at poor site conditions such as confined root system, on precipitous slope, compacted soil, shallow soil depth or poorly drained soil;

(vii) New planting trees and transplanted trees;

(viii) Trees with recent tree failure records;

(ix) Trees infected with BRRD or trees growing in the same root zone area of a BRRD infected tree; and

(x) Any tree of particular interest.

(b) <u>Precautionary Measures to Reduce Tree Risks</u>

If any potential tree hazard is identified, necessary mitigation measures should be conducted as soon as possible and before wet season. The preventive pruning should take into consideration the following categories:

(i) Remove dead, wilted, diseased, damaged branches and trunks;

(ii) Thin or reduce a dense canopy by removing some interior or overgrown small branches;

(iii) Encourage single stem leader and good branch attachment by shortening or removal of branches competing with the leader and/or conflicted with other branches;

(iv) Direct the leader of a leaning tree to a more upright lateral stem by shortening or removing outgrown branches;

(v) Shorten or remove any branches overhanging on or overextended towards buildings and utilities; and

(vi) Avoid inappropriate pruning such as topping and lion-tailing to prevent the trees becomes more susceptible to typhoon damage.

3.4. Pruning Storm-damaged Trees

Storm-damaged tree pruning is essential for tree restoration. It selectively removes branches, water sprouts, and stubs from trees that have been severely damaged or broken in storm. The aim is to manage the growth of new epicormics and branches from a storm-damaged tree and to restore the tree health and structure. After a storm, trees are damaged or collapsed under extreme gust wind. Trees have to use stored energy to recover from damage and produce new growth. Therefore, during the cleaning process, removal of live wood should be minimised. Post-inclement weather inspection is paramount to ensure public safety, and appropriate mitigation measures must be carried out as soon as possible. The restorative pruning procedures may have to be repeated for a period of years until tree health and forms are recovered to their desirable conditions.

(a) Considerations for Restorative Pruning

Not all storm-damaged trees can be restored. Storm-damaged trees should be evaluated for the possibility and necessity of restorative pruning. Reference should be made to the inspection record of the latest TRA conducted by the responsible Inspection Officer. Key considerations when conducting pre-restoration assessment are given in the following paragraphs.

(i) Extent of Damage

The location of damaged tree parts, proportion of damage and wound sizes would determine the possibility of tree recovery. The larger the wound in relation to the size of parent branch or stem, particularly with heartwood exposed, the less likely the wound closure and compartmentalisation can be achieved; and the more vulnerable the tree would decay, invaded by diseases and become stressed. Numerous damages and significant loss of tree crown would adversely affect the ability of recovery from storm damages.

(ii) Tree Size and Age

Younger and smaller trees can restore much quickly than more mature and larger trees. Old and senescence trees, which have accumulated multiple defects over years, often become more susceptible to damage in subsequent storms.

(iii) Tree Species

Tree species characteristics should be considered when evaluating the value of restoration. Species that may not fully compartmentalise the wounds and may be prone to further decay should generally not be restored. Storm-damaged trees of any invasive species, such as *Leucaena leucocephala*, are recommended to be removed and replanted with native tree species or other tree species as appropriate.

(iv) Tree Conditions

Storm-damaged trees with better health and structural conditions are worth to be restored as they can recover more quickly and easily. Trees suffering from poor health and extensive damage would be more susceptible to failure and further health decline after a storm. Uprooted trees are not recommended to be restored as the root plate is already destabilised and root system is severely damaged.

(v) Site Conditions

Trees growing at poor site conditions such as confined root system, precipitous slope, compacted soil, shallow soil depth or poorly drained soil are very susceptible to wind loading especially with substantial root damage after a storm. Trees such as *Acacia confusa* in afforestation planting on slope, which have outgrown from the compact growing environment or are reaching the end of their life cycle, are not recommended for restoration. If trees are suppressed by dense tree population or shaded by building structures, tree removal of these damaged trees is more preferable.

(vi) Tree Value

In addition to its economic value and ecological services, damaged trees may be memorial trees, or have historical significance, or associated with other cultural attributes. Restoration of trees of particular interest such as Old and Valuable Trees, Stonewall Trees (SWTs) and “Fung Shui” trees should be considered as far as practicable due to potential public concerns.

(b) Strategies in Restorative Pruning

After all the safety concerns have been addressed and justifications to restore storm-damaged trees have been made, the primary objective of restorative pruning should be retaining as much of the live wood as possible. Typically, restorative pruning requires over a period of years to restore the original foliage mass and desirable tree form. This would maintain tree vitality and encourage good management of water sprouts. The major strategies in restorative pruning are given in following paragraphs.

(i) Removing Hazards from Public

After a storm, tree parts with imminent failure risks should be removed from targets as soon as possible. Cleaning tree canopies of damaged or broken branches, hangers and stubs should be the focus of mitigation measures. Moderate crown reduction or crown lifting may be necessary to perform restoration.

(ii) Restoring Tree Health and Structure

Defective branches should be pruned by natural target pruning, which allows better closure of pruning wounds. In order to sustain recovery, removal of live wood should be kept at the least amount to minimise additional stress to damaged trees. Structural restoration should be conducted by progressive reduction of lever of arms and lion-tailing to achieve a balanced tree crown. Some live branches can be removed to redistribute the loadings and relocate the center of gravity in tree crown. Heading cuts should be avoided as a large proportion of lateral branches would be removed that results in large pruning wounds and severely disfigured tree form.

(iii) Sprout Management

Most of the damaged trees would develop water sprouts from wounds and weakened tree parts. The ultimate goal of sprout management is to relocate energy reserves, develop new branch leader and encourage wound closure. Measures can begin approximately one to two years after crown cleaning and typically require multiple pruning practices over years to remove interfering sprouts and to direct new growth. Sprouts on recovering trees usually grow aggressively but weakly attached to parent stems, therefore growth of sprouts should be managed properly.

The most vigorous sprouts often develop side branches, which should be left for lateral branch development. Then, sprouts located near the selected sprouts should be removed to provide sufficient growing space. In general, sprouts management requires more than two times of pruning in order to develop new branches from dominant sprouts. Sprout management can be performed in conjunction with normal pruning work for better resource management.

(c) Other Mitigation Measures

(i) During the recovery process, it is important to manage root zones for optimum tree growth, through providing adequate irrigation, mulching, mitigation of compacted soil, and proper drainage.

(ii) In order to prevent further failure and provide support to weaken trees, appropriate guying and cabling should be provided to trees with significant structural defects such as severe leaning, asymmetric crown and heavy lateral limb.

(iii) When restorative pruning is not applicable and there are imminent dangers posing to public or properties by storm-damaged trees, tree removal should be conducted as soon as practicable.

3.5. Pruning Palms

Palms are monocots and they grow differently from other trees. They should not be excessively pruned and primarily only be pruned to remove fronds, flowers, fruits, loose petioles which, if not removed, may pose potential hazards to targets. The general guidelines of palm pruning are listed below:

(a) Dead, chlorotic, broken fronds should be removed. Palms that produce hazardous large fruits or frequently drop old fronds may require pruning works every 3 to 6 months. The location of cuts should be close to the petiole base and without damaging the stem.

(b) Removal of live, healthy fronds should be avoided. Excessive loss of healthy fronds may inhibit palm growth, cause spreading of pests and diseases, and threaten palm health. If healthy fronds must be removed, removal of fronds growing upright or above 20 degrees in relation to the horizontal plane should be avoided.

(c) All fronds are originated from the top of the palm – terminal bud. Therefore, terminal bud of a palm should never be damaged or removed as it would lead to poor frond development and palm death. For multi-stemmed or clumping palm species, entire stem can be removed due to aesthetic or risk management reason.

(d) Some climbing devices, such as spikes which would create wounds on palms should not be used. The wounds would leave permanent scarring and palms health would decline due to the infestation of pest and pathogens at wounded tissues.

3.6. Root Pruning

As pruning of roots may adversely affect normal tree health and growth, in general, root pruning is strictly prohibited for mature trees. However, root pruning may be necessary under the following circumstances.

(a) Removing girdling roots;

(b) Cutting dead, diseased and severely damaged roots back to sound wood;

(c) Preparing root ball for tree transplanting; or

(d) Avoiding irreparable damages and encroachments to underground utilities or infrastructures by root development.

Pruned roots should be sharply cut and covered by wet hessian or backfill soil with adequate watering to prevent the death of absorbing roots, minimise exposure to pest and pathogens, reduce pruning stresses and increase the chance of survival.

Some tree species, such as *Ficus microcarpa*, can develop extensive aerial root systems. Aerial roots should be retained as far as practicable and trimming of them should be the last resort. Guide tubes or ushering ropes can be installed to improve aerial root anchorage and strengthen tree support and nutrient uptake. A majority of SWTs in Hong Kong are *Ficus microcarpa,* which require intensive care. Details of various aerial roots treatments of SWTs are provided in the “Management Guidelines for Stonewall Trees” promulgated by the GLTMS.

TPRP with justification of the dose and needs of root pruning should be prepared and submitted to the responsible TWVP for approval, prior to the pruning works, if necessary.

Part 4. Quality Control

4.1. Implementation

Inspection Officers should ensure that clear pruning instructions are delivered to Tree Work Supervisors and Tree Workers (Figure 16). Form 1, Form 2 or other proper inspection reports should be prepared to compile a pruning plan and provide at least but not be limited to the following information:

(a) Pruning objective;

(b) Tree information (i.e. tree no., species, height, crown spread, DBH);

(c) Location, site condition and presence of wildlife and habitat (if any);

(d) Site observations;

(e) Tree parts with potential failure risks to public and properties, if any;

(f) Proposed pruning types and techniques;

(g) Proposed tree parts to be pruned and the extent of pruning;

(h) Time frame for pruning work and pruning interval;

(i) Specific equipment and tools, if any;

(j) Occupational Safety and Health as mentioned in Part 4.5;

(k) Technical circular, ordinance and guidelines, if necessary;

(l) Clear location map to show the pruning site location; and

(m) Photographic record in colour to illustrate the whole view of the tree, concerned tree parts and the recommended pruning procedures.

4.2. Work Supervision

Government departments should monitor and ensure the efficacy and quality of pruning work. The process and outcome of pruning work should follow the instructions provided by the responsible Inspection Officer as far as practicable. Pruning work should be under supervision in accordance with the following steps:

(a) A Tree Work Supervisor should be arranged to provide on-site tree work supervision;

(b) Full photographic records should be taken before and after the pruning work;

(c) A tree work completion report providing at least but not be limited to the following information should be prepared by Tree Work Supervisors or Tree Workers and submitted to the Inspection Officer for endorsement;

    (i) Tree information (i.e. tree no., species, height, crown spread, DBH);

    (ii) Location of pruning work;

    (iii) Pruning work taken;

    (iv) Date of work completion;

    (v) Photographic records of the whole tree and tree parts taken before and after pruning work.

(d) The pruning work can only be endorsed upon its satisfactory completion.

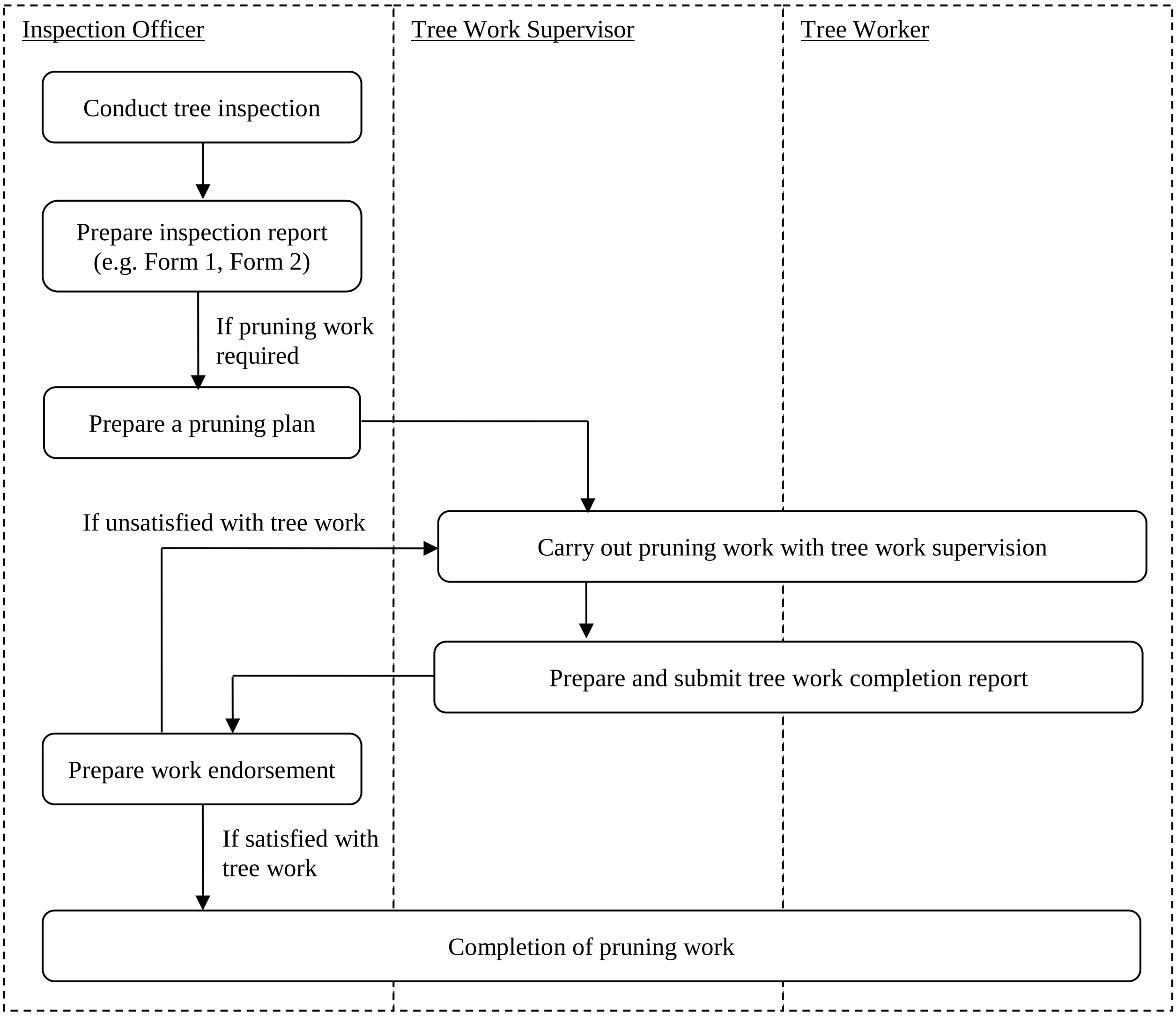

Figure 16. Flowchart of work implementation and supervision

4.3. Personnel Qualifications

Tree pruning requires arboricultural knowledge and professional techniques in the use of mechanical equipment and tools that pose potential occupational safety hazards. Tree management personnel should have academic, professional and training qualification as well as work experience as appropriate as set out below.

(a) Details of requirements for Inspection Officers conducting Form 1 and Form 2 are stipulated in Appendix 3 of the "Guidelines for Tree Risk Assessment and Management Arrangement (10th Edition or latest edition)" promulgated by the GLTMS.

(b) Details of requirements for Tree Work Supervisors, Tree Climbers and Tree Workers are stipulated in "List of Minimum Personnel Requirements for Landscape Works, Tree Management Works and Vegetation Maintenance Contracts" promulgated by the GLTMS.

(c) Details of requirements for Tree Work Supervisors, Tree Climbers and Chainsaw Operators are stipulated in the Registration Scheme for Tree Management Personnel managed by the GLTMS.

4.4. Equipment and Tools

Different kinds of equipment and tools are recommended to be used to assist and complete tree pruning work in different scenarios. Pruning objectives, tree part size, pruning cut location, accessibility, and other factors should be taken into account in choosing the appropriate pruning equipment and tools. Equipment such as spurs and spikes that may damage tree bark or conductive tissues should not be used. The following equipment and tools (Figures 17 to 24) are commonly used in pruning work:

Figure 17. Hand pruner

It can be used to cut small living branches less than 1.5cm in diameter.

Figure 18. Looper

It can be used to prune small branches up to around 2.5cm in diameter.

Figure 19. Extension pruner

It is useful for pruning small branches at height and less than 2cm in diameter.

Figure 20. Hand saw

It is more appropriate to be used for pruning branches larger than 2.5cm in diameter.

Figure 21. Pole saw

It is commonly used for pruning branches at height or at far distance.

Figure 22. Chainsaw

It can be used for pruning tree parts of different size.

Figure 23. Tree climbing

Pruning may be carried out at height by registered Tree Climbers in accordance to the "Guidelines on Arboriculture Occupational Safety and Health" (OSH Guidelines).

Figure 24. Elevated platform

It should be used for tree pruning at height where practicable.

4.5. Occupational Safety and Health

Tree pruning work should be completed in a safe and proper manner. When conducting tree pruning works, tree management personnel should comply with relevant safety requirements of the site and have good communication with safety officers, if necessary. Details of guidance in provision of a safe system of pruning work, are stipulated in the OSH Guidelines. The following safety measures for pruning work are recommended in order to protect the operatives and public:

(a) <u>Planning Factors</u>

(i) Prepare work plan and assess risks of tree work with mitigation measures;

(ii) Inspect and evaluate trees and sites in question before the operation to identify any potential safety concern, then prepare necessary safety measures;

(iii) Determine any underground utilities and overhead cables around the sites and coordinate with relevant utility companies as appropriate; and

(iv) Ensure safe and clear access routes to the tree and site for Tree Workers, elevated platform and other necessary equipment; and

(v) Check latest weather forecast prior to tree work and avoid pruning trees under undesirable weather such as humid, strong wind and extreme hot days as far as possible by re-scheduling the tree work, when necessary.

(b) Environmental Factors

(i) Identify and reduce/eliminate failure potential of any objects in height, such as pruned tree parts, tools and debris;

(ii) Clear and cordon-off tree pruning areas during pruning work to prevent entry by unauthorised persons;

(iii) Deploy adequate manpower to maintain uninterrupted traffic flow;

(iv) Implement Temporary Traffic Arrangement, if necessary, following the requirements mentioned in the “Code of Practice for the Lighting, Signing and Guarding of Road Works" issued by Highways Department;

(v) Place directional/warning lighting and signage to divert pedestrians and traffic;

(vi) Provide adequate cool drinking water and/or temporary sunshade, especially during hot weather;

(vii) Keep flammable materials such as chainsaw fuel at least 3m away from the heat source;

(viii) Prevent interference to wildlife and habitats, especially protected wild animals and rare or endangered species; and

(ix) Be aware of hazards associated with animals and plants such as snakes, mosquitoes, ants, beehives and poisonous plants.

(c) Personnel Factors

(i) Wear appropriate clothing and put on proper personal protective equipment (PPE) such as goggles, hearing protections, helmets, chainsaw trousers, safety boots, gloves, and reflective vests, if necessary;

(1) Chainsaw operators should wear chainsaw protective clothing, safety helmet, eye and hearing protection, gloves and safety shoes/boots during chainsaw operation;

(2) Tree Climbers and Tree Workers on elevated platform should always wear suitable PPE such as safety helmet, and safety harness with lanyard(s) anchored to secure anchor point(s);

(ii) According to the OSH Guidelines, Chainsaw operators should have completed recognised training on chainsaw operation before handling any tree pruning work by using chainsaw;

(iii) Adopt safe and proper operational procedures of chainsaw during tree work by chainsaw operators;

(iv) According to "Overview of Work-at-height Safety" published by the Labour Department, a power-operated elevated platform should only be operated by persons who have received suitable training and are competent to operate the machine;

(v) Perform sufficient and effective communication and teamwork between Tree Work Supervisors and Tree Workers;

(vi) Always stay alert to other Tree Worker's activities, surrounding environment and potential hazards during tree work;

(vii) If tree climbing is applied, arrange at least two Tree Workers with aerial rescue qualification at the same site as far as practicable, in case of emergency situations;

(viii) Only those who receive relevant training in handling electrical hazards can engage in pruning work near power lines;

(ix) Ensure correct posture for manual and mechanical handling of tree pruning such as pulling, pushing and lifting;

(x) Be aware of health conditions of every tree management personnel, e.g. allergic reaction, heat stroke and dehydration;

(xi) Bring along a first-aid kit for emergency; and

(xii) Must not smoke when handling flammable liquid.

(d) <u>Equipment Factors</u>

(i) Select appropriate equipment for corresponding tasks such as hand saws, chainsaws, pole saws, extension pruners and ropes;

(ii) Use equipment only for operations within its capabilities and in accordance with standards, guidelines and recommendations provided by the manufacturers;

(iii) Carry out tree work at ground level and safe conditions as far as practicable by the use of suitable hand tools such as extension pruner and pole saw;

(iv) Cut large or heavy tree parts into smaller pieces and make use of equipment such as tree rigging systems to move heavy tree parts and to avoid overloading of manual delivery;

(v) Use equipment, such as ropes, rigging equipment and elevated platform, to move any materials at height to a safe dropping zone;

(vi) If tree climbing is applied, provide at the pruning site suitable and secure anchor point(s) at height, independent lifeline(s) or fall arresting system(s), and continuous attachment to the safety harness for the Tree Climbers;

(vii) According to "Overview of Work-at-height Safety" published by the Labour Department, ladders should only be used for work at height of less than 2m above ground and should normally be restricted for ascending and descending purposes only;

(viii) Clean and regularly sterilise all pruning tools by alcohol (75%) or bleach solution (10% bleach and 90% water) before and after pruning work, especially when working with infected trees in order to prevent the spread of pests and diseases among trees.

4.6. Cleaning and Disposal

The working area should be kept safe and tidy at all time during and after each pruning work. Any tree materials, debris and wood chips, generated from the pruning work should be removed from the site as soon as practicable and disposed at an appropriate waste depot or landfill.

(a) Accumulation of debris at pruning sites may cause hygienic problems as it provides favourable breeding and decomposition sites for insects, fungi and bacteria.

(b) Tree debris of some tree species (e.g. *Leucaena leucocephala*) should be removed from sites as soon as possible in order to prevent the growth of water sprouts from the tree debris.

(c) If trees are infected with pests and diseases such as BRRD, particular precaution measures such as sterilising the pruning tools by alcohol (75%), soil treatment and properly disinfecting and disposal of infected tree debris should be undertaken. Details of handling procedures of BRRD infected trees are provided in the "Manual on the Management of Brown Root Rot Disease" promulgated by the GLTMS.

(d) To reduce yard waste generated from pruning work, clean and uninfected wood waste can be utilised as the followings:

(i) To be retained on site to achieve conservation benefits such as providing micro-habitat, composting of organic matters and recycling of nutrients to the environment.

(ii) To be chipped for mulching to improve the quality of soil; and

(iii) To be converted into usable products such as biofuel, furniture, decorative features and handcrafts.

Details of general guidance regarding the handling of tree debris treatment are provided in the “Guidelines on Yard Waste Reduction and Treatment” promulgated by the GLTMS.

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Appendix A. Sample Pruning Plan

Pruning Plan

A. General Information

Department / Agency: ____________________ Project / Contract No.: ____________________

Inspection Report: File Ref.: ____________________

☐ Form 1 ☐ Form 2 ☐ Other form

Inspection Officer: ____________________ Tree Work Supervisor: ____________________

Tree Worker: ____________________

Date of Inspection: ____________________ Anticipated Completion Date of Works: ____________________

B. Site Information

Location:	____________________
Target Description:	☐ Pedestrian road ☐ Cycling track ☐ Public road ☐ Railway ☐ Building/structure ☐ Carpark ☐ Power lines ☐ Lamppost ☐ Signboard ☐ Others: ____________________
Site Limitation:	☐ No ☐ On slope ☐ Traffic/expressway ☐ Railway ☐ Restricted area ☐ Others: ____________________
Wildlife and Habitat:	☐ No ☐ Bird nest ☐ Bee hive ☐ Others: ____________________

C. Tree Information

Tree ID No.: ____________________ Species: ____________________

Height(m): __________ Crown Spread(m): __________ DBH(mm): __________

Observation:	☐ Dead branch/stub ☐ Dead trunk ☐ Broken branch/trunk ☐ Hanger ☐ Crack ☐ Leaning ☐ Overgrown branch ☐ Heavy lateral limb ☐ Others: ____________________
Pruning Objective:	☐ Regular maintenance ☐ Reduce failure risk/nuisance ☐ Enhance resistance to inclement weather ☐ Improve aesthetics and urban environment ☐ Others: ____________________
Mitigation Measure:	☐ Crown raising ☐ Crown reduction ☐ Crown thinning ☐ Crown cleaning ☐ Formative pruning ☐ Cabling ☐ Pest & disease control ☐ Others: ____________________
Pest & Disease:	☐ No ☐ Termite ☐ Brown root rot disease ☐ Others: ____________________

D. Pruning Work Information	
Tree Part(s) to be Pruned: ☐ Crown: % of foliage: ___________________ ☐ Branch: Quantity: ___________________ Fall distance(m): ___________________ Cut size(mm): ___________________ Length of tree part(m): ___________________ ☐ Trunk: Quantity: ___________________ Fall distance(m): ___________________ Cut size(mm): ___________________ Length of tree part(m): ___________________ ☐ Others:_______________________________ Equipment & Tools: ☐ Hand pruner ☐ Looper ☐ Extension pruner ☐ Hand saw ☐ Pole saw ☐ Chainsaw ☐ Tree climbing gear ☐ Elevated platform ☐ Others: _______________________________	Photo record
Tree Part(s) to be Pruned: ☐ Crown: % of foliage: ___________________ ☐ Branch: Quantity: ___________________ Fall distance(m): ___________________ Cut size(mm): ___________________ Length of tree part(m): ___________________ ☐ Trunk: Quantity: ___________________ Fall distance(m): ___________________ Cut size(mm): ___________________ Length of tree part(m): ___________________ ☐ Others:_______________________________ Equipment & Tools: ☐ Hand pruner ☐ Looper ☐ Extension pruner ☐ Hand saw ☐ Pole saw ☐ Chainsaw ☐ Tree climbing gear ☐ Elevated platform ☐ Others: _______________________________	Photo record

E. Occupational Safety and Health (OSH)	
Factors with Potential Risk: ☐ Work at height ☐ Overhead object ☐ Delivery of tree debris ☐ Traffic flow ☐ Use of equipment ☐ Fire precaution ☐ Heat related disorder ☐ Application of chemical ☐ Inclement weather ☐ Very hot weather ☐ Electrical hazards ☐ Wildlife and habitat ☐ Others:______________________	Mitigation Measure: ☐ Personal protective equipment ☐ First-aid kit ☐ Appropriate clothing ☐ Appropriate and safe equipment and tools ☐ Directional/warning signage/notice ☐ Cordoning-off work site ☐ Deploying staff to maintain traffic flow ☐ Temporary traffic arrangement ☐ Safe access/working platform ☐ Adequate cool drinking water ☐ Temporary sunshade ☐ Others:_____________________________

F. Other Information	
Wood Waste Disposal:	☐ Waste depot or landfill ☐ Retained on site ☐ Mulching ☐ Upcycling
Remarks:	____

Appendix A. Example 1 - Tree pruning in residential area

Pruning Plan

A. General Information

Department / Agency: Housing Department

Project / Contract No.: TRA for KE Region (CB20170219 3rd cycle)

Inspection Report: ☐ Form 1 ☑ Form 2 ☐ Other form

File Ref.: ______

Inspection Officer: ______

Tree Work Supervisor: ______

Tree Worker: ______

Date of Inspection: 3/3/2020

Anticipated Completion Date of Works: 3/5/2020

B. Site Information

Location:	Kai Yip Estate
Target Description:	☑ Pedestrian road ☐ Cycling track ☐ Public road ☐ Railway ☑ Building/structure ☐ Carpark ☐ Power lines ☐ Lamppost ☐ Signboard ☑ Others: Playground
Site Limitation:	☑ No ☐ On slope ☐ Traffic/expressway ☐ Railway ☐ Restricted area ☐ Others: ______
Wildlife and Habitat:	☑ No ☐ Bird nest ☐ Bee hive ☐ Others: ______

C. Tree Information

Tree ID No.: KY-T0437 Species: *Ficus microcarpa*

Height(m): 7 Crown Spread(m): 6 DBH(mm): 320

Observation:	☑ Dead branch/stub ☐ Dead trunk ☐ Broken branch/trunk ☐ Hanger ☐ Crack ☐ Leaning ☑ Overgrown branch ☐ Heavy lateral limb ☐ Others: ______
Pruning Objective:	☑ Regular maintenance ☑ Reduce failure risk/nuisance ☐ Enhance resistance to inclement weather ☐ Improve aesthetics and urban environment ☐ Others: ______
Mitigation Measure:	☐ Crown raising ☑ Crown reduction ☐ Crown thinning ☑ Crown cleaning ☐ Formative pruning ☐ Cabling ☐ Pest & disease control ☐ Others: ______
Pest & Disease:	☑ No ☐ Termite ☐ Brown root rot disease ☐ Others: ______

D. Pruning Work Information

Tree Part(s) to be Pruned:

☑ Crown: % of foliage: 20%

☐ Branch:

Quantity: ____ Fall distance(m): ____

Cut size(mm): ____ Length of tree part(m): ____

☐ Trunk:

Quantity: ____ Fall distance(m): ____

Cut size(mm): ____ Length of tree part(m): ____

☐ Others: ____

Equipment & Tools:

☐ Hand pruner ☐ Looper ☐ Extension pruner

☐ Hand saw ☑ Pole saw ☐ Chainsaw

☐ Tree climbing gear ☐ Elevated platform

☐ Others: ____

Photo record

Tree Part(s) to be Pruned:

☐ Crown: % of foliage: ____

☑ Branch:

Quantity: 1 Fall distance(m): 5

Cut size(mm): <100 Length of tree part(m): 0.5

☐ Trunk:

Quantity: ____ Fall distance(m): ____

Cut size(mm): ____ Length of tree part(m): ____

☐ Others: ____

Equipment & Tools:

☐ Hand pruner ☐ Looper ☐ Extension pruner

☐ Hand saw ☑ Pole saw ☐ Chainsaw

☐ Tree climbing gear ☐ Elevated platform

☐ Others: ____

Photo record

D. Pruning Works Information

Tree Part(s) to be Pruned:

☐ Crown: % of foliage: ____________

☑ Branch:

Quantity:	Fall distance(m):
3	5
Cut size(mm):	Length of tree part(m):
<100	0.5

☐ Trunk:

Quantity:	Fall distance(m):
Cut size(mm):	Length of tree part(m):

☐ Others:____________

Equipment & Tools:

☐ Hand pruner ☐ Looper ☐ Extension pruner

☐ Hand saw ☑ Pole saw ☐ Chainsaw

☐ Tree climbing gear ☐ Elevated platform

☐ Others: ____________

Photo record

E. Occupational Safety and Health (OSH)

Factors with Potential Risk:	Mitigation Measure:
☐ Work at height	☑ Personal protective equipment
☑ Overhead object	☑ First-aid kit
☑ Delivery of tree debris	☑ Appropriate clothing
☐ Traffic flow	☑ Appropriate and safe equipment and tools
☑ Use of equipment	☑ Directional/warning signage/notice
☐ Fire precaution	☑ Cordoning-off work site
☐ Heat related disorder	☑ Deploying staff to maintain traffic flow
☐ Application of chemical	☐ Temporary traffic arrangement
☐ Inclement weather	☐ Safe access/working platform
☐ Very hot weather	☑ Adequate cool drinking water
☐ Electrical hazards	☐ Temporary sunshade
☐ Wildlife and habitat	☐ Others:____________
☐ Others:____________	

F. Other Information

Wood Waste Disposal: ☑ Waste depot or landfill ☐ Retained on site ☐ Mulching ☐ Upcycling

Remarks: ____________

Appendix B. Adverse Effect of Pruning Malpractices

Pruning Malpractices	Possible Adverse Influences on Tree							
	Increase branch / tree failure potential	Health and growth rate decline	Disfigure tree form	Stimulate growth of water sprouts	Cause damage to branch collar or trunk tissue	Hard to complete compart-mentalisation	Become vulnerable to pests and diseases	Become vulnerable to sunburn
Topping	✘	✘	✘	✘		✘	✘	✘
Lion-tailing	✘	✘	✘	✘			✘	✘
Over-lifting	✘	✘	✘	✘			✘	✘
Flush cut	✘				✘	✘	✘	
Stub remaining	✘					✘	✘	
Large pruning wound	✘			✘	✘	✘	✘	
Bark tearing	✘				✘	✘	✘	
Jagged wound	✘			✘	✘	✘	✘	
Wound dressing		✘			✘	✘	✘	

✘ Possible adverse effect

APPENDIX 18 - Do's and Don'ts in Pruning (Factsheet)

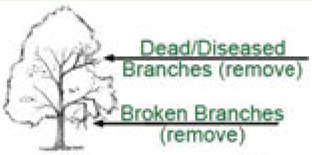
DO's and DON'Ts in Pruning

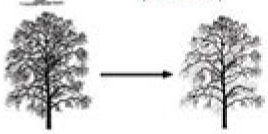
Introduction

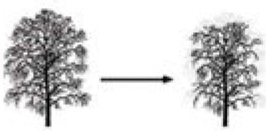
> *"Pruning is one of the best things an arborist can do for a tree but one of the worst things we can do to a tree"*
>
> *-Alex Shigo*

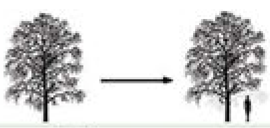
Pruning is the most common tree maintenance work. Proper pruning helps to selectively remove defective parts of a tree and improves the structure of a tree, thereby contributes to the overall tree health and structure and reduces the risk a tree may cause to nearby persons or properties. Improper ways of pruning, in particular topping, can be detrimental to the health and structure of a tree and make a tree hazardous, hence it is essential to establish clearly defined objectives before commencement of any pruning

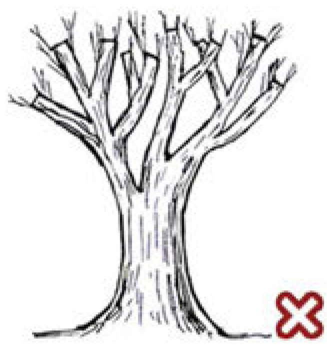
PROPER TREE PRUNING

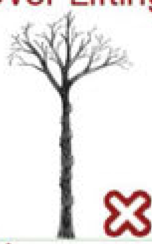
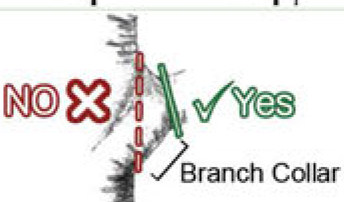
<table>
<tr><th></th><th>✓ DO's</th><th>✗ DON'Ts</th></tr>
<tr><td>Objective</td><td>• Prune as necessary.</td><td>• Do not prune excessively or unnecessarily.</td></tr>
<tr><td>Common Types of Pruning</td><td>
• Crown Cleaning


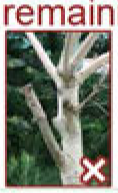
• Crown Thinning


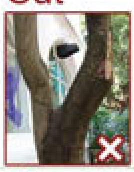
• Crown Reduction


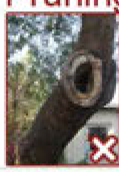
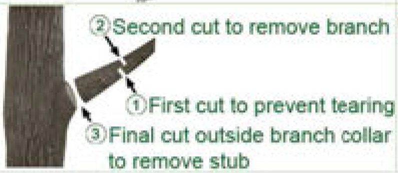
• Crown Raising

</td><td>
• Lion Tailing


• Topping


• Over Lifting

</td></tr>
<tr><td>Where to prune?</td><td>
• Edge of Branch Collar


</td><td>
• Stub remaining


• Flush Cut


• Large Pruning Cut

</td></tr>
<tr><td>How to make pruning cut?</td><td>
• 3-point Cut


</td><td>
• Jagged Wounds


• Bark Tearing

</td></tr>
</table>

How much to prune?

In general, pruning of large/mature trees should be avoided as far as practicable. No more than 25% of the live crown should be removed in any one year even for young trees.

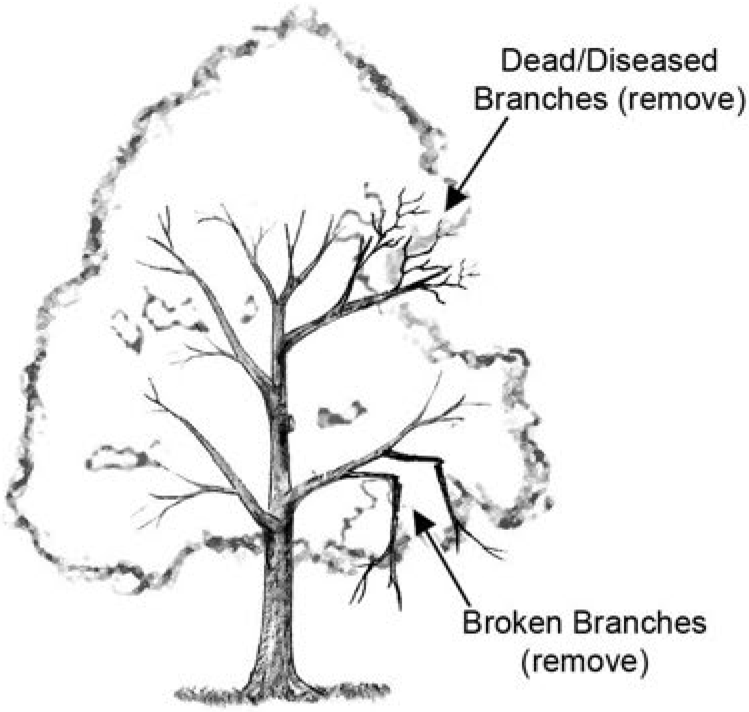
Common Types of Pruning

✓ Crown Cleaning

Definition: Crown cleaning consists of selective removal of dead, dying, diseased and weak branches from a tree's crown.

Objective: As a tree grows, defective branches and watersprouts are found in the tree's crown from time to time. If these are not removed in a timely manner, the condition may worsen and affect the overall health of the tree.

Do's: Crown cleaning can be undertaken any time to correct these small growth problems before they have a chance to become major problems.



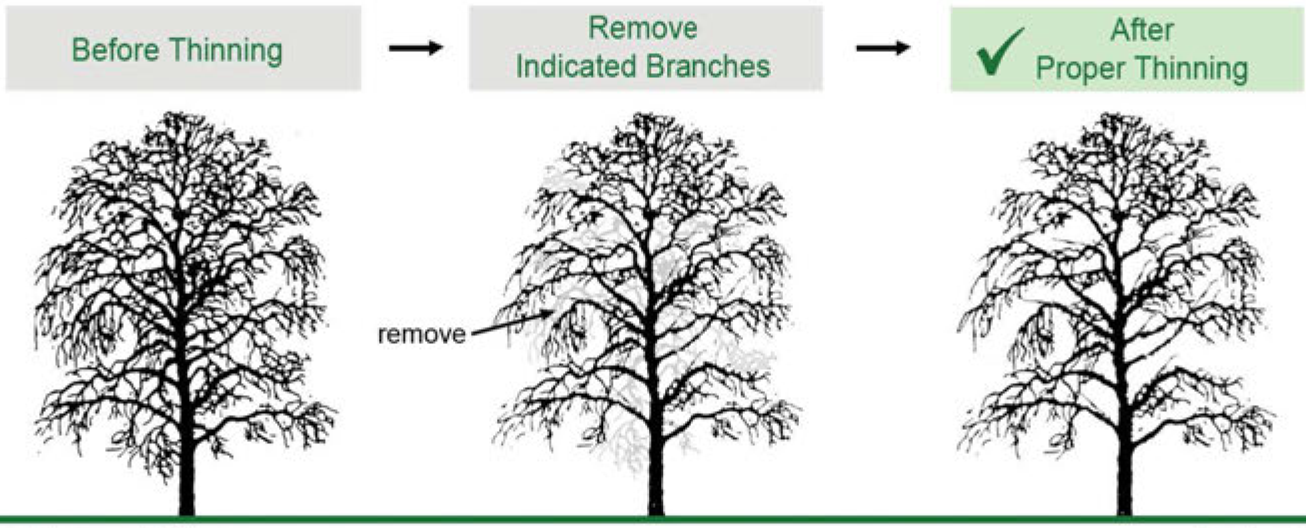
✓ Crown Thinning

Definition: Crown Thinning involves crown cleaning as well as the selective removal of small branches to reduce crown density.

Objective: To allow sunlight and air movement to penetrate to interior branches by developing a lighter and more open branch canopy.

Do's: Crown Thinning should be performed in a way to maintain an even distribution of branches and foliage, and care must be taken not to over-thin a tree. The extent of thinning in a year should be in the range of 10-15% of the live crown and should not exceed 25% in any case, especially for mature trees.

Don'ts: Clearing too much inner foliage will adversely affect the health of a tree. Vigorous production of watersprouts on interior limbs indicates over-thinning.



Common Types of Pruning

✓ Crown Reduction

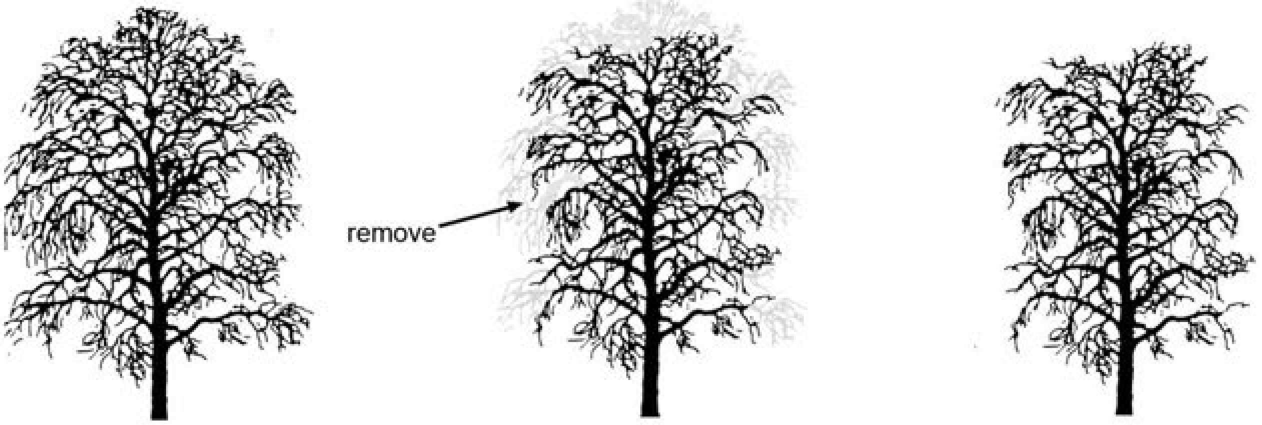
Definition: Crown reduction is the selective removal of branches and stems to reduce the height and/or spread of a tree.

Objective: This type of pruning should be done when there is a need to minimize risk of failure of a tree, or reduce interference onto nearby buildings or other structures.

Do's: Reduction shortens stems and branches back to live lateral branches.

Dont's: Reduction should be avoided for mature, old or stressed trees. In any case, no more than 25% of the foliage should be removed.

Before Reduction → Remove Indicated Branches → ✓ After Proper Reduction



✓ Crown Raising

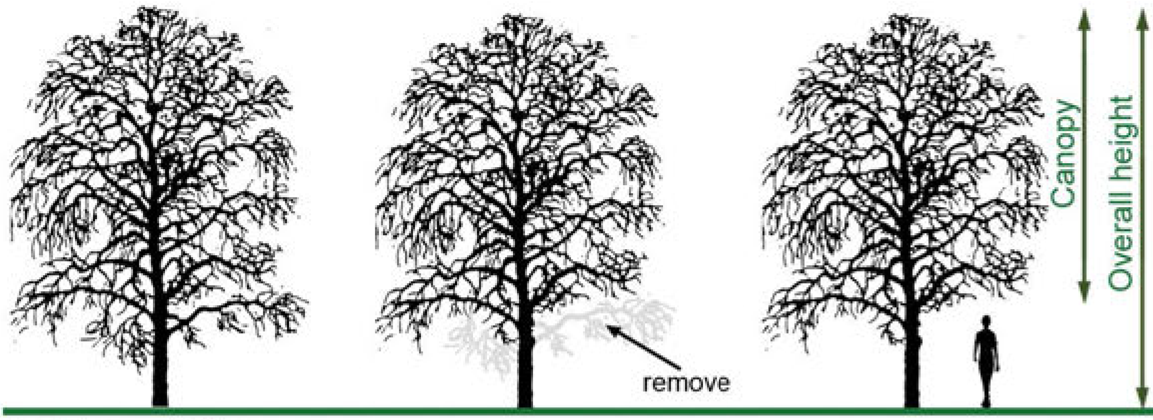
Definition: Crown Raising involves removal of lower branches of a tree.

Objective: To provide head height clearance for buildings, signs, vehicles, and pedestrians.

Do's: The resulting live crown ratio* should be more than 60%. Crown raising is best done gradually over a period of years.

Don'ts: Excessive removal of lower limbs should be avoided so that development of trunk taper is not affected.

Before Raising → Remove Indicated Branches → ✓ After Proper Raising



$$\frac{\text{Canopy}}{\text{Overall height}} = \text{Live Crown Ratio}^{*}$$

Where to prune?

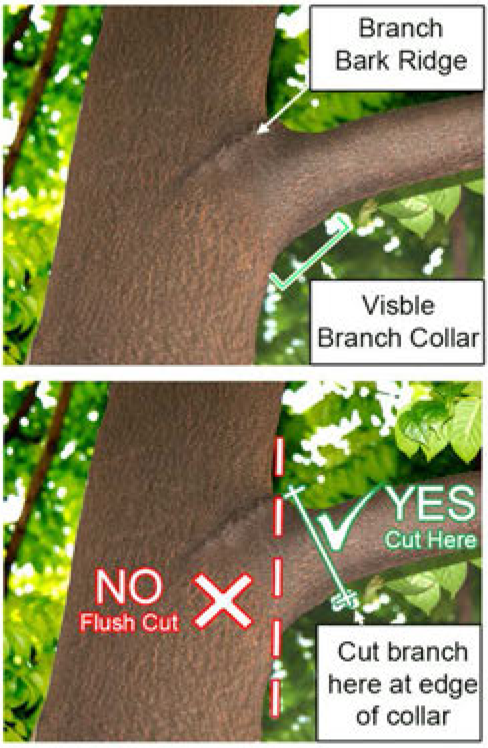
✓ Edge of the Branch Collar

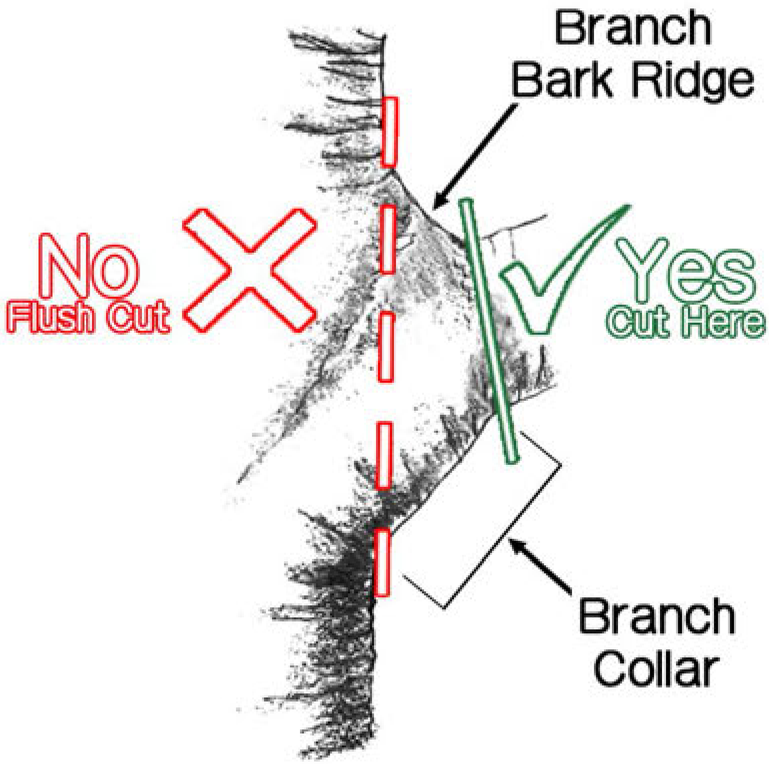
Scenario 1- when there is **visible** Branch Collar

At the base of a branch where it joins the trunk, a **branch collar** can often be seen as a distinct swelling on the bottom, sides, and top of the branch base.

Do's: When removing a branch, it is best to make the pruning cut as close to the trunk as possible but just outside the edge of the collar. This will leave the branch protection zone intact, and prevent any possible decay from spreading to the trunk.

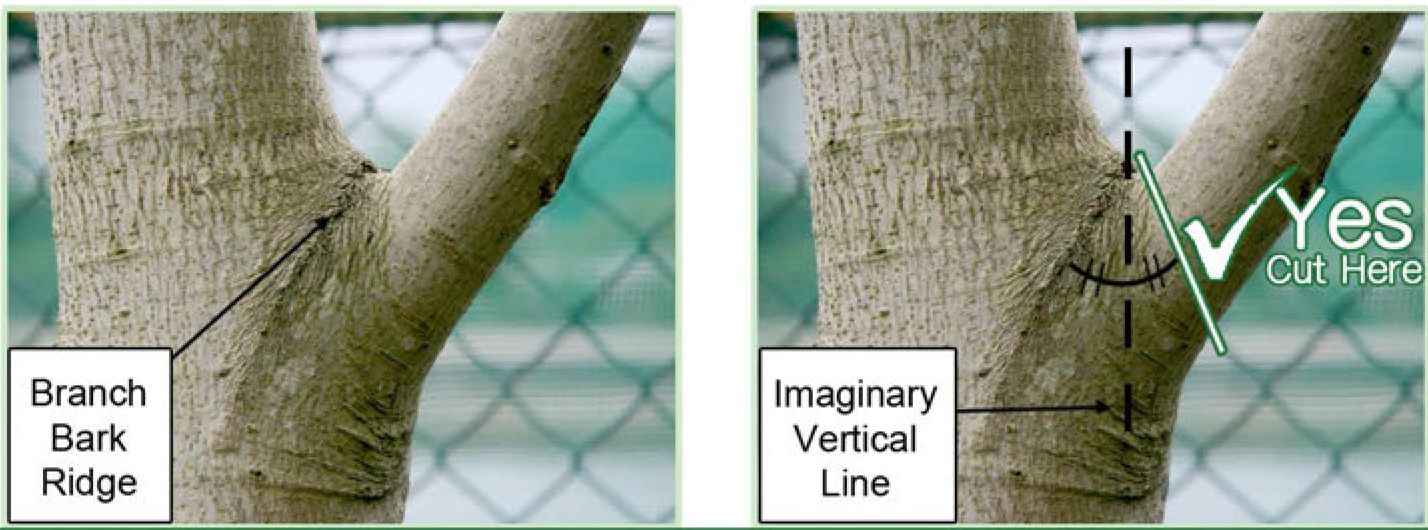
Dont's: Damage to the collar due to improper pruning may initiate decay in the trunk below the pruning wound.





Scenario 2- when there is **no visible** Branch Collar

Do's: Create an imaginary line parallel with the trunk when there is **no visible branch collar**. Duplicate the angle between the Branch Bark Ridge and the imaginary line to another side of the line. Execute the pruning cut from the top of the branch that shows an abrupt turn into the union.



✓ 3-point Cut

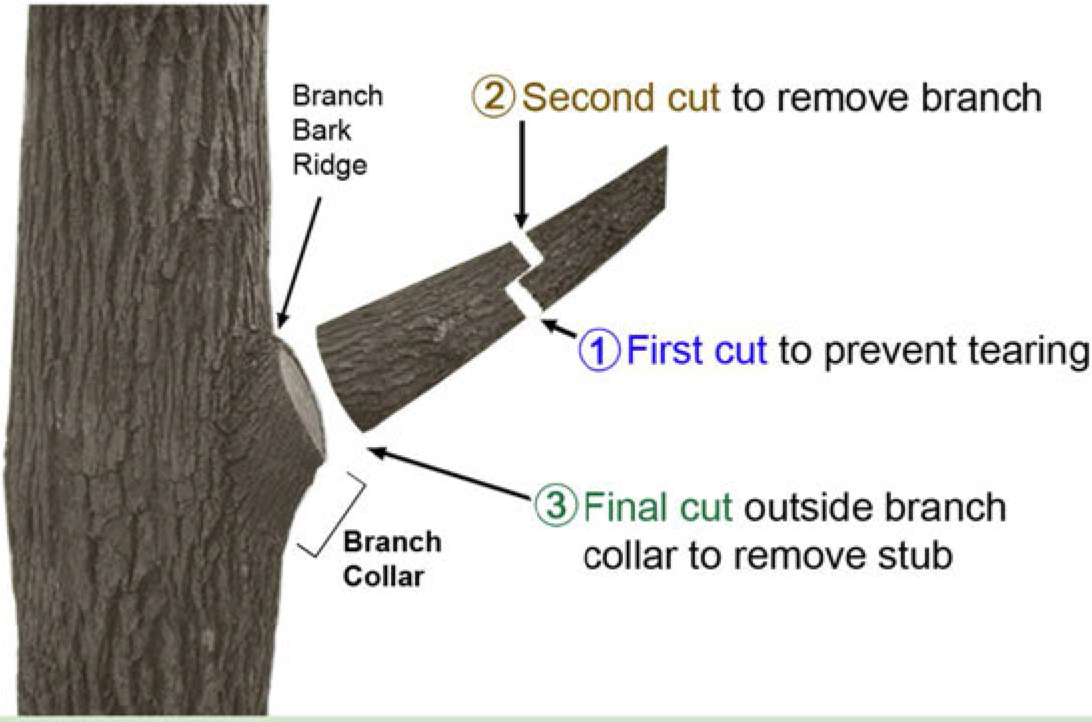
Objective: The most efficient and least damaging way to remove large branches without causing damage to the tree is adopting a 3-cut approach, by which a branch is removed by three sequential cuts.

Do's:

① The first cut undercuts the limb at some distance away from the parent branch or trunk. A properly made undercut eliminates the chance of bark tearing during removal of the limb.

② The second cut is a top cut undertaken slightly further out than the undercut which helps to remove the limb.

③ The final cut is performed just outside the branch collar to remove the resultant stub.



Good pruning cut will help tree to compartmentalize decay

Complete closing of wound after a few years

No Topping

1. Starvation:

- After topping, a large portion of the tree crown is removed.
- The removal of green foliage which is the source of food production will temporary cut off the food making ability.

2. Insects and Diseases:

- After topping, the large diameter and the terminal location of these cuts reduce the process of 'Compartmentalization Of Decay In Trees', i.e. the natural process of wound closure in trees.
- The tree becomes vulnerable to pests and diseases.

3. Weak Limbs:

- Extensive water sprouts will develop, giving rise to new limbs that are weakly attached.
- These weak attachments are prone to failure.

4. Ugliness:

- The tree form is heavily distorted. Even if the tree survives, it will never return to its original and natural form.
- The valuable landscape for the community is permanently lost.

5. Cost:

- The adverse impact on the tree may give rise to increased expenses in the long term, due to the replacement cost, the risk of liability from failure of weakened branches, and increased future maintenance.

Common Types of Improper Pruning

No Lion Tailing

Definition: If only the branches from the interior of the canopy are removed, too much weight at the ends of the branches would cause limbs to over-elongate, a situation known as lion-tailing.

Why Not: Lion-tailing may result in sunburn, watersprouts, reduced branch taper, weakened branch structure and breakage.

No Over-Lifting

Definition: A common malpractice on pruning a large tree or when performing crown raising is removing many or all interior low branches, giving rise to a situation known as over-lifting.

Why Not:

- Interior branches also provide food source needed by the tree to carry on normal defense and other functions.
- Health of the tree can be adversely affected with removal of excessive live tissues.
- A poor tree form with low live crown ratio is created.
- The tree will become more prone to failure.

Where to prune?

No Flush Cut

Definition: Cutting into the branch collar creates a flush cut.

Why Not: A pruning cut flush with the trunk will damage the branch collar and make a larger wound that opens the trunk to decay, causes cracks, and increases the likelihood of disease infection.

No Stub remaining

Definition: Pruning cut that is located far beyond the branch collar will leave behind a branch stub.

Why Not: The remaining stub is susceptible to wood-decaying organisms, especially while the cut is open to the air, before wound-wood completely closes over it. Decay beginning in stubs can break through the branch protection zone and move into the trunk, causing trunk rot and increasing the potential of branch/trunk failure.

No Large Pruning Cut

Why Not: Large pruning cut outside of branch collar exposes a large area of heartwood and creates a large wound that increases the likelihood of decay and disease infection.

How to make pruning cut?

No Bark Tearing

Why Not:

- Tree bark protects the inner bark that is responsible for bringing food produced by the leaves to the rest of the tree.
- When a pruning cut is improperly made resulting in bark tearing, the branch collar is damaged and this would impair the tree's ability to close wound and will lead to decay.

No Jagged Wounds

Do's:

- A clean cut during pruning is important.
- Pruning tools should be sharp so as to make clean cuts without jagged edges or stubs. Tools adequate for the size of cuts being made should be selected.

Why Not:

- Jagged wounds don't close well and may lead to more extensive decay, resulting in more broken limbs.
- Jagged wounds will interfere with the tree's ability to transport nutrients and therefore affect the overall tree health.

General Note

Please read in conjunction with 'Guidelines on Pruning' at
http://www.devb.gov.hk/greening/en/preservation/guidelines.pdf

References

Gilman, E. F., "An Illustrated Guide to Pruning", 2nd edition, Delmar Publishers, Albany NY, 2002

Gilman, E. F., Lilly S.J., "Best Management Practices- Tree Pruning", International Society of Arboriculture, US, 2002

Harris, R.W., Clark, J.R., & Matheny, N.P., "Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines", 4th edition, Prentice Hall, Upper Saddle River, NJ, 2004

Hazell, J., et al., "Guidance Note 8- Framework For Tree Work Contracts", The Arboricultural Association, UK, 2009

Tree Care Industry Association, "American National Standard for Tree Care Operations- Tree, Shrub, and Other Woody Plant Maintenance- Standard Practices (Pruning) (A300, Part1)", Tree Care Industry Association, Manchster, NH, 2007

APPENDIX 19 - Do’s and Don’ts in Pruning (Leaflet)

修剪樹木的對與錯 Do's and Don'ts in Pruning

目的 Objective

✓ 對 Do's

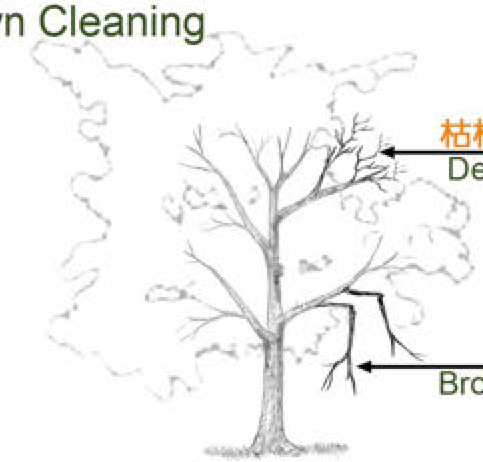
- 在展開修剪工作前，須清楚定下修剪的目的。
- 有需要時才修剪。
- **It is essential to establish clearly defined objectives before commencement of any pruning operation.**
- **Prune as necessary.**

✗ 不要 Don'ts

- 不要過度修剪；如非需要，不應修剪。
- 每年修剪幅度應盡量減低；並且應避免不必要地修剪成熟或衰老的樹木。
- **Do not prune excessively or unnecessarily.**
- **Keep annual pruning to the minimum and do not prune mature tree or over mature tree as far as practicable.**

常見的修剪 Common Types of Pruning

• 清理樹冠 Crown Cleaning



• 提升樹冠 Crown Raising

樹冠 Canopy / 總高度 Overall height = 樹冠比 Live Crown Ratio

清除較低的樹枝，藉此增加地面與枝葉的垂直距離，並須保留約60%的樹冠比

Remove lower branches to increase vertical clearance from ground level and keep a live crown ratio around 60%.

✗ 錯

• 獅尾式修剪 Lion Tailing

• 截頂 Topping

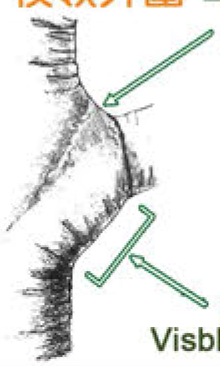
• 過度提升樹冠 Over Lifting

注意! Caution!

樹冠比太低
Live crown ratio is too low

應該在哪裡修剪？ Where to prune?

• 枝領外圍 Edge of Branch Collar



錯 ✗
不可平貼樹幹施鋸
No Flush Cut

✓ 對
在枝領邊緣下切口
Cut branch at edge of collar

注意! Caution!

切勿剪入樹枝的枝皮脊或枝領內
Do not cut into the Branch Bark Ridge or Branch Collar

• 留下枝柄 Stub remaining

• 過大的剪切口 Large Pruning Cut

• 平貼樹幹切割 Flush Cut

如何妥善地修剪樹木？ How to make pruning cut?

• 三刀法 3-point Cut

• 扯脫樹皮 Bark Tearing

• 鋸齒狀的傷口 Jagged Wounds

備忘 Note

請瀏覽 *http://www.devb.gov.hk/greening/tc/preservation/guidelines.pdf* 網址，與「修剪樹木的一般指引」一起參照。
Please read in conjunction with 'Guidelines on Pruning' at *http://www.devb.gov.hk/greening/en/preservation/guidelines.pdf*

參考資料 References

Gilman, E. F., "An Illustrated Guide to Pruning", 2nd edition, Delmar Publishers, Albany NY, 2002
Gilman, E. F., Lilly S.J., "Best Management Practices- Tree Pruning", International Society of Arboriculture, US, 2002
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Tree Care Industry Association, "American National Standard for Tree Care Operations- Tree, Shrub, and Other Woody Plant Maintenance- Standard Practices (Pruning) (A300, Part1)", Tree Care Industry Association, Manchster, NH, 2007

APPENDIX 20 - Manual on the Management of Brown Root Rot Disease

Manual on the Management of Brown Root Rot Disease

人樹共融
綠滿家園
PEOPLE • TREES • HARMONY

GREENING, LANDSCAPE AND TREE MANAGEMENT SECTION

DEVELOPMENT BUREAU

APRIL 2019

TABLE OF CONTENT

ANNEXES

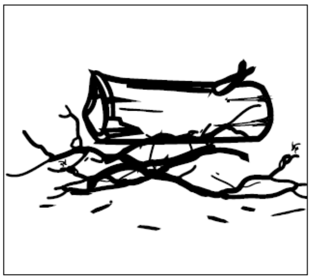
PART 1 - INTRODUCTION

1.1 BROWN ROOT ROT DISEASE (BRRD)

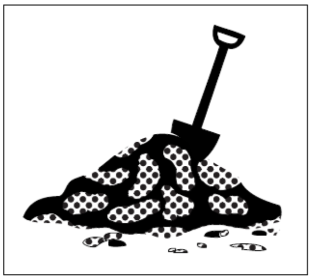
BRRD is caused by the aggressive fungal pathogen *Phellinus noxius*, a white rot fungus that could result in rapid health and structural deterioration of trees and may lead to tree failure.

It is an international disease prevalent in tropical and sub-tropical regions with no cure. There have been numerous claims of cures or effective management, but once the tree is infected, it cannot be cured. It can lead to swift deterioration in the health of a tree, causing eventual decay and irreversible structural damage to tree roots, posing a serious threat to public safety, and potentially spreading the disease to surrounding trees and vegetation.

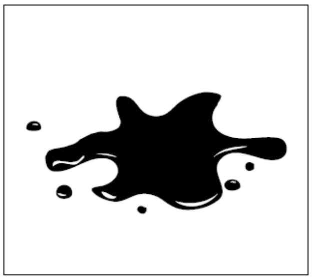
It can be spread through root contact, infected wood materials, contaminated soil, ground water, surface water, and even through the air by dissemination of basidiospores from fruiting bodies. The public shall stay away from known infected trees to avoid spreading of the disease via contaminated soil on shoes. Currently, BRRD has devastating impact on our landscape. Once a site is infected, it must be completely disinfected.



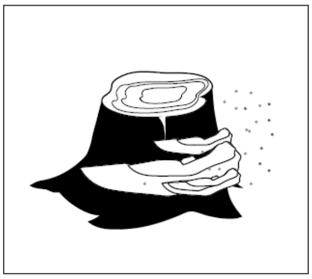
Infected wood material



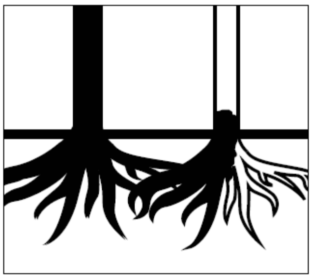
Contaminated soil



Contaminated water



Basidiospores from fruiting bodies



Root contact

1.2 PURPOSE OF THIS MANUAL

International best practice and policy position is to prevent the spread to other trees and vegetation and remove the infected material as soon as practicable, including the root system of the infected trees, and other plants and associated soil within the infection area.

This Manual provides the proper removal and follow-up requirements of BRRD infected tree. The steps are clearly illustrated for better understanding by operating personnel. The Manual includes:

- Key information about the identification of BRRD infected trees;
- Personal protection equipment (PPE) in handling infected trees; and
- Step-by-step guide in planning, site preparation, removal, site clearance and post-removal follow-up requirements.

1.3 HOW THIS MANUAL CAN HELP?

For Tree Inspection Officers and tree management personnel (Please observe Part 2 and Part 4)

- Understand the typical symptoms and signs of BRRD infected trees.
- Understand the procedure in referring suspected and confirmed BRRD infected cases to the Greening, Landscape and Tree Management Section (GLTMS) and the necessary follow-up actions (only for government departments and bureaux).
- Understand the importance of on-site supervision.

For Tree Work Supervisors, Tree Workers and tree management personnel (Please observe Part 3 and Part 4)

- Understand the proper procedures and requirements in the removal of BRRD infected trees.
- Understand the necessary follow-up requirements after the removal of infected trees.

1.4 MANUAL STRUCTURE

The Manual comprises the following four parts, together with a set of supplementary annexes.

- **Part 1 – INTRODUCTION**

  Introduce BRRD and the purpose and target users of the manual;

- **Part 2 – PREVENTION**

  Provide the information on the characteristics of typical symptoms and signs of a BRRD infected tree, to facilitate the identification of BRRD and prevent further spread of the disease;

- **Part 3 – CONTROL**

  Detail a step-by-step requirement for the removal and clearance of BRRD infected trees, to minimise the disease pathogen and control the spread;

- **Part 4 – IMPLEMENTATION**

  Emphasise the importance of on-site supervision, to implement proper practices in BRRD infected tree management; and

- **Part 5 – ENQUIRY AND REREFENCES**

  Provide a list of references to supplement the information in the above parts.

PART 2 - PREVENTION

2.1 IDENTIFICATION OF BRRD INFECTION

Identification of BRRD infected trees can be carried out through field diagnosis or laboratory diagnosis or the combination of the two.

2.1.1 Field Diagnosis

Precautionary measures should be taken during field diagnosis, e.g. wearing suitable footwear, proper disinfection of footwear, used tools and equipment.

Typical symptoms of BRRD infection that could be identified by visual assessment of the tree crown include:

- Sparse foliage density;
- Abnormal foliage colour;
- Abnormal leaf size; and
- Dieback twigs.

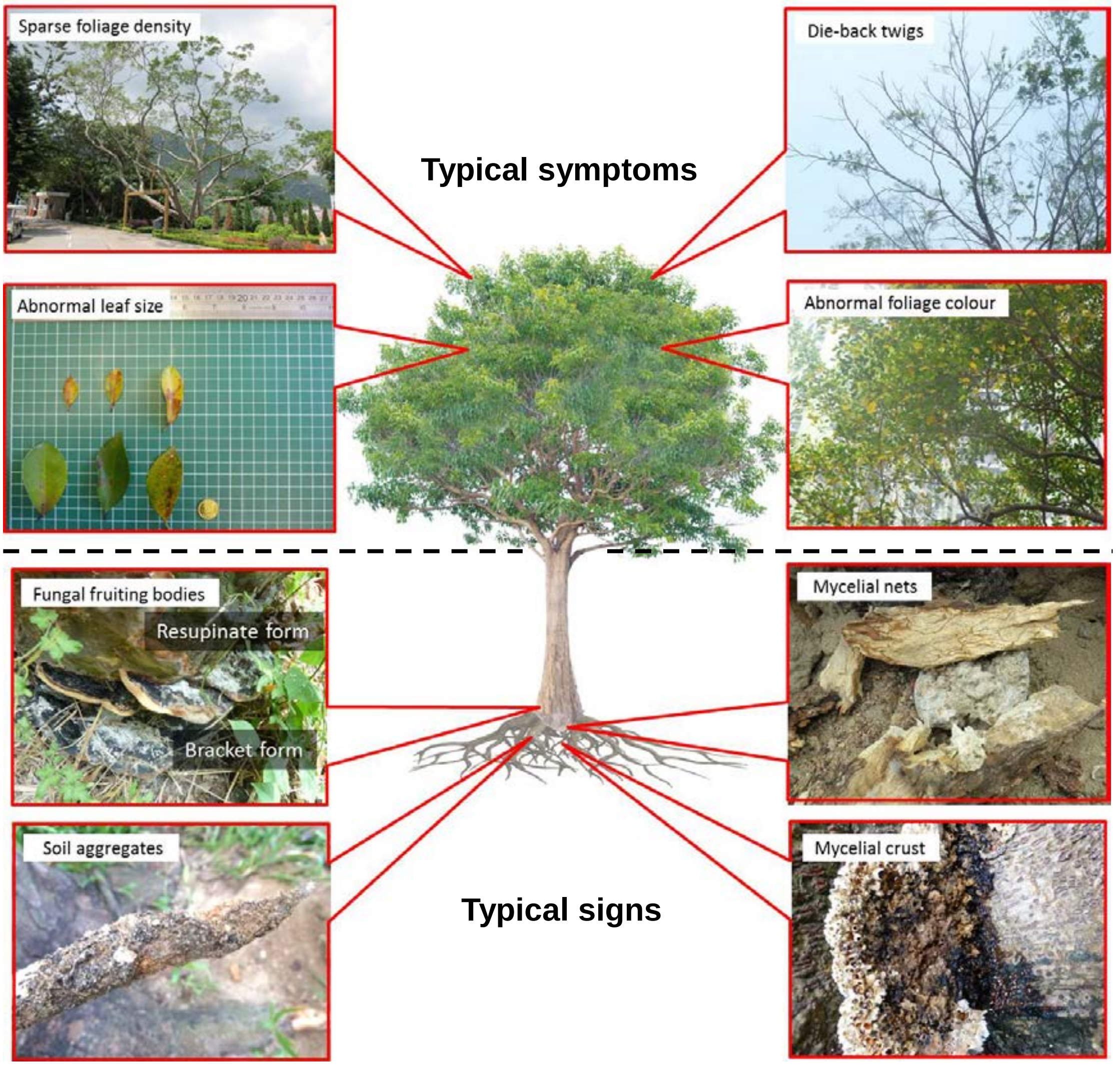
Trees having the above symptoms may NOT necessarily have BRRD infection. Further investigation on signs of infection is required.

Further detailed examination of the entire lower trunk, root collar and individual roots of the trees is also required to identify the BRRD signs. Root excavation and scraping off bark tissue with appropriate tools may be necessary to expose the roots and inner tissue for further examination of typical signs of BRRD infection which include:

- Fruiting bodies of *P. noxius*;
- Mycelial crust;
- Mycelial nets; and
- Soil aggregates.

Once the typical signs are observed on the trees, the infection is likely to be at advanced stage. PROMPT action shall be carried out to control the spread of disease.

However, unnecessary damage to healthy wood/roots should be avoided as this may create open wounds for fungal invasion. The use of mallets is recommended to differentiate healthy wood/roots from decayed, damaged or dead wood/roots



Annex A - Pictorial Guide for Identification of Brown Root Rot Disease Infected Trees

2.1.2 Laboratory Diagnosis

In certain situations or tree species, the symptoms and signs of BRRD infection may not be obvious and field diagnosis will not be effective enough to confirm the infection. Laboratory diagnosis can then be utilized to analyse samples from the trees with suspected BRRD infection. Samples could be cultured for fungal growth and subsequent molecular analysis through DNA sequencing or other techniques with equivalent analytical capacity to confirm the species of the fungi in the sample.

2.2 REPORTING AND CONFIRMATION OF BRRD INFECTED TREES

Suspected BRRD cases on government lands should be reported to departmental representative(s) for coordination of a departmental return to the Tree Management Office (TMO) of the GLTMS, Development Bureau (DEVB) for confirmation and record.

Please refer to **Annex B** for details of the referral mechanism and **Annex C** for the referral document:

Annex B - Procedures for Handling Suspected Brown Root Rot Disease (BRRD) Cases on Government Land

Annex C - Referral Form of Suspected Brown Root Rot Disease (BRRD) Case – from Departments

For guidance of further actions required after the referral of suspected BRRD cases to the TMO, please refer to **Annexes D to E**:

Annex D – Reply Slip for Referral of Suspected Brown Root Rot Disease (BRRD) Case - from TMO

Annex E - Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments

2.3 HANDLING OF BRRD INFECTED TREES

For non-Old and Valuable Trees (OVTs) confirmed with BRRD infection, tree removal should be arranged within 4 weeks. If tree removal cannot be completed within 4 weeks, departments have to take the below actions:

1) Appropriate temporary mitigation measures should be completed as far as practicable to ensure public safety;
2) Continuous monitoring with Form 2 assessment should be arranged every 3 months to monitor the tree condition until the removal of the tree; and
3) Tree information should be uploaded to the Tree Register.

For OVTs confirmed with BRRD infection, departments have to take the below actions:

1) Continuous monitoring with Form 2 assessment should be arranged every 3 months to monitor the tree condition until the removal of the tree;
2) Tree information should be uploaded to the Tree Register;
3) Appropriate mitigation measures should be completed within 6 weeks as far as practicable to ensure public safety;
4) Proper arrangement to control the spread of disease should be implemented; and
5) Warning signs should be installed to notify the public.

Please refer to **Annex F** for the template of warning sign for OVTs infected with BRRD infection:

Annex F - Template of Warning Sign for Brown Root Rot Disease Infected Old and Valuable Trees

PART 3 - CONTROL

Infected materials, including infected tree trunk and branches, stump, roots, soil and adjoining vegetation, shall be promptly removed as far as practicable to control the spread of disease. In certain circumstances, the surrounding hard landscape has to be removed in order to facilitate the removal of infected material.

3.1 PHASE 1 – PLANNING AND PREPARATION FOR TREE REMOVAL

Proper planning and preparation ensure smooth workflow, and occupational safety and health (OSH) throughout the removal operation. Appropriate tools and equipment for removal works, including those for follow-up actions for the site and surrounding area, must be available at the site to avoid accidental spread of infected material.

Phase 1 – Planning and Preparation for Tree Removal

Step 1 - Plan for tree removal

Step 2 - Plan for necessary temporary traffic arrangement (TTA)

Step 3 - Prepare appropriate tools and equipment

Step 4 - Conduct job briefing

Step 1	Plan for tree removal
1.1	Make reference to the prevailing technical circulars or guidelines in arranging tree removal application to relevant departments.
1.2	Ascertain the objectives and requirements of the operation which may include stump removal or follow-up actions for the site.
1.3	Determine appropriate follow-up action for the site after tree removal such as: a) In-situ soil fumigation; and b) Excavation and removal of contaminated soil and backfilling.
1.4	Prepare method statement after necessary pre-works site visit that encompasses all works including site preparation and removal operation, necessary OSH considerations, communication plan, emergency plan and follow-up actions.
1.5	Conduct necessary consultation with stakeholders that would be affected by the works and sensitivity analysis for OVTs and Stonewall Trees and trees with significant values.
1.6	Assign personnel for different tasks in the tree removal operation.

Step 2	**Plan for necessary temporary traffic arrangement (TTA)** *[Optional: Only when the removal operation will affect nearby traffic]*
2.1	Apply TTA with the Transport Department (TD). Proposal should be submitted to the TD in advance for necessary assessment.]
2.2	Prepare traffic management roster assigning different tasks to personnel involved in the TTA for the traffic management during the operation when necessary. Assistance for traffic control and comments on the TTA should be sought from the Hong Kong Police Force if necessary
2.3	Designate a safe path for pedestrians.

Step 3	**Prepare appropriate tools and equipment**
3.1	Appropriate tools and equipment include: • Shielding material for cordoning off the works area, if site conditions allow. The shielding material should meet the following criteria: - ≥2m in height; - Minimum 90% shade weave; - Light weight and easy to transport; - Closed-bottom; and - No holes, rips or tears. • Stakes, ties, cables and footings to anchor and stabilise the shielding materials. • Warning signage to be displayed at prominent locations. • Disinfection materials and equipment include but not limited to: - Disinfectant (e.g. 70% ethanol or 1:49 bleach solution);

	- Fungicides or soil fumigants* for site disinfection; - PPE for handling disinfectant and other chemicals; - Disinfection mats made of absorbents materials and not smaller than 60 cm x 90 cm in size or disinfection trays that are made of durable material and not be smaller than 30 cm (W) x 60 cm (L) X 5 cm (D); and - Application device for large area or vehicle/ machinery disinfection. • Tools and equipment, vehicles and machinery for tree removal and follow-up actions for the site and surrounding area. • Tools and equipment for emergency response and temporary traffic arrangement. • Landscape materials, including clean soil for necessary backfilling, and follow-up actions for the site and surrounding area. • Vehicles with sturdy cover for disposal of infected materials to landfill.
3.2	Countercheck with the checklist of tools and equipment to ensure necessary items will be available on site. Please refer **Annex G**.

* Active ingredients of fungicides and soil fumigants should include:

Fungicides -

- Propiconazole;
- Triadimefon;
- Chlorothalonil; or
- Iprodione.

Soil Fumigants -

- Dazomet

Annex G - Checklist for Tools and Equipment and Personal Protection Equipment in the Removal of Brown Root Rot Disease (BRRD) Infected Tree

Step 4	Conduct job briefing
4.1	Conduct job briefing before the operation by Tree Works Supervisor to ensure all personnel involved: • Be clear in their own duties and responsibility • Understand the appropriate workflow of the tree removal operation; • Understand specific hazards associated with the operation before it starts or while it is in progress, especially on the nature of BRRD; • Be attentive to what other personnel are doing, as unexpected actions can create new hazards; • Comply with existing statutory OSH requirements and relevant guidelines for the use of all tools and materials and chemicals during all work procedures; • Maintain a good communication during the operation; • Equip with necessary and appropriate PPE and use it according to instructions; and • Understand the emergence plan and response in case of accident.

3.2 PHASE 2 – SITE ARRANGEMENT

To ensure that the operation is effective in managing and minimising the spread of disease, proper site arrangement is important. It should also minimize the disturbance to general public and enable safe working environment of the personnel involved. Tree work supervisors should be involved since this phase.

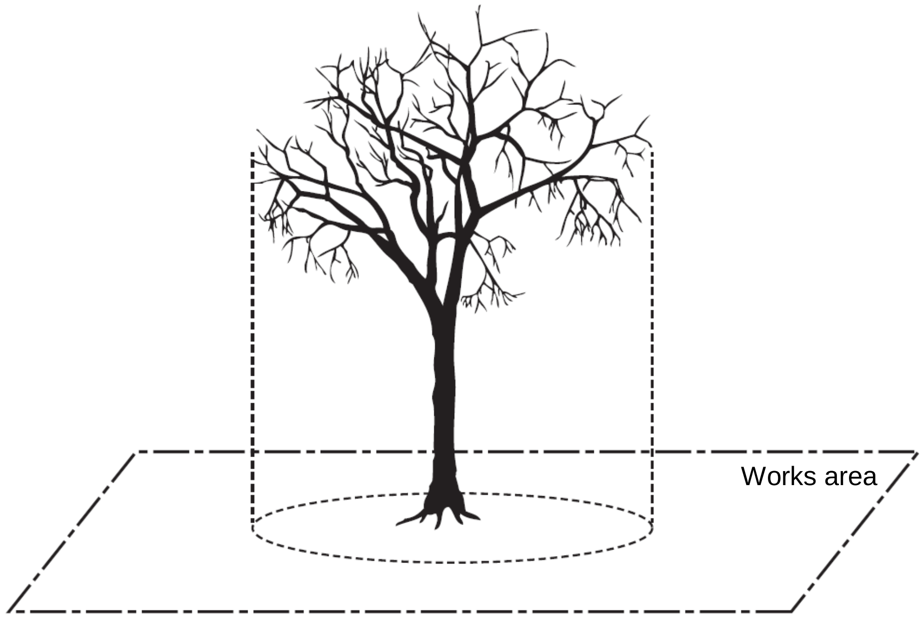
Phase 2 – Site Arrangement

Step 1 - Define Your Works Area

Step 2 - Display Proper Signage

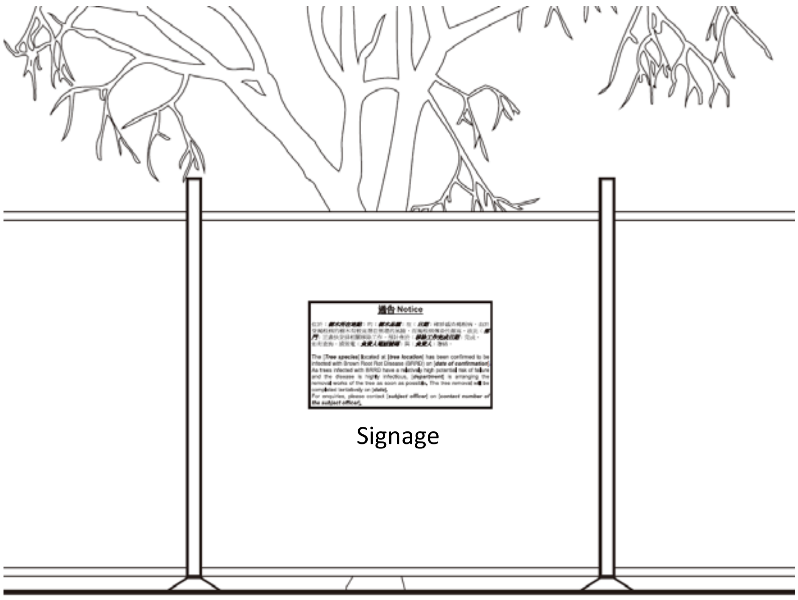
Step 3 - Prepare Your Works Area

Step 1	Define Your Works Area
1.1	Assess and determine the extent of works. This may include removal works of the infected tree; surrounding vegetation; soil and the entire root system, which will extend beyond the dripline.
1.2	Allow sufficient space to safely work within the works area. You may need to adjust the delineated works area during the operation to accommodate adjoining public uses if necessary. You may also need to stage your works according to the availability of space.
1.3	Include the temporary storage area for infected wood debris and soil and disinfection area for tools and footwear in the delineated works area.



Defining the works area

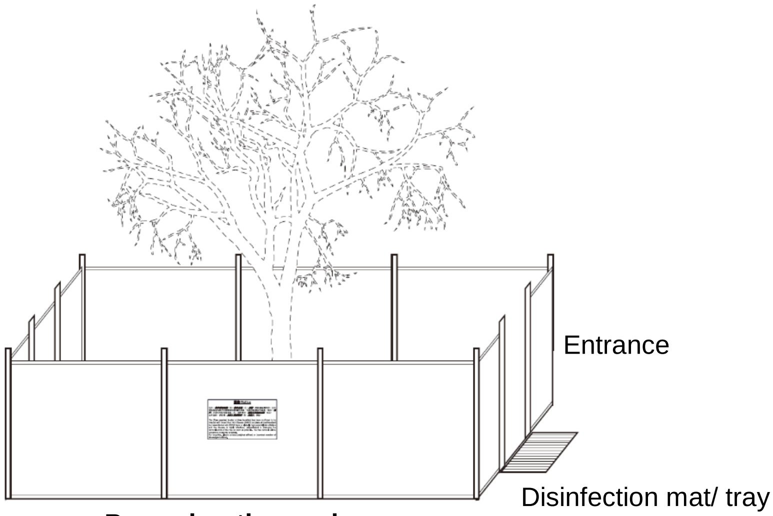
Step 2	**Display Proper Signage**
2.1	Install clear and proper warning signage with succinct messages at prominent locations nearby the delineated works area with information on: • Tree species; • Tree location; • Date of confirmation of BRRD infection; • Name of responsible department; • Tentative completion date of tree removal; and • Contact information.
2.2	Install appropriate signage to prohibit public access into the cordoned off areas and notify the public of the tree removal operation and the TTA, if any. Please refer to **Annex H** for the template of warning sign.



Displaying the proper signage

Annex H - Template of Warning Sign for Brown Root Rot Disease Infected Tree

Step 3	Prepare Your Works Area
3.1	Cordon off the delineated works area as described in **Step 1** in **Phase 2** with shielding materials and stakes mentioned in **Step 3** in **Phase 1** as far as practicable, if site condition allows.
3.2	Arrange proper entrance as decided in **Step 1** in **Phase 2**. All personnel should follow the designated entrance(s) in entering and exiting the works area.
3.3	Ensure the shielding material is tightly fixed, stable and secure at all time.
3.4	Place the disinfectant mat or tray at the designated entrance(s) of the works area designated in **Step 1** in **Phase 2**.
3.5	Apply the disinfectant to the disinfection mats and/or trays. If **disinfection mat** is used, soak the mat until it is saturated and disinfectant would be squeezed out when you lightly put your foot on it. If **disinfection tray** is used, fill the tray with disinfectant till it reaches a depth of not less than 3 cm.
3.6	Replenish with disinfectant when necessary.



Preparing the works area

3.3 PHASE 3 – REMOVAL PROCEDURES

Trees infected with BRRD and their surrounding area must be handled with great care. Understanding and following proper and well-planned removal procedure can minimize the spread of disease during the operation and at the same time uphold the OSH. The removed materials, especially tree stump and roots, should be handled and treated properly with great caution as the disease is highly infectious.

Phase 3 – Removal Procedures

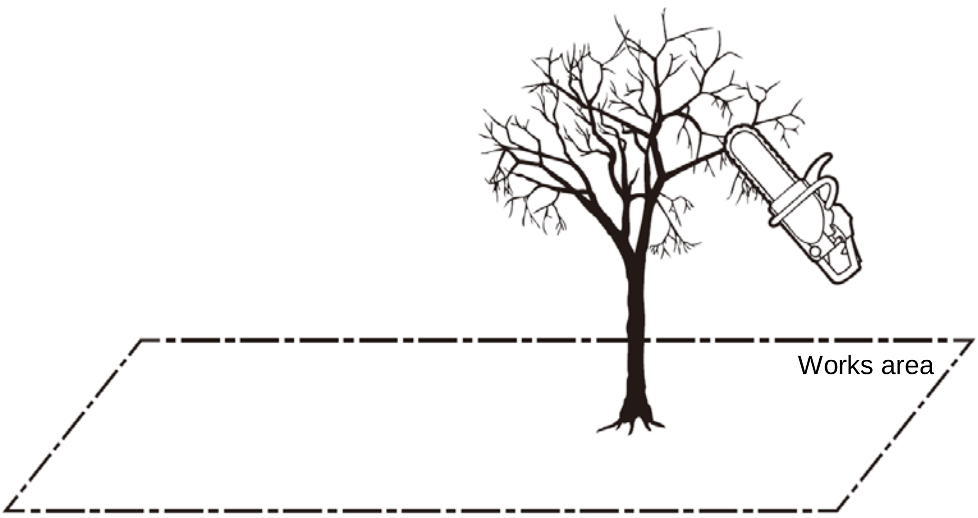
Step 1 - Remove and handle the tree branches and trunk

Step 2 - Remove and handle stump, roots and associated soil

Step 3 - Dispose of wood debris and removed soil

Step 4 - Manage used tools and equipment

Step 1	Remove and handle the tree branches and trunk
1.1	Remove vegetation (e.g. shrubs, perennials or herbs) within the infected area, i.e. area with reference to but not limited to dripline area of the infected tree.
1.2	Remove the tree branches and trunk with proper procedure and tools and equipment.
1.3	Keep all removed tree parts and vegetation within the delineated works area.
1.4	Apply disinfectant to the removed tree parts and vegetation thoroughly.



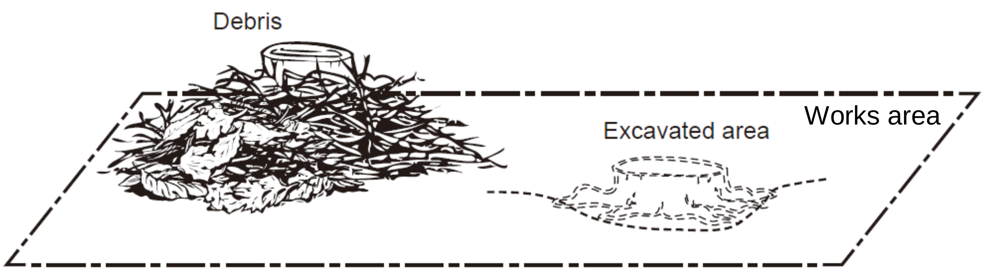
Removing the tree branches and trunk

Handling the removed tree branches and trunk

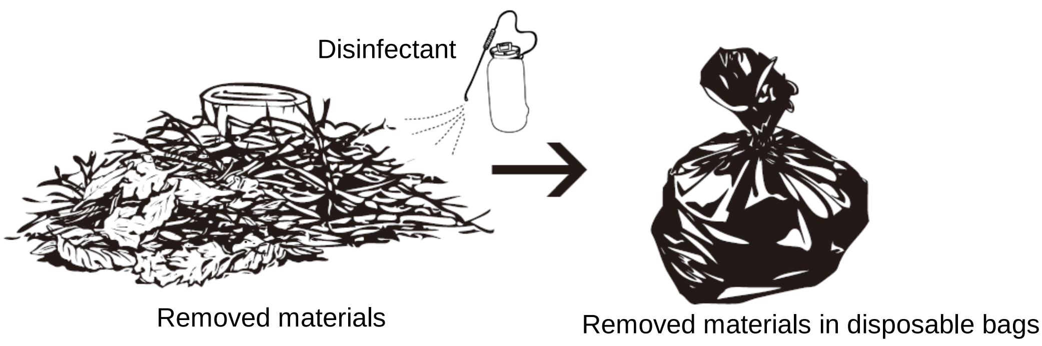
Step 2	Remove and handle stump, roots and associated soil
2.1	Remove tree stump and roots that are larger than 1cm in diameter within infected area or within physical boundary as much as practicable, if site condition allows.
2.2	Apply disinfectant to the removed stump and roots thoroughly.
2.3*	Excavate all soil to a depth of 1m within the infected area.
2.4*	Apply disinfectant to the removed soil thoroughly.
2.5#	Pack the removed materials, including removed tree parts and vegetation in **Step 1** in **Phase 3**, into durable and disposable bags.

** If it is decided in Step 1 in Phase 1 that the site will be followed up with soil removal, site disinfection and replacement with clean soil.*

 # If the infected materials, except soil medium, is too large to be packed, they shall be uploaded to suitable vehicles directly and the vehicles shall be disinfected thoroughly after the disposal of the infected materials.

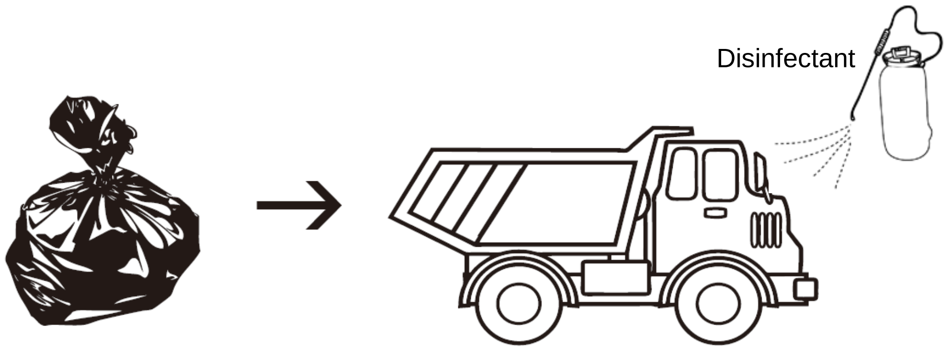


Removing and handling the stump, roots and associated soil



Handling the removed materials

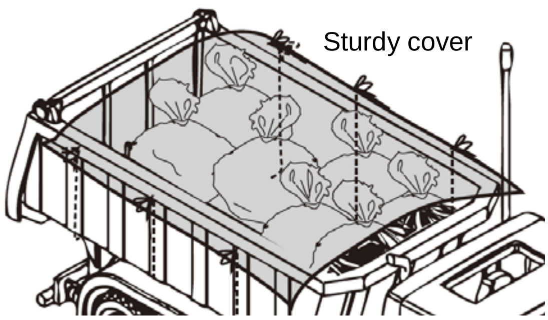
Step 3	Dispose of wood debris and removed soil
3.1	Upload all packed removed materials and other infected materials onto designated vehicle.
3.2	Apply disinfectant to the materials thoroughly.
3.3	Cover the materials properly with sturdy cover to avoid accidental spread of the materials during transportation.



Removed materials in disposable bags

Vehicle for transferring infected materials

Uploading and disinfecting the removed materials



Covering the removed materials with sturdy cover

Step 4	Manage used tools and equipment
4.1	Put all tools and equipment used in the tree removal operation at a designated zone inside the works area for disinfection at later stage.
4.2	Designate a proper location inside the works area for disinfection of vehicles and machinery, except the vehicle for disposal of infected materials.
4.3	Ensure all tools and equipment will not be taken out of the site before the completion of disinfection.

Managing used tools and equipment

3.4 PHASE 4 – DISINFECTION PROCEDURES

Proper disinfection procedures are required during and after tree removal operation to minimize the spread of disease. The disinfection procedures must be thorough and covered every element involved in the operation.

Phase 4 – Disinfection Procedures

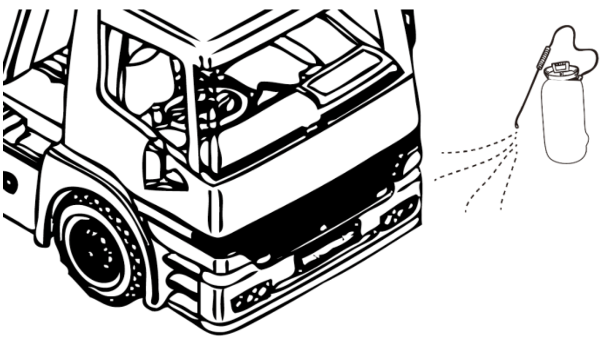
Step 1 - Disinfect the vehicle for disposal of infected materials

Step 2 - Disinfect used tools and equipment

Step 3 - Disinfect works area

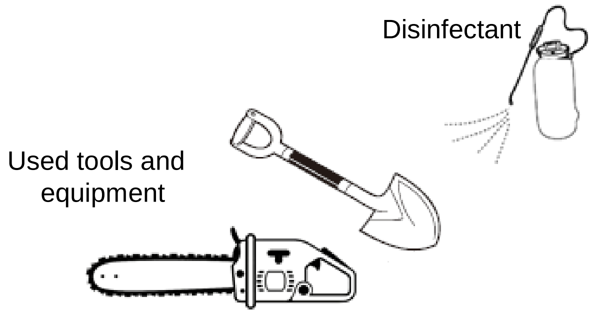
Step 4 - Disinfect hands and footwear

Step 1	Disinfect the vehicle for disposal of infected materials
1.1	Before leaving the works area (if the vehicle has entered the works area): • Wash away the soil and infected material on the tyres as far as practicable; and • Apply appropriate disinfectant thoroughly to the vehicle, especially the tyres. * Clean the tyres in trenches with disinfectant if site condition allows.
1.2	When leaving the landfill site: • Apply appropriate disinfectant thoroughly to the vehicle after the disposal of all infected materials, especially the container of the vehicle.
1.3	For other vehicles and machinery: • Wash away the soil and infected material on the tyres as far as practicable; and • Apply disinfectant thoroughly to the vehicles and machinery, especially the tyres. * Clean the tyres in trenches with disinfectant if possible.



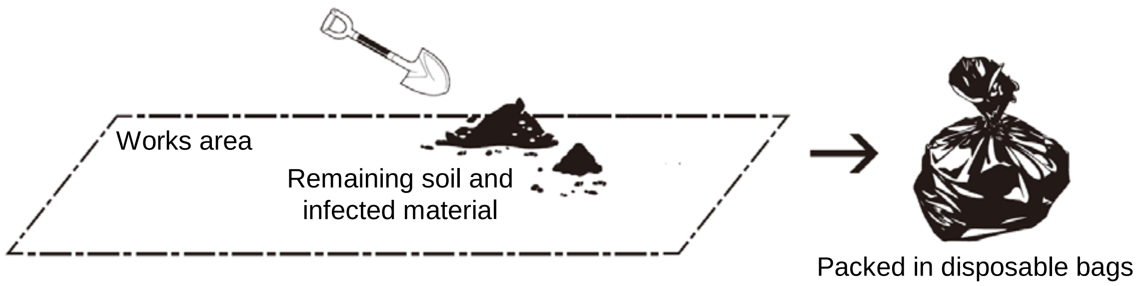
Washing soil away from the tyres and disinfecting the vehicle

Step 2	Disinfect used tools and equipment
2.1	Disinfect all tools, equipment and PPE used in the tree removal operation thoroughly, and ensure they will not be taken out of the works area before the completion of disinfection.

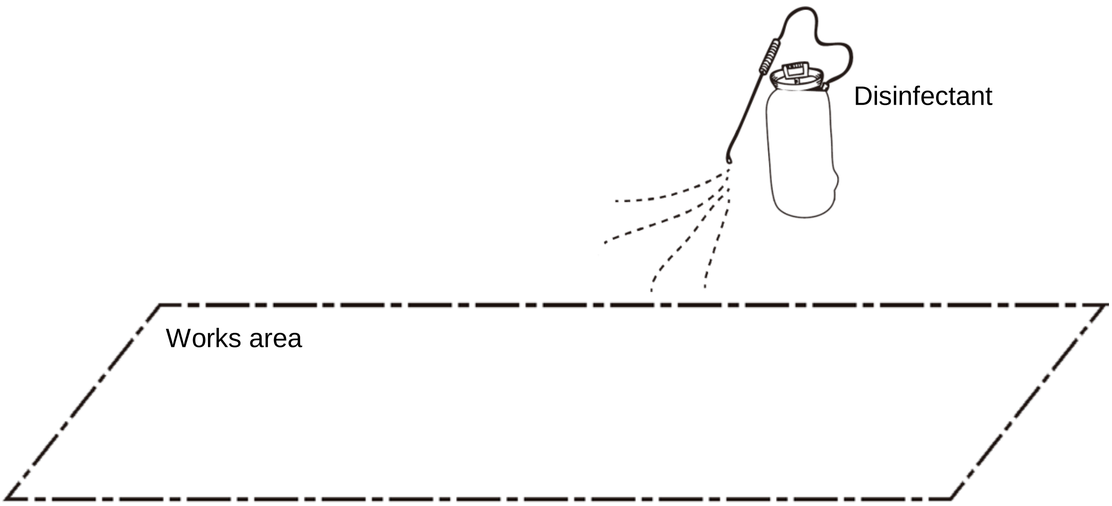


Disinfecting used tools and equipment

Step 3	Disinfect works area
3.1	Remove and clean up all soil and infected material in the works area as far as practicable, and treat and dispose it as infected wood debris following **Steps 2.5 to 3.3** in **Phase 3**.
3.2	Disinfect the whole delineated works area with disinfectant thoroughly.

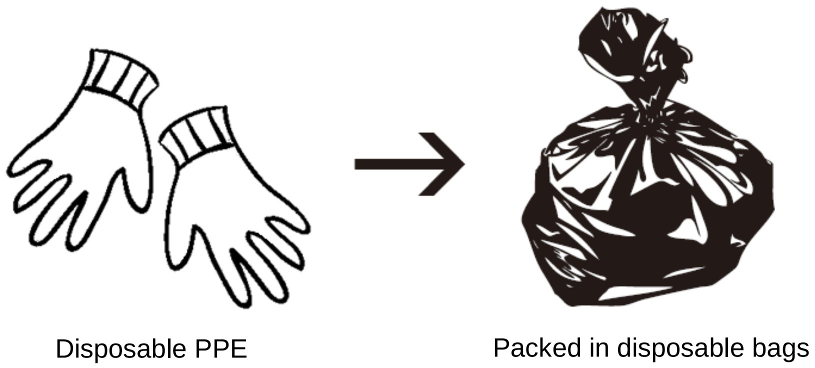


Cleaning up the works area

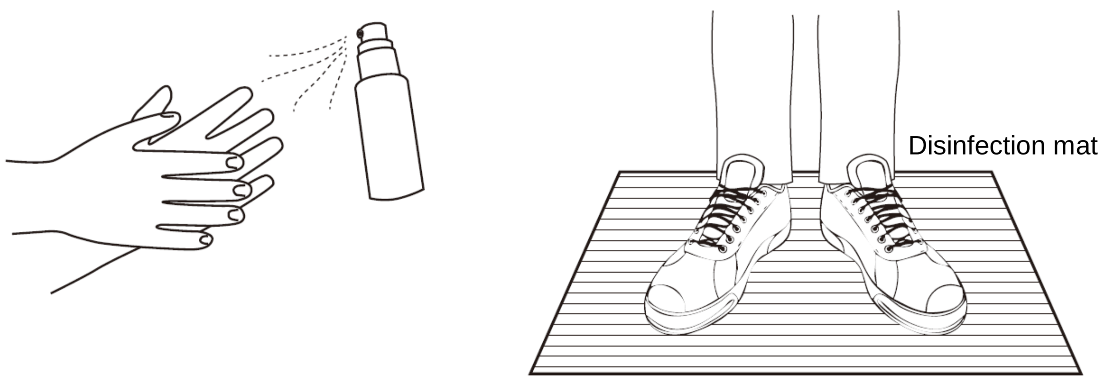


Disinfecting the whole works area

Step 4	Disinfect hands and footwear
4.1	Dispose of disposable PPE following **Steps 2.5 to 3.3** in **Phase 3**.
4.2	Disinfect hands and footwear at the end of the operation. * During the operation, any personnel exiting the works area shall have their footwear disinfected thoroughly on the disinfection mat/ tray at the entrance.



Disposing disposable PPE



Disinfecting hands and footwear

3.5 PHASE 5 – FOLLOW-UP ACTIONS

After tree removal, proper follow-up actions are required. In addition, trees in vicinity must be carefully monitored to eradicate any possible source of BRRD in the area.

Phase 5 – Follow-up Actions

Step 1 - Manage infected site

Step 2 - Report tree removal operation

Step 3 - Monitor the trees in vicinity

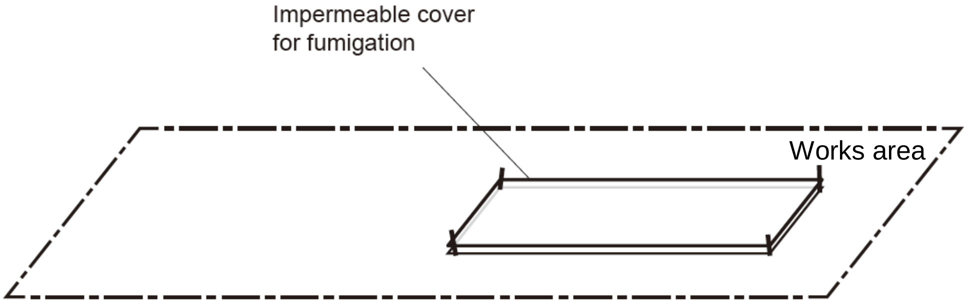
Step 1 - Manage infected site

After the removal operation, where site condition allows, the infected site should be managed with the following options of post-removal measures:

Option A

Conduct in-situ soil fumigation* following the instruction mentioned on the application manual of the fumigant. The area of fumigation should at least cover the infected area; and

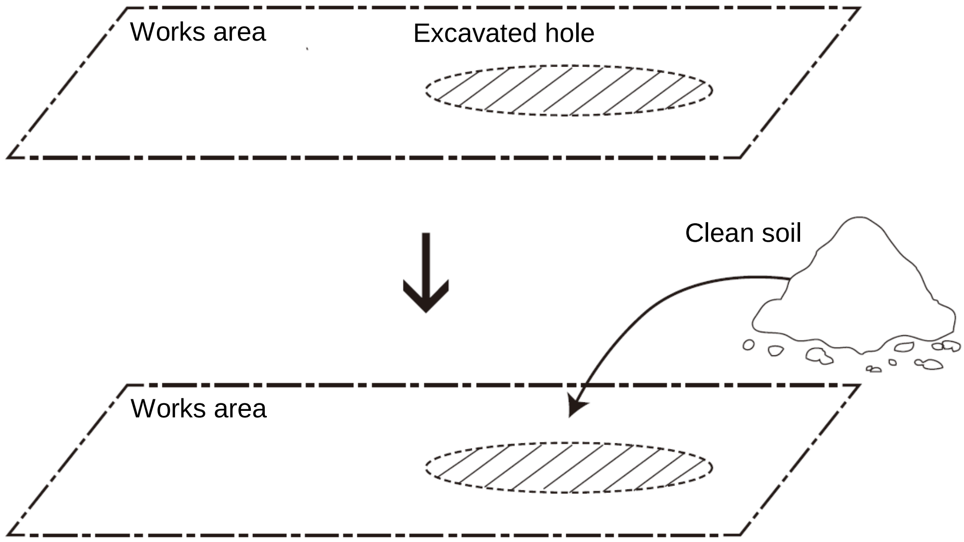
* *Toxic gas may be produced during the process of fumigation. Please implement necessary precautionary measures.*



Conducting in-situ soil fumigation

Option B

Excavate all soil to a depth of 1m within the infected area and refill with clean soil. The excavated soil shall be properly treated and disposed of following **Steps 2.5 to 3.3** in **Phase 3**. If the tree stump and its associated soil are located on a slope, please consult geotechnical engineer before the stump and soil removal.



Conducting soil excavation and refilling of clean soil

Replanting of trees is not recommended unless the site is proven to be rid of disease pathogen to avoid possible reoccurrence of BRRD.

Advice from geotechnical engineer should be sought in order to assess the feasibility and the implementation of Option B. For complicated cases, advice from the GLTMS may be sought.

Step 2	Report tree removal operation
2.1	Take photo record for the tree removal, site follow-up actions and disinfection of tools and equipment, vehicles and machinery.
2.2	Provide the information and photo record by filling in **Annex E** - “Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments” to report completion of all operation procedures to GLTMS.

Annex E - Reply Slip for Completion of Tree Removal Works of Brown Root Rot Disease (BRRD) Case – from Departments

Step 3	Monitor the trees in vicinity
3.1	Monitor the condition of the trees in vicinity, especially trees growing in the same planter, on the same slope or with roots possibly interwined with the root system of the removed infected tree.
3.2	Observe and look for typical symptoms or signs of BRRD infection on trees in vicinity, especially during wet season.
3.3	Report suspected cases of infection to GLTMS.

PART 4 - IMPLEMENTATION

4.1 CONTRACT MANAGEMENT

Appropriate provisions for handling of BRRD infected trees should be incorporated into relevant vegetation maintenance contracts. The relevant information should include but not limited to the following:

- Method statement;
- Personnel qualification and requirements; and
- Supervision and checking mechanism.

4.1.1 Method Statement

A clear method statement is important to ensure the proper handling of BRRD infected trees. Tree management departments or tree owners shall encompass the steps in the removal of BRRD infected materials as mentioned in the **Part 2** of this manual in their contract.

Nº	**Checklist: Method Statement**	
1	Planning and Preparation for Tree Removal	☐
2	Site Arrangement	☐
3	Removal Procedures	☐
4	Disinfection Procedures	☐
5	Follow-up Actions	☐

Annex I - Sample Method Statement on Removal of Brown Root Rot Disease Infected Tree

4.1.2 Personnel Qualification and Requirements

Removal of BRRD infected tree involves arboricultural knowledge, understanding of the disease and OSH, which require professional input. Tree management departments or tree owners shall engage qualified personnel, including tree inspection officers, tree work supervisors and tree workers, to advise, supervise and handle all matters in relation to tree works.

4.2 ON-SITE SUPERVISION AND CHECKING MECHANISM

Stringent supervision and checking mechanism should be implemented when any tree work on BRRD infected trees are carried out to ensure due compliance of:

- Government policy;
- Procedural requirements; and
- Contract specifications.

№	Checklist: Supervision and Checking (Before Work Starts)
1	Prepare appropriate tools and equipment ☐
2	Conduct job briefing ☐
3	Define Your Works Area ☐
4	Display Proper Signage ☐
5	Prepare Your Works Area ☐

№	Checklist: Supervision and Checking (During Work)	
1	Remove and handle the above-ground part	☐
2	Remove and handle stump, roots and associated soil	☐
3	Dispose of wood debris and remove soil	☐
4	Manage used tools and equipment	☐
5	Disinfect the vehicle for disposal of infected materials	☐
6	Disinfect used tools and equipment	☐
7	Disinfect works area	☐
8	Manage infected site	☐
9	Record the tree removal operation properly	☐
10	Report tree removal operation	☐

PART 5 – ENQUIRY AND REFERENCES

5.1 ENQUIRY

Any further enquiry on this manual or related issues should be addressed to:

AS(TM)2

Greening, Landscape and Tree Management Section

Development Bureau, 16/F, West Wing

Central Government Offices

2 Tim Mei Avenue, Tamar, Hong Kong

5.2 REFERENCES

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▪ *Phellinus noxius*. Distribution map of plant diseases. 1980. CAB International. April (edition 4). Map 104.

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APPENDIX 21 - Note on Common Wood Decay Fungi on Urban Trees of Hong Kong

Note on Common Wood Decay Fungi on Urban Trees of Hong Kong

Greening, Landscape and Tree Management Section
Development Bureau
The Government of the Hong Kong Special Administrative Region

May 2015

CONTENT

1. INTRODUCTION

Wood decay is predominantly driven by wood decay fungi that possess a whole array of enzymes for impairing the structural strength and physiological function of living trees. In this regard, the Tree Management Office (TMO) has produced and compiled this note (with photographic illustrations) on 12 common wood decay fungi that occur on the urban trees of Hong Kong. Detailed information about the individual fungal species is based on a previous consultancy study commissioned by the TMO on the “Occurrence and Distribution of Common Wood Decay Fungi on Trees of Hong Kong” undertaken by the University of Hong Kong from late 2011 to early 2014. The study involved a territory-wide baseline survey in some of the populated areas of Hong Kong and collected information on the distribution and occurrences of local wood decay (saprotrophic and pathogenic) fungi. This study is also aimed to enhance our understanding of the arboricultural significance of certain fungal decay on urban trees.

Any further enquiries on this note or related issues should be directed to:

Tree Management Office
Development Bureau
16/F, West Wing, Central Government Offices
2 Tim Mei Avenue, Tamar
Hong Kong
Email : gltms@devb.gov.hk
Tel : 2848 2334

2. PURPOSE OF THIS NOTE

This note aims to provide the government departments and other arboricultural practitioners a quick and illustrative reference for the identification of common wood decay fungi associated with living trees to facilitate early identification of problems during the Tree Risk Assessment* process and/or other routine tree inspection.

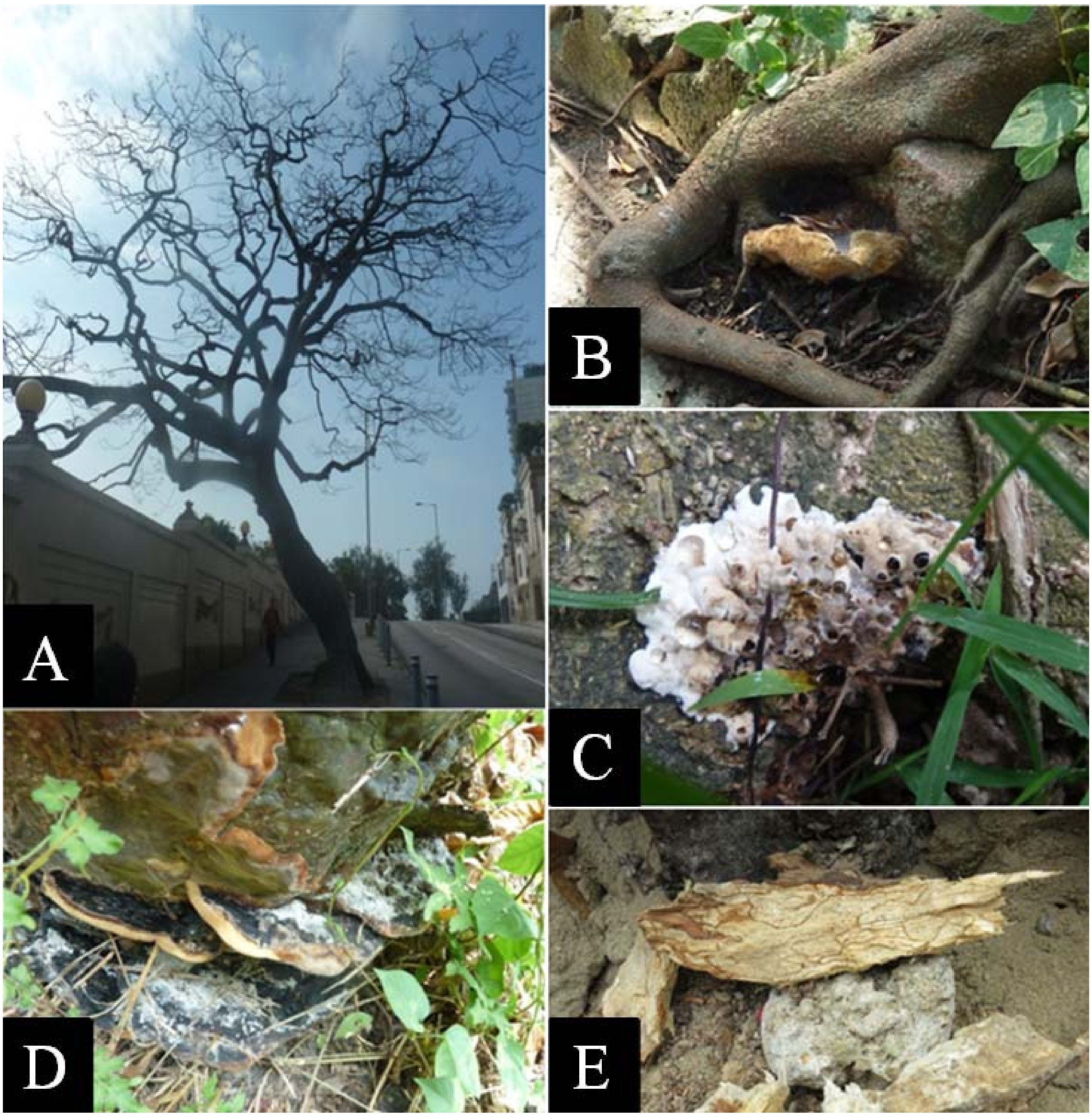
To facilitate users' application of this note, the 12 wood decay fungi have been categorised in terms of their arboricultural significance particularly the potential risks of tree failure that they may cause. Four risk categories, each of which has been assigned a specific colour code (RED, ORANGE, YELLOW or GREEN in descending order of risk) have been established taking into account the information about their pathogenicity, virulence, local occurrence, impact arising from their infection on the prognosis of the health and stability of the infected trees. Recommendations on the management of trees infected with each species are also provided. As a general rule, trees infected with wood decay fungi in the RED category should be urgently attended to while those in the GREEN category could be kept under monitoring in view of their limited impact to the trees but their presence indicate the presence of dead/ decaying wood.

Nevertheless, it should be borne in mind that the presence of particular wood decay fungi is only one of the many factors that have to be considered when evaluating the potential risk of tree failure in the urban settings. Other factors that may affect the health/structural conditions of the trees under inspection should also be taken into account when formulating mitigation measures.

* Please refer to the 'Guidelines for Tree Risk Assessment and Management Arrangement on an Area Basis and on a Tree Basis' issued by the Greening, Landscape and Tree Management Section, Development Bureau, available at www.trees.gov.hk.

3. COMMON WOOD DECAY FUNGI

Phellinus noxius[1]



(A) *Delonix regia* infected by *Phellinus noxius* resulting in abnormal defoliation. (B) Mature fruiting body of *P. noxius* on the root of a *Ficus microcarpa*. (C) Primordial stage fruiting bodies of *P. noxius* on *Celtis sinensis* (with white margin and droplets of exudates). (D) Mature fruiting bodies of *P. noxius* on a dead tree stump. (E) Mycelial nets on dead stump of *Aleurites moluccana*.

[1] *Phellinus noxius* (Corner) G. Cunn., Bulletin of the New Zealand Department of Industrial Research 164: 221 (1965).

FRUITING BODY

Mature fruiting bodies perennial, usually from about 3 × 4 cm to 10 × 20 cm up to 40 × 75 cm, mostly solitary, sessile; pilei applanate, dimidiate or appressed-reflexed, surface dark brown to almost black, glabrous, and narrowly but irregularly zonate, margin white then concolourous, obtuse; pore surface grayish brown to brown, irregular, polygonal, tubes in one to four layers, 1-3 mm long, similar in colour to the pore surface, tubes contrasted sharply with the deep chocolate brown of the context; spores 3-3.5 μm × 3.5-4.5 μm, broadly ellipsoid, smooth, thick-walled, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is prevalent in tropical and subtropical regions in different parts of the world and has been found in Asian countries and areas such as Japan, China, Hong Kong Special Administrative Region (SAR), Macau SAR, Taiwan, Malaysia, Singapore as well as Central America, Africa and Oceania.

Over 200 plant species in 59 families are known hosts to *P. noxius* worldwide. Locally, host trees species include *Acacia confusa*, *Aleurities moluccana*, *Bauhinia* spp., *Bombax ceiba*, *Celtis sinensis*, *Delonix regia*, *Ficus microcarpa*, *Ficus benjamina*, *Ficus elastica*, *Gleditsia fera*, and *Melia azedarach* etc. that grow on artificially created or disturbed sites along roadsides, on artificial slopes and in parks.

SIGNS AND SYMPTOMS

This fungus causes the Brown Root Rot (BRR) disease on trees. Infected trees would become structurally unstable and symptoms of the disease may emerge progressively through gradual thinning out of the crown, yellowing of the leaves, reduction in leaf size or shedding of leaves as a result of impaired water transportation function of the vascular system. Infected trees could die in a few months' time but may survive another one to two years. Some infected trees would suffer quick decline in conditions and wilt rapidly. Their leaves would turn brown in colour and the trees could die within weeks, with wilted leaves of the dead trees remaining attached on the branches for months. The typical signs of BRR disease include fruiting bodies (i.e. primordial/mature stages), mycelial encrustation, soil aggregates and mycelial nets.

PATHOLOGY

P. noxius is a pathogenic fungus with strong virulence causing a white simultaneous rot usually on the roots and root collars of infected trees but could occasionally observed on locations higher up on trees. Wounds are not prerequisite for infection for this fungus as it can actively infect living trees. Infection could be by means of root to root contact and by dissemination of basidiospores from mature fruiting bodies.

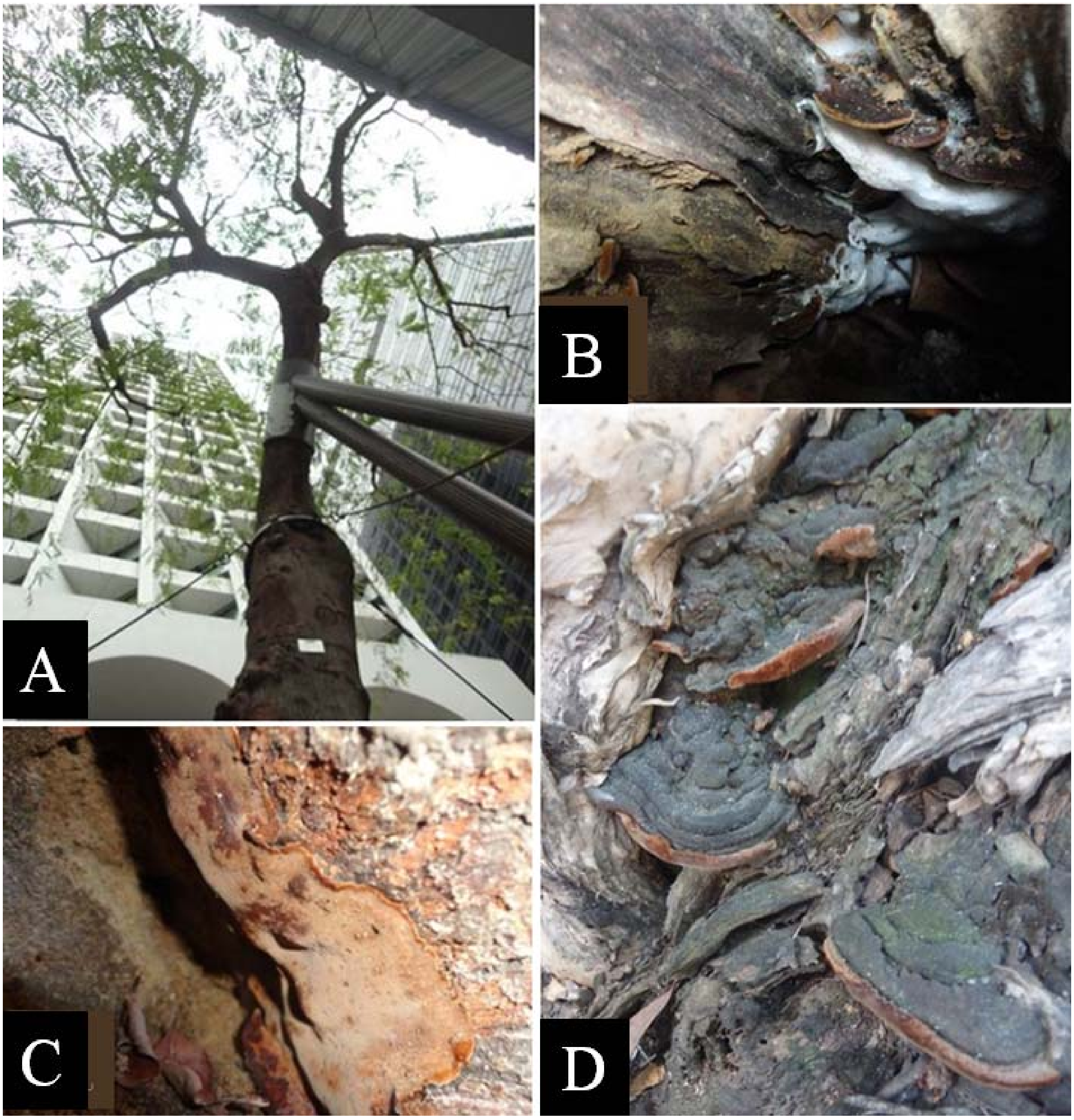
MANAGEMENT AND CONTROL

Risk category: High (RED)

Since this fungus could severely impact on the health and structural stability of the infected trees and there is currently no direct remedy for the BRR disease, removal of infected trees remains the most effective means to mitigate risk and control the spread of disease. Besides tree removal, all precautionary measures should be undertaken to prevent the spread of the disease to other healthy trees.

The 'Guidelines on Brown Root Rot Disease' issued by the Tree Management Office provides comprehensive information on the BRR disease and its management strategy, which is available at www.trees.gov.hk.

Fuscoporia senex[2]



(A) A *Cassia javanica* var. *indochinensis* colonised by *Fuscoporia senex*. (B) The fruiting bodies of *F. senex* in the cavity of *Sophora japonica*. (C) The fruiting bodies of *F. senex* located in the stem cavity of *Syzygium samarangense*. (D) The fruiting bodies of *F. senex* located on the stem cavity of *Melaleuca cajuputi* subsp. *cumingiana*.

[2] *Fuscoporia senex (Nees & Mont.) Ghobad-Nejhad, Mycotaxon 101: 208 (2007).* Index Fungorum and Mycobank as the two main fungal depositories hold different views on the taxonomy of this fungus. The former uses *Fuscoporia senex* as the current name while the latter uses *Phellinus senex*. *Fuscoporia senex* is adopted as the current name in this note.

FRUITING BODY

Fruiting bodies perennial, up to 3.5 × 8.5 cm and 2 cm thick, solitary, broadly attached to substrate, semicircular, convex, consistency coriaceous to woody hard; pilei surface first fulvous then brown to raw umber, finely velvety tomentose, narrow concentric sulcate zones with stiff, erect hairs, margin 1 mm thick, paler, obtuse, entire, context fibrous, glossy, dark blond to golden brown, a darker line above the tubes, 2 mm thick; pore surface fulvous then brownish grey, pores round and small, 10-11 per mm, layers up to 6 mm thick, margin sterile, fulvous; spores 4-6 × 3-4 µm, broadly ellipsoid, smooth, hyaline.

DISTRIBUTION AND HOST RANGE

Host trees recorded locally include *Albizia lebbeck, Cassia javanica* var. *indochinensis*, *Melaleuca cajuputi* subsp. *cumingiana* and *Syzygium samarangense*.

SIGNS AND SYMPTOMS

There is not much information on the mode of infection for this species Nevertheless, it is mostly observed on wounds and basal cavities on main trunks. Once entered through wounds, it may cause localised decay at first and move on to colonisation of deadwood. The presence of fruiting bodies on tree host is an obvious sign of advanced infection by this fungus. The infected trees may show non-specific symptoms such as crown defoliation, cavities and cracks at the advanced stage of infection.

PATHOLOGY

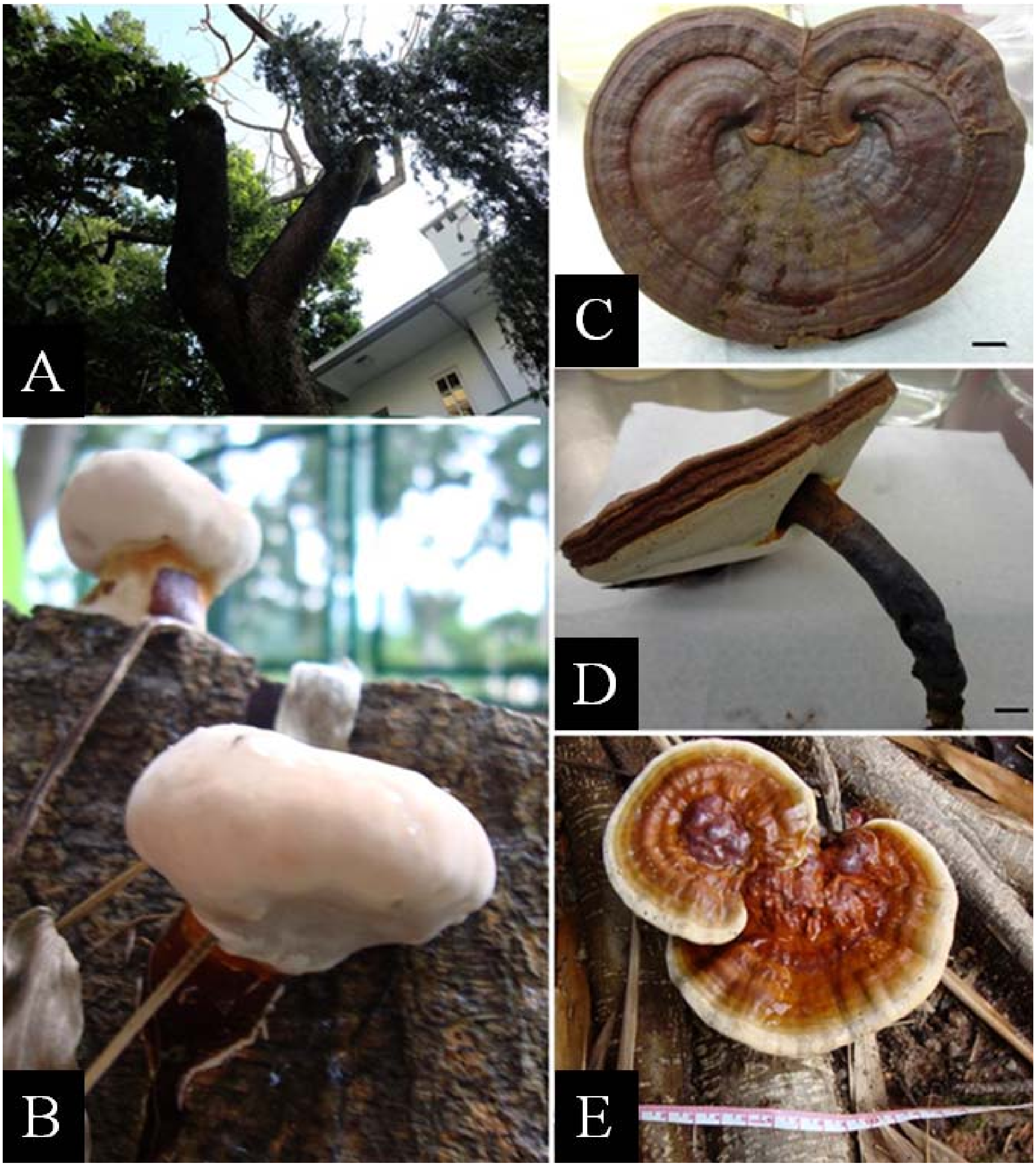
This fungus has a pantropical distribution range, including its presence in China. It could grow as a saprotrophic fungus on deadwood but could also act as a wound parasite causing white stringy rot in the heartwood of standing trees, particularly on stressed hosts.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

As this fungus is mainly associated with wounds and cavities of the main trunks and some structural branches, trees infected with this fungus should be monitored on a regular basis. Fruiting bodies of this fungus observed on trees should be removed to minimise the building-up of fungal inoculum. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. As wounds may serve as entry court for this fungus, trees should be avoided and minimised from injury arisen from large area pruning cut/mechanical damages as far as possible. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through pruning and/or installation of props/wires, removal of structural limbs concerned and/or whole tree should be considered.

Ganoderma lucidum (broad sense)[3]



(A) *Albizia lebbeck* infected by *G. lucidum*. (B) Immature fruit-bodies of *G. lucidum* on a wood stump. (C) A mature fruit-body of *G. lucidum*. Scale bars of C and D = 1cm. (D) Side-view of a fruit-body of *G. lucidum*. (E) Fruiting bodies of *G. lucidum* on a root of *Ficus microcarpa*.

[3] *Ganoderma lucidum (Curtis) P. Karst., Revue Mycologique Toulouse 3 (9): 17 (1881).* Please note that *Ganoderma lucidum sensu lato* (broad sense) covers the species *Ganoderma lucidum* and *Ganoderma tropicum* within this complex that are commonly found in Hong Kong and could only be authenticated through micro-morphology, cultural characteristics and phylogenetic analysis.

FRUITING BODY

Fruiting bodies 2 × 4 cm to 4 × 8 cm in size and 1 cm to 3 cm in thickness; pilei reniform, flat, spongy, corky or woody when aged, yellowish-brown to red brown in colour, with a white margin, lacquer-like luster, striate, young or fresh fruiting bodies occasionally appeared as chunks of white mycelia-like masses on the stalks; stipes 7-15 cm long, 1-2.5 cm thick, lateral; pore surface white, with yellow patches sometimes, blood red to purple red when touched, pores round 5-6 per mm; spores 9-12 × 4.5-7.5 μm, oval, brown.

DISTRIBUTION AND HOST RANGE

Ganoderma lucidum sensu lato (broad sense) infects broadleaved trees. Locally it is commonly found on *Acacia confusa* and *Ficus microcarpa*.

SIGNS AND SYMPTOMS

Ganoderma lucidum sensu lato (broad sense) is mainly associated with roots and root collar regions. Occasionally the lower trunks would also be affected. At the early stage of infection, no obvious abnormality could be observed in the tree crown, although fruiting bodies of the fungus may be present. As the infection continues, crown abnormality (e.g. sparse foliage density, small leave size, discolouration on leave, etc.) become obvious along with profuse formation of annual fruiting bodies on roots, root collar and lower trunk of the infected tree. Fruiting bodies are easily observable during wet season and withered, discoloured ones could also be observed in the dry season. At the time of sporulation, brownish yellow powdery spores could sometimes be found near the fruiting bodies.

PATHOLOGY

It is a pathogenic fungus causing white rot decay on trunks and roots, which can lead to tree death in a few years after infection, in particular, if the trees have been under stress.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus could adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Fruiting bodies of this fungus observed on trees should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Ganoderma applanatum[4]

(A), (B) and (C) Mature fruiting body of *Ganoderma applanatum* at the trunk.

[4] *Ganoderma applanatum* (Pers.) Pat., Bulletin de la Société Mycologique de France 5: 67 (1889).

FRUITING BODY

Fruiting bodies perennial, 10-20 cm × 5-15 cm and 1.5-12 cm thick; pilei broadly rounded, hoof-shaped or irregularly shaped bracket, flat and directly attached to the substrate in clusters and tiers, cork-like to woody, grey turning into brown, upper surface forming an uneven crust, with ridges and concentrated furrows, covered by a thick chocolate brown to copper coloured layer of spore powder up to 1 mm thick, fresh fruiting bodies with white margin and slightly rounded, stalkless; pore surface white but becoming brown when damaged or with age, pores 4-5 per mm; spores 7.5-10 μm × 4.5-6.4 μm, oval, brown or yellowish brown.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution and locally it could be found on broadleaved trees such as *Acacia confusa*, *Ficus microcarpa*, *Hibiscus tiliaceus* and *Sapium sebiferum*. Occasionally found on coniferous trees.

SIGNS AND SYMPTOMS

This fungus is mainly associated with roots and root collar of tree trunks, particularly on trees with obvious open wound and/or root damages. Trees with early stage of fungal infection by this fungus may experience stunted growth and non-specific symptoms on the crown such as defoliation and abnormal leave size and colour. As the infection advances over time, crown symptoms may get worsen and accompanied by bark loosening at the infection zone.

Perennial fruiting bodies are often observed at the advanced stage of infection during which the fungus may have already been well-established by spreading vertically and radially along the trunk.

PATHOLOGY

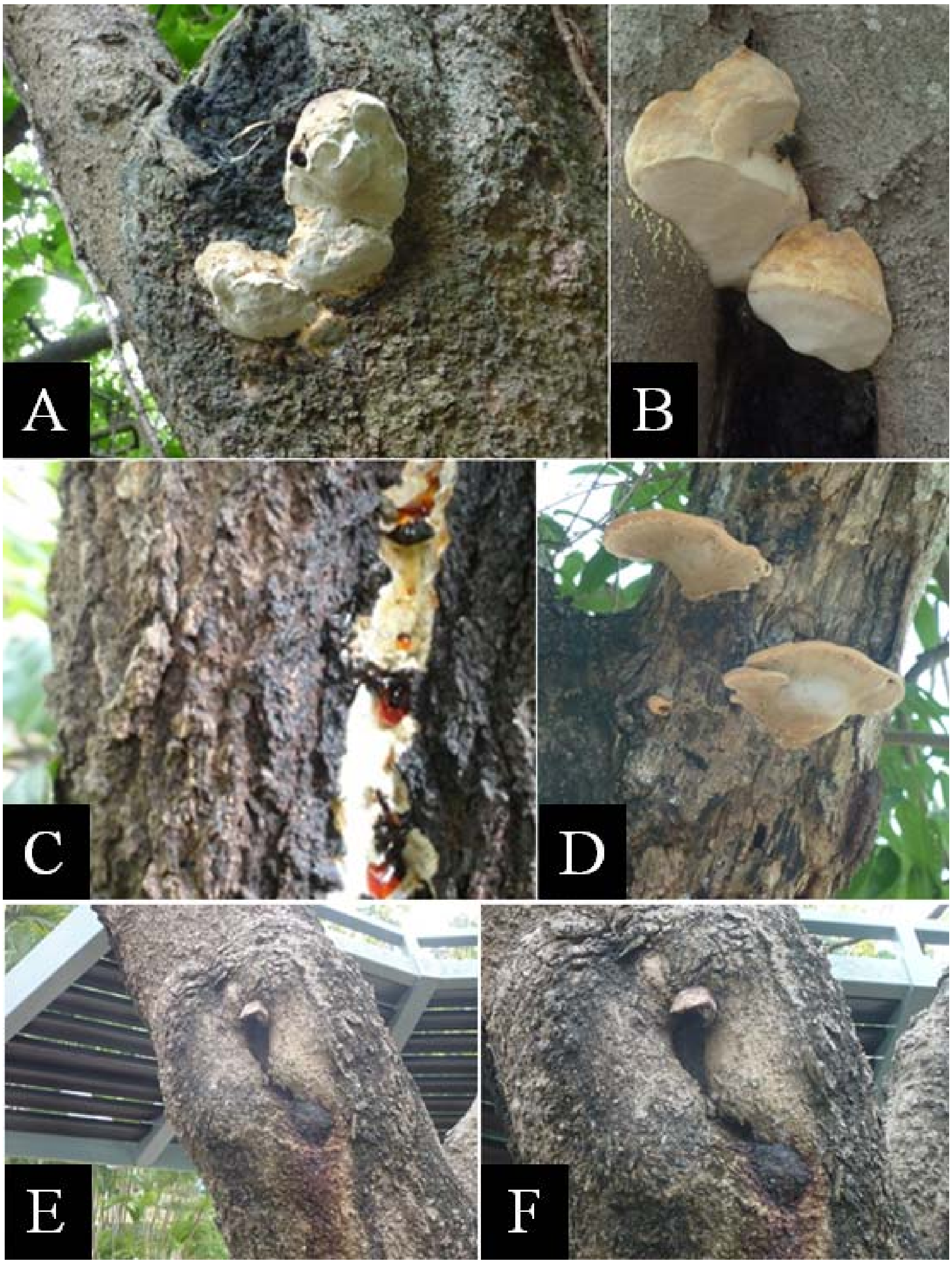
This white rot fungus is known for its capacity in impacting the health and structural stability of trees in the urban environment. Some experts view it as a predominantly saprotrophic fungus with the ability to degrade deadwood while others consider it as a pathogenic wood decay fungus with strong virulence owning largely to its association with extensive internal decay. Nevertheless, the ability of this fungus in colonising the heartwood and sapwood of trees substantiates the pathogenic nature of this fungus.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus could adversely affect tree health and structural stability, infected trees should be put under regular monitoring. As the disease may be disseminated through basidiospores, fruiting bodies observed should be removed to minimise the risk of building up of fungal inoculum in the infected trees. To reduce the chance of fungal infection, trees should be properly maintained and avoided from injury through pruning with large pruning wounds and/or large area mechanical damages. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Inonotus rickii[5]



(A) Anamorph or asexual stage of *Inonotus rickii* (i.e. *Ptychogaster cubensis*) observed on the trunk of *Celtis sinensis*. (B) Anamorph of *I. rickii* (i.e. *P. cubensis*) near a canker of *Celtis sinensis*. (C) Immature fruiting bodies of *I. rickii* on a trunk. (D) Mature fruiting bodies of *I. rickii* on a decaying branch. (E) Senescent asexual fruiting bodies (*P. cubensis*) on a cavity of *Celtis sinensis*. (F) Close-up view of the senescent asexual fruiting bodies (*P. cubensis*).

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5 *Inonotus rickii* (Pat.) D.A. Reid, Kew Bulletin 12 (1): 141 (1957).

FRUITING BODY

Sexual stage: fruiting bodies annual, up to 45 cm wide and 10 cm thick, sessile, attached to the substrate widely and firmly; pilei applanate to ungulates, single to imbricate, at first soft and fleshy and then becoming firm, margin acute or obtuse, entire, undulate, upper surface golden brown and tomentose in younger parts, oldest parts dark rusty brown and rough, becoming rimose; pore surface pale brown, round to angular, 2-4 per mm; spores 6-8.5-(9) μm × 4.5-5.5 μm, broadly ellipsoidal, thick-walled, golden yellow.

Asexual stage: asexual fruiting bodies (i.e. anamorph of *Inonotus rickii*, also named as *Ptychogaster cubensis*) semi-spherical or cushion shaped-like mass, soft and fleshy at first, velvety to the touch, yellowish brown to golden brown without the hymenial layer; becoming dark brownish and brittle, crumbling with the inner parts totally disintegrating to a mass of chlamydospores (i.e. thick-walled resting spores) when aged.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution extending from tropical to temperate regions affecting trees in both the rural and urban settings. Locally, this fungus is found on broadleaved trees such as *Celtis sinensis*, *Cinnamomum camphora* and *Sapindus saponaria* along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

As wounds serve as entry courts for this fungus, fruiting bodies are often found associated with pruning wounds and cankers on branches and main trunks. Most often, the semi-spherical/cushion shaped-like mass asexual fruiting bodies instead of the sexual fruiting bodies are observed emerging from branch stubs, pruning wounds, and cankers of the infected trees during rainy seasons. Later at the dry seasons as the asexual fruiting bodies age, they often turn dark-brownish and become senescent.

Similar to most wood decay fungi, early stage of fungal infection is not easily detected. As the infection progresses, the crown may exhibit non-specific symptoms such as defoliation, dieback and chlorosis. After establishment, the fungus starts causing localised decay and spread vertically and horizontally and cause internal decay. At the advanced stage after years of infection, crown dieback associated with structural weakness may eventually be experienced on the infected trees.

PATHOLOGY

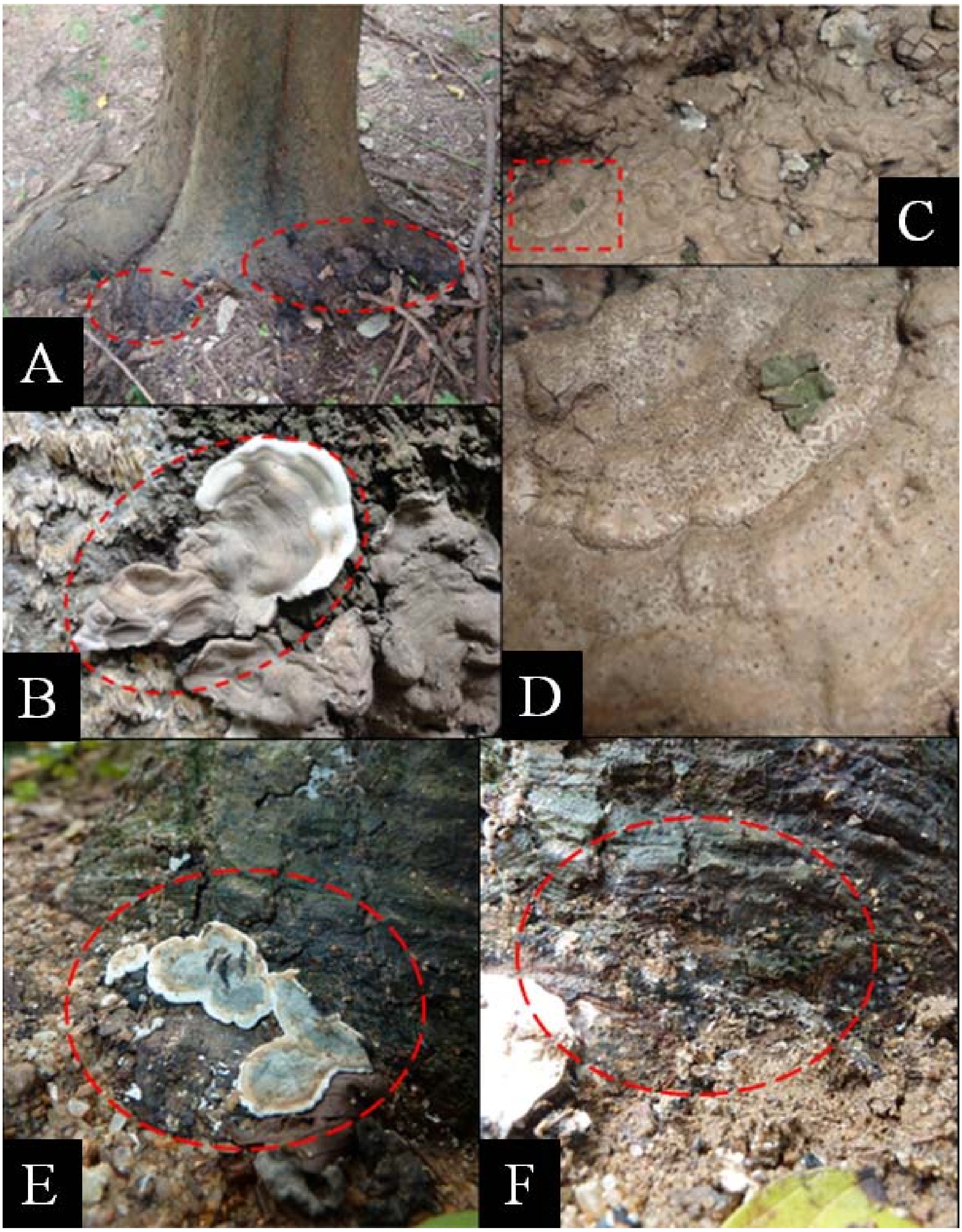
This white rot fungus is a well-documented canker causing pathogen with moderate virulence in Europe. It is able to cause decay on heartwood as well as sapwood and cambium on branches and trunks of trees resulting in eventual tree decline and mortality.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Fruiting bodies of sexual stage (*Inonotus rickii*) and their asexual anamorphs (*Ptychogaster cubensis*) observed should be removed to minimise the building of fungal inoculum. Fungicides may still be used as an interim measure for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. To reduce the potential damage of this fungus, trees should be minimised from injury arisen from large area pruning cut/mechanical damages. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through pruning/installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Kretzschmaria sandvicensis[6]



(A) Fruiting bodies of *Kretzschmaria* sp. at a root collar of *Celtis sinensis*. (B) Primordial fruiting body of *K. sandvicensis* colonised on *C. sinensis*. (C) Mature fruiting bodies of *K. sandvicensis* colonised on *C. sinensis*. (D) Close-up of the mature fruiting body enlarged from C (the red square part). (E) Primordial fruiting body of *K. sandvicensis* colonised on *C. sinensis*. (F) Decaying tissue underneath the fruiting body in (E).

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[6] *Kretzschmaria sandvicensis* (Reichardt) J.D. Rogers & Y.M. Ju (1998).

FRUITING BODY

Stromata 1.5-7 cm in diameter, 2-3 mm thick, separated, aggregated or fused, attached to substrate with narrow connectives, with crenate margins, surface brown-coppery to dark brown, with reticulate cracks, immediately beneath surface carbonaceous, tissue between and beneath perithecia brown to dark brown; perithecia 1.3-1.8 mm high, 0.6-1.5 mm wide, globose to obovoid; ostioles papillate to finely papillate; asci 7-9 µm × 3-4.5 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped; ascospores 33-43 µm × 8-11 µm, unicellular, dark brown, fusiform to ellipsoid, inequilateral, smooth, germ slit straight, slightly less than or nearly equaling spore length.

DISTRIBUTION AND HOST RANGE

Kretzschmaria species have a worldwide distribution with *K. sandvicensis* occurring in the tropics. Locally, *K. sandvicensis* is found on *Celtis sinensis* and *Ficus microcarpa* along roadsides and in parks.

SIGNS AND SYMPTOMS

K. sandvicensis is found associated with roots and tree collar region of infected trees. Obvious symptoms may not be easily discerned on infected tree as infection is a slow process. During the advanced stage of infection, non-specific symptoms such as crown defoliation and cankers on lower trunk may be observed on infected trees. Both the primordial grayish leathery white margins fruiting bodies and the mature carbonaceous lumpy fruiting bodies (i.e. stromata), though inconspicuous, could be found on the roots and root collar regions of infected trees and served as readily available signs to confirm the presence of this fungus. Extensive decay of woody tissue could be observed underneath the locations where fruiting bodies are found.

PATHOLOGY

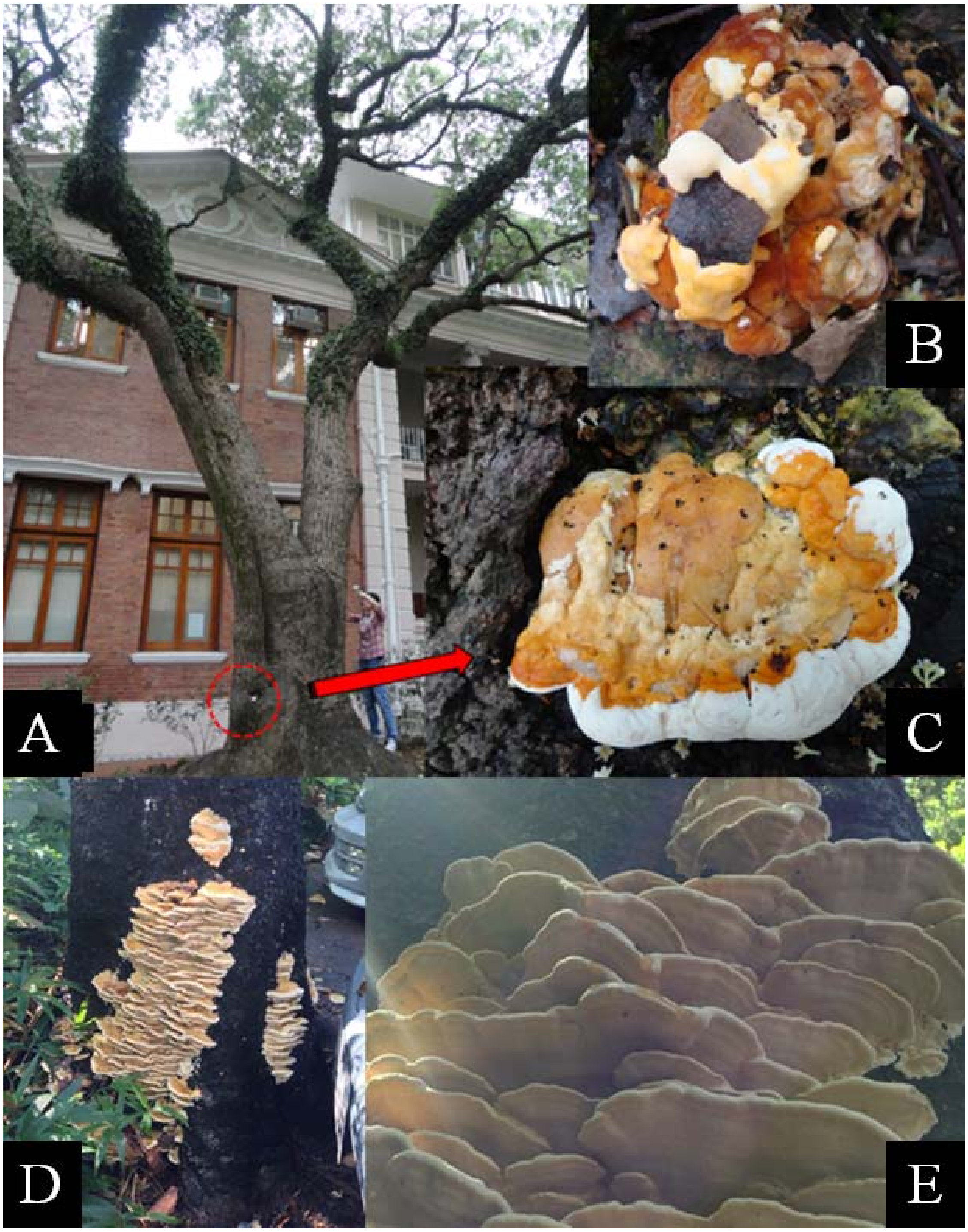
Kretzschmaria spp. cause soft and white rot decay on trees. This fungus could grow readily on woody substrata as a saprotrophic fungus but could act readily as a pathogenic fungus causing damages to sapwood and heartwood of living trees.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. As infection could be initiated through wounds, trees should be kept healthy and prevented from damages that would result in mechanical wounds of the lower trunk and the root systems. Fruiting bodies, if discernible and spotted should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may be used for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees is undermined and could not be mitigated through installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Rigidoporus ulmarius[7]



(A) *Cinnamomum camphora* infected with *Rigidoporus ulmarius*. (B) Fruiting bodies of *R. ulmarius*. (C) Close-up of the fruiting bodies of *R. ulmarius* in (A). (D) Clusters of fruiting bodies of *R. ulmarius*. (E) The under-side of the fruiting bodies of *R. ulmarius.*

[7] *Rigidoporus ulmarius* (Sowerby) Imazeki, Bulletin of the Government Forest Experimental Station Meguro 57: 97 (1952).

FRUITING BODY

Fruiting bodies up to 30 cm across, thick; pilei semi-circular, flat, hoof-shaped or irregular, woody yet pliable, upper surface cream-coloured, usually with green algal growth in older specimens; pore surface red-orange, fading to buff or dull pink with age, tube layers cinnamon brown in contrast to the paler flesh, pores 5-6 per mm; spores 5-7 μm, round, smooth-walled, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical and subtropical regions but has also been reported in the temperate region. Locally, it is found in broadleaved trees such as *Celtis sinensis* and *Delonix regia*.

SIGNS AND SYMPTOMS

This fungus is mainly associated with root collars and lower trunks of infected trees. Like most wood decay fungi, symptoms associated with inception decay at the early stage of fungal infection is not easily detected. As the decay advances during the late stage of infection, non-specific symptoms such as crown defoliation and internal decay may be experienced on the infected trees. Fruiting bodies of this fungus serve as readily observable signs which occur individually or in aggregated forms on trunks.

PATHOLOGY

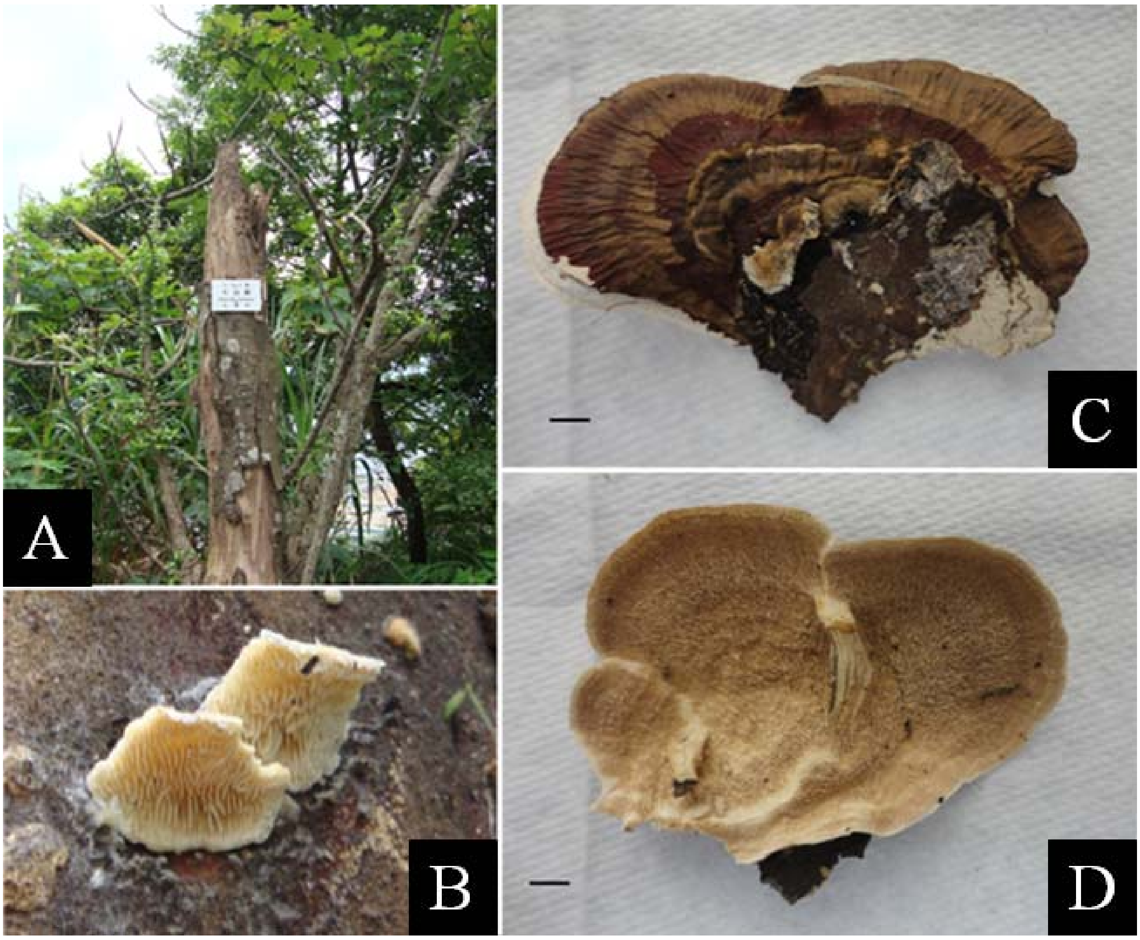
This fungus is a pathogenic wood decay fungus with the ability to cause white rot decay on the root collars and lower trunks. Trees after years of infection by this fungus would start experiencing decline as the fungus could gradually disrupt the function of vascular system in the sapwood and degrade the heartwood.

MANAGEMENT AND CONTROL

Risk category: Moderate (ORANGE)

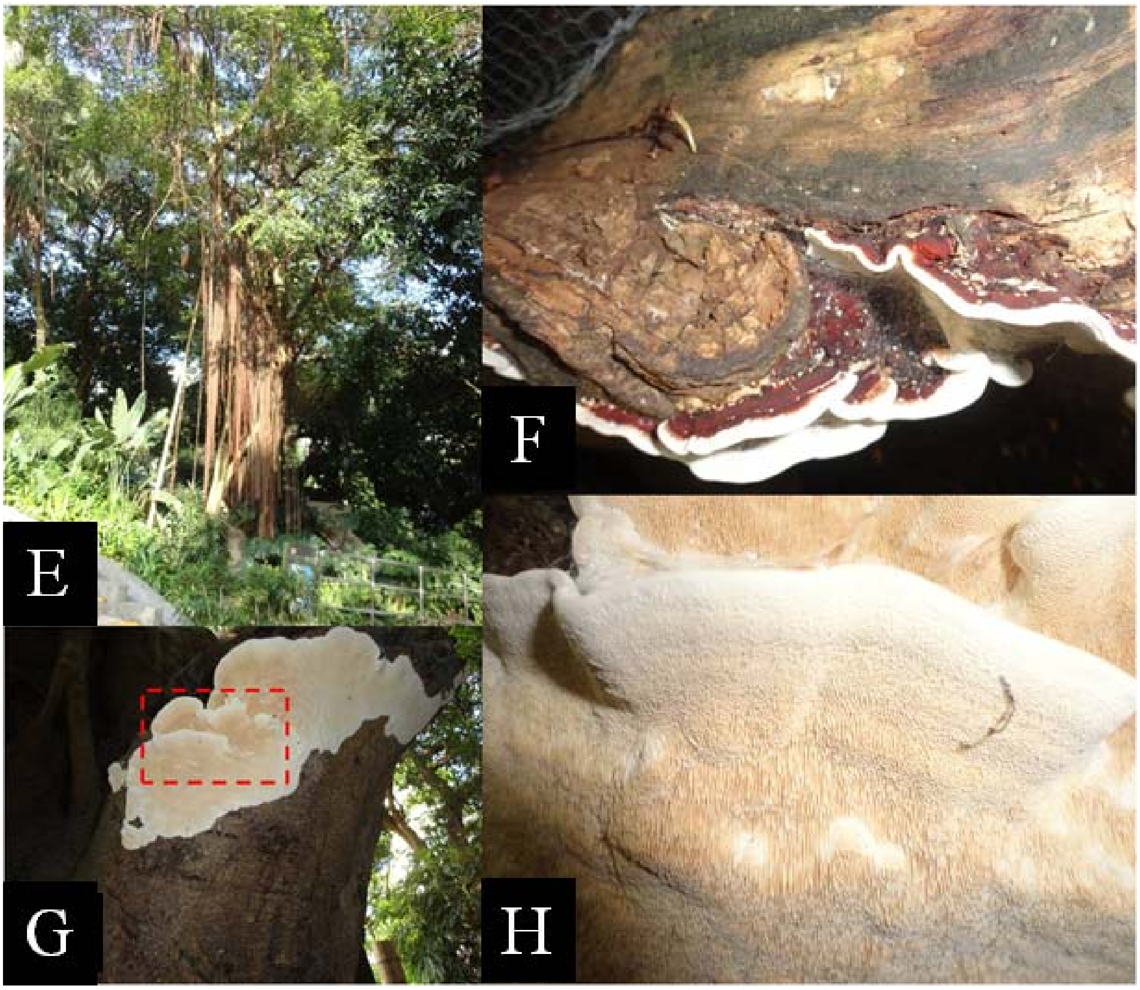
Since this fungus would adversely affect tree health and structural stability, infected trees should be put under regular monitoring. Avoidance of tree injury from pruning and mechanical damages could substantially reduce the chance of infection by this fungus as the main route of infection is from basidiospores. Fruiting bodies should be removed to minimise the risk of building up of fungal inoculum and infecting adjacent trees. Fungicides may be used for trees exhibiting early or advanced stage of infection, though the treatment may not be effective to hamper the onset of the disease. At the advanced stage of infection in which the structural integrity of the trees are undermined and could not be mitigated through pruning/installation of props and wires, removal of structural limbs and/or whole tree should be considered.

Earliella scabrosa[8]



(A) *Earliella scabrosa* on dead tree. (B) Young fruiting body of *E. scabrosa* on a dead tree. (C) and (D) Upper and underside of a mature fruiting body of *E. scabrosa* detached from on a fallen branch. Scale bars of C and D = 1cm.

[8] *Earliella scabrosa* (Pers.) Gilb. & Ryvarden, Mycotaxon 22 (2): 364 (1985).



(E) *Ficus microcarpa* colonised by *Earliella scabrosa.* (F) Surface of the fruiting body of *E. scabrosa.* (G) The underside of the fruiting body of *E. scabrosa* showing the hymenium layer. (H) Enlarged picture showing the pores from C (indicated with red rectangular).

FRUITING BODY

Fruiting bodies sessile, resupinate or laterally attach to wood surface; pilei 1 × 2 cm to 4 × 6 cm in size, bracket-shaped, grow in bunches, tough and coriaceous, white at early stage, later covered with red or red-brown layer of cutin with white margin; pore surface white to cork coloured, 2-3 per mm, irregular shaped; spores 8-12.5 µm × 3.5-5 µm, cylindrical to oblong ellipsoid, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical region and associated with broadleaved trees such as *Acacia* spp., *Ficus microcarpa* etc. as well as on dead/dying trees locally in urbanised setting along roadsides, on slopes and in parks. It is also found associated with surface of pruning wounds on braches and damaged areas on the tree trunks.

SIGNS AND SYMPTOMS

As wounds serve as entry courts for this fungus, fruiting bodies could be observed on pruning wounds and damaged tissues on branches and tree trunks. This fungus is likely to cause localised decay on tree. Most often trees observed with this fungus are already weakened with non-specific symptoms of crown abnormality such as defoliation, dieback and small leave size, etc.

PATHOLOGY

This fungus is reported as a saprotrophic fungus on deadwood and causing white rot decay, but its ability to associate with exposed living tissues (sapwood) on the main trunk of weakened tree hosts reveals the weakly pathogenic nature of this fungus with low virulence. Further to the degradation by this fungus, the infected trees may be subject to attack by other opportunistic fungal pathogens.

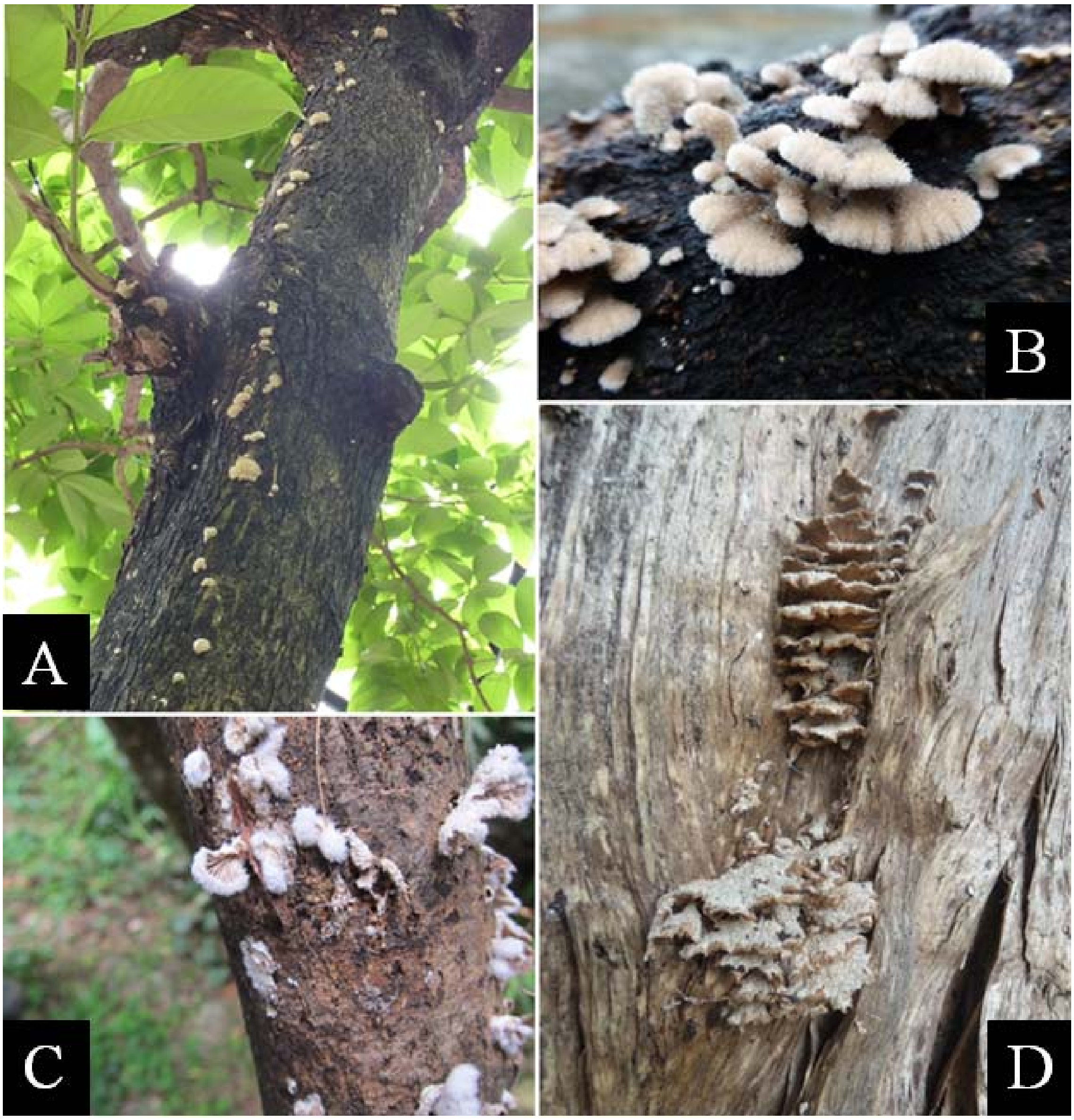
MANAGEMENT AND CONTROL

Risk category: Low (YELLOW)

Since this fungus may aggravate the health and structural stability of weakened trees, infected trees should be put under monitoring if the fungus is associated with the main trunk and major branches of stressed trees. For trees observed with this fungus on small branches, the defective part should be removed. Fruiting bodies observed on trees should be removed to minimise building-up of fungal inoculum. Fungicides may be applied on the trees as an interim measure to retard fungal growth.

As there are occasions where trees detected with *Earliella scabrosa* are also infected with some other pathogenic root rotting fungi such as *Phellinus noxius* and *Ganoderma* spp., it is advisable to check the root and root collar regions of the host trees for the presence of other pathogenic root rotting fungi. As wounds may serve as entry courts for this fungus, trees should be avoided and minimised from injury arisen from large area pruning cut/ mechanical damages.

Schizophyllum commune[9]



(A) Fruiting bodies of *Schizophyllum commune* colonised the bark of *Lagerstroemia speciosa*. (B) The upper surface of fruiting bodies of *S. commune*. (C) The lower surface of the fruiting bodies of *S. commune*. (D) Senescent fruiting bodies of *S. commune* on a dead tree trunk.

[9] *Schizophyllum commune* Fr., Systema Mycologicum 1:330 (1821).

FRUITING BODY

Fruiting bodies (pilei) 1-3(5) cm in diameter, round, fan-shaped or kidney-shaped, flesh hard, becoming thin and elastic when wet, and fragile under dry conditions, outer surface felted, wavy, slightly lined, with white, grey-white or pale orange areas, margin curling inwards, either split or lobed, stemless, simply sitting on the substrate; spores 5-5.5µm × 2 µm, oblong, hyaline.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution and has a very board host range. Locally, it could be observed on broadleaved trees such as *Acacia* spp., *Celtis sinensis* and *Lagerstroemia speciosa* along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

Wounds from pruning cuts as well as injury arisen from low temperature and sunscald damages could readily serve as entry courts for this fungus. As such, it is often found associated with wounded barks and cankers on branches and trunks of trees. Once established on infected trees, localised decay may proceed and pave the way for further infection by other opportunistic wood decay fungi. Most trees observed with the presence of this fungus are usually already weakened and exhibit non-specific symptoms of tree crown abnormality such as defoliation, dieback and small leave size etc.

PATHOLOGY

This white rot fungus is regarded as a saprotrophic fungus with the ability to recycle deadwood but may also cause damages on weakened trees as a pathogenic fungus with weak virulence. It is therefore regarded as a wound parasite having the ability to cause wood decay on injured cambium/sapwood and exposed heartwood.

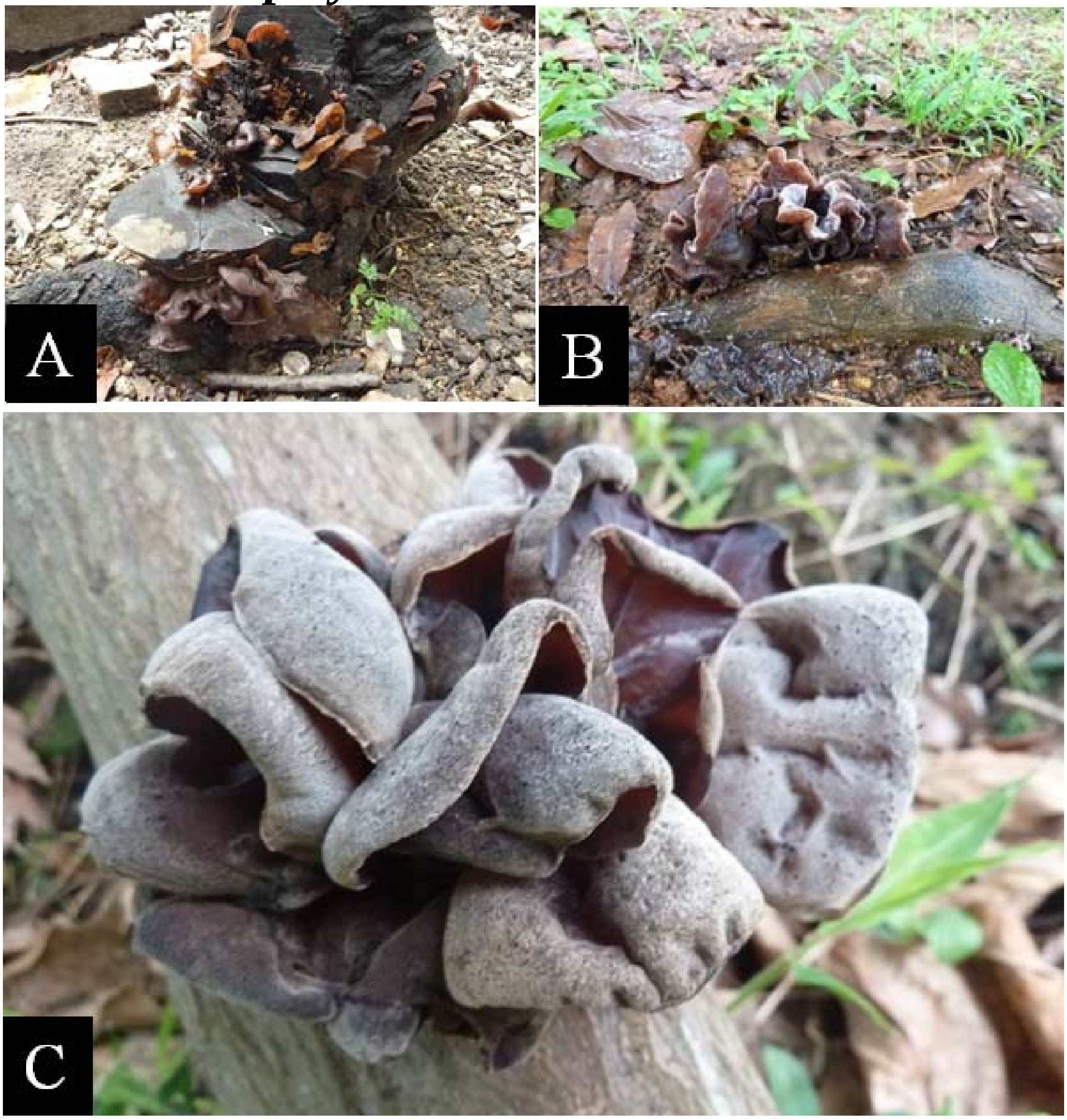
MANAGEMENT AND CONTROL

Risk category: Low (YELLOW)

Since this fungus may affect the health and structural stability of trees, mitigation measures should be exercised depending on tree conditions and the location at which the fungus is observed. Trees infected with this fungus should be put under monitoring only if the fungus is associated with the main trunk or structural branches of trees. Alternatively, removal of the defective parts could be considered if the fungus is observed on small size branches with weak attachment. Fungicides may be applied on trees infected with this fungus as an interim measure to retard fungal growth.

It is worthy to note that as fruiting bodies of this fungus are relatively small, they may not be easily detected. As such, one should carefully examine for sign of this fungus, particularly in wounded areas of the trees during inspection. By increasing tree vigour through proper tree care regimes and minimising tree damage from pruning cuts, the chance of fungal infection would be substantially reduced.

Auricularia polytricha[10]



(A) *Auricularia polytricha* colonized a dead wood stump. (B) Mature fruiting bodies of *A. polytricha* on dead root. (C) Mature fruiting bodies of *A. polytricha* on dead branch. (D) Mature fruiting bodies of *A. polytricha* emerged from a pruning wound.

[10] *Auricularia polytricha* (Mont.) Sacc., Atti dell´Istituto Veneto Scienze 3:722 (1885).

FRUITING BODY

Fruiting bodies annual, 4-16 cm wide, resupinate or pileate, loosely attached, laterally and sometimes by a very short stalk, elastic, gelatinous, hymenium smooth, or wrinkled, pale brown to dark brown to blackish brown with a whitish boom, sterile surface dark yellowish brown to dark brown with greyish brown bands, hairy, silky; hairs up to 0.6mm long, thick-walled; basidia 46-60μm × 4-5.5 μm, cylindrical, hyaline, 3-septate, with 1-3 lateral sterigmata; spores 13-16μm × 4-5.5 μm, reniform to allantoid, hyaline, guttulate.

DISTRIBUTION AND HOST RANGE

This fungus is widely distributed throughout the world. Locally, it is found on broadleaved trees, such as *Acacia confusa, Aleurites moluccana, Celtis sinensis* and *Ficus microcarpa* in urbanised setting along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

This fungus is found associated with surface of pruning wounds, dying and dead branches as well as dead trees. Fresh pruning cuts and dying/dead branches with defoliation are locations to observe for the fungus. Fruiting bodies serve as obvious sign for this species.

PATHOLOGY

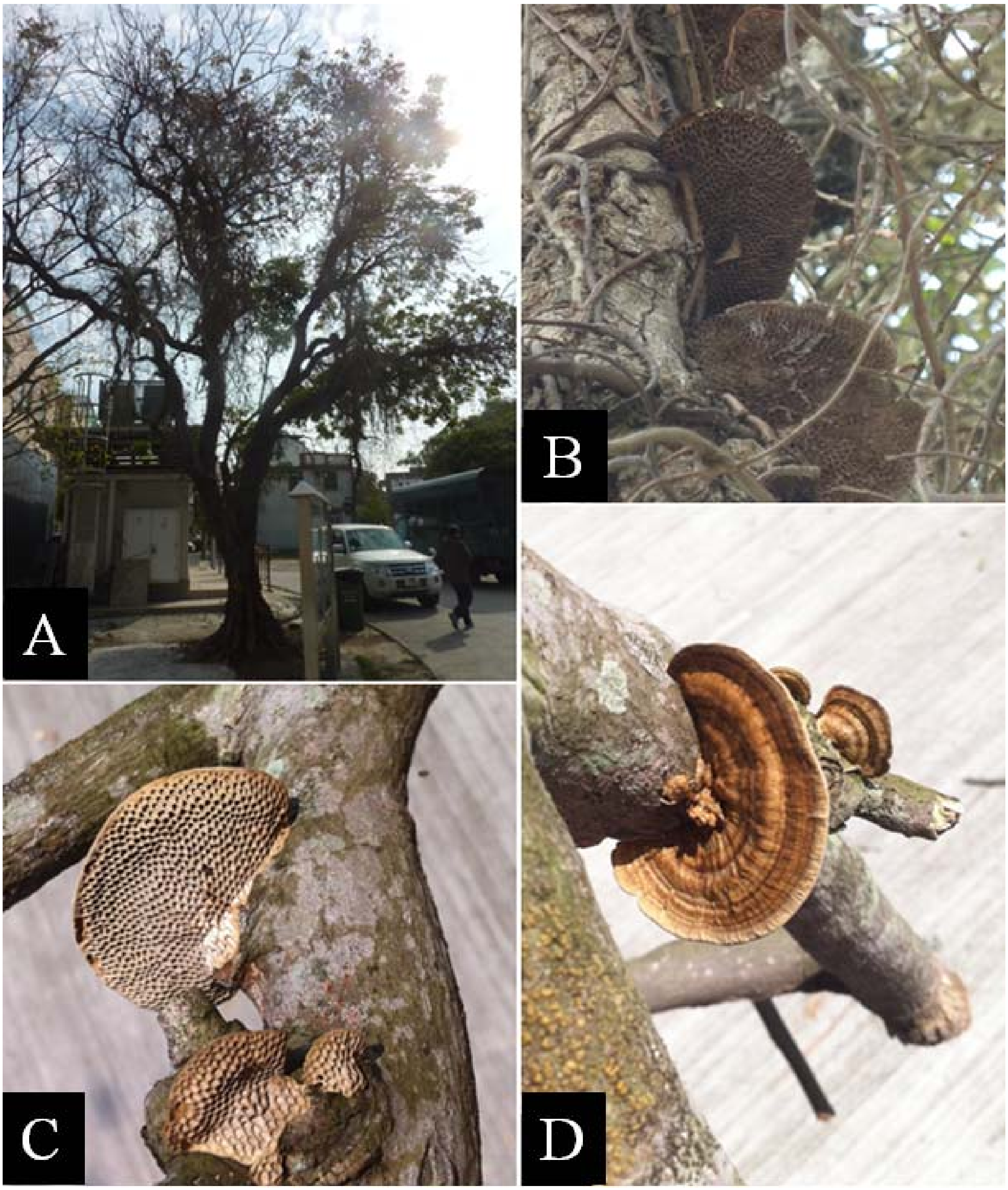
It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (GREEN)

Although there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Branches with weak attachment observed with sign of this fungus should be removed.

Hexagonia tenuis[11]



(A) Dead branches of a *Dimocarpus longan* were colonised by *Hexagonia tenuis*. (B) Mature fruiting bodies of *H. tenuis* on a dead branch of the *D. longan*. (C) Mature fruiting bodies of *H. tenuis* (upper-side) on dead log. (D) Mature fruiting bodies of *H. tenuis* (under-side) on dead log.

[11] *Hexagonia tenuis* (Hook.) Fr., Epicrisis Systematis Mycologici: 498 (1838).

FRUITING BODY

Fruiting bodies (pilei) annual to perennial, 3-5 cm × 4-8 cm and 0.2 cm thick, solitary or in clusters, pileate, flabelliform to semi-circular bracket, broadly or narrowly attached to the substrate or almost stipitate, thin, flexible and coriaceous when dry, upper surface concentrically zoned, ochraceous to dark brown; pore surface with grayish to ashy bluish tint, pores angular to hexagonal, very variable, mostly 2 per mm; spores ellipsoidal, smooth-walled hyaline.

DISTRIBUTION AND HOST RANGE

This fungus has a worldwide distribution. Locally it is commonly found on broadleaved trees such as *Delonix regia*, *Ficus microcarpa* and *Dimocarpus longan* in urbanised setting along roadsides, on slopes and in parks.

SIGNS AND SYMPTOMS

Fruiting bodies of this fungus are mainly found on dying/dead branches, dead trees as well as aged pruning cuts.

PATHOLOGY

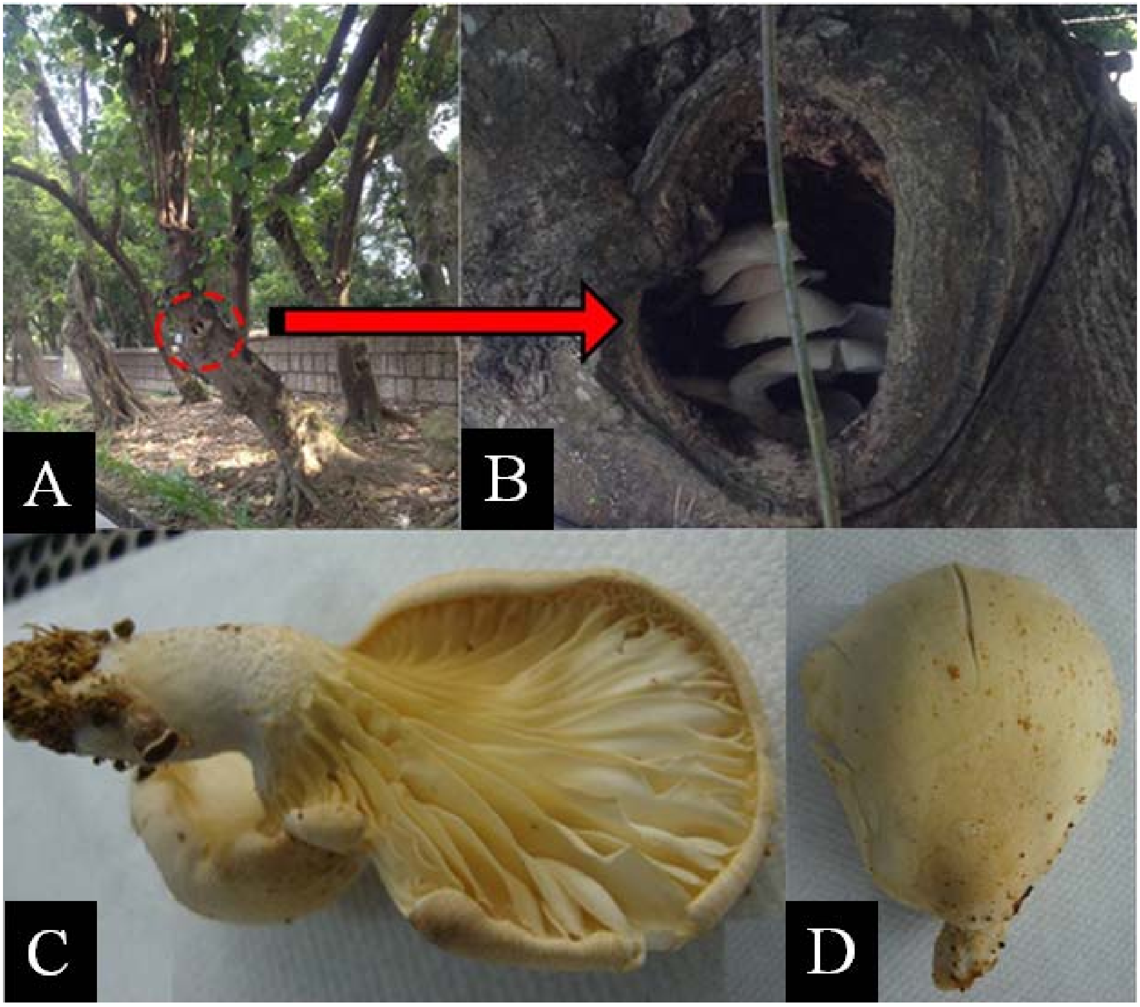
It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (GREEN)

Although there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Dead branches and branches with weak attachment observed with sign of this fungus should be removed.

Pleurotus cystidiosus[12]



(A) *Pleurotus cystidiosus* in the cavity of a *Hibiscus tiliaceus*. (B) Close-up of the fruiting bodies of *P. cystidiosus* in (A). (C) The under-side of the fruiting body of *P. cystidiosus*. (D) The upper-side of the fruiting body of *P. cystidiosus*.

[12] *Pleurotus cystidiosus* O.K. Mill., Mycologia 61: 889 (1969).

FRUITING BODY

Fruiting bodies up to 9.0 cm in height, pleurotoid; pilei up to 10.5 cm in diameter, depressed, surface grayish brown bearing brownish to purplish squamules, dry, fleshy, flesh up to 0.3 cm thick, white, lamellae yellowish white, decurrent, extending down on to the stipe, subdistant (up to 0.4 cm apart from each other), unequal, divided into two tiers, ventricose, gill edges wavy, spore print white; stipe 4.5 to 6.5 cm long, 2.2 to 3 cm broad, grayish brown, lateral, tapering downwards, solid, flesh white underneath; basidia 33.0-50.0 × 5.0-8.3 μm; spores 8.5-14.5 × 4.5-6.64 μm, oblong, elliptical, inamyloid.

DISTRIBUTION AND HOST RANGE

This fungus is mainly found in the tropical and subtropical regions. Locally, it is found in broadleaved trees such as *Hibiscus tiliaceus* etc.

SIGNS AND SYMPTOMS

This fungus is found associated with wounds, cavities, dying and dead branches as well as dead trees. Fresh pruning cuts, exposed wood and dying/dead branches with defoliation are locations to observe for the fungus. Fruiting bodies serve as obvious sign for the presence of this saprotrophic fungus on trees.

PATHOLOGY

It is a saprotrophic fungus with the ability to cause white rot decay on dead and decaying wood tissue.

MANAGEMENT AND CONTROL

Risk category: Insignificant (GREEN)

Though there is insignificant concern on tree health and structural stability due to the presence of this fungus, the trees should be checked for the presence and extent of localised decay in the region where fruiting bodies are observed. Dead branches and branches with weak attachment observed with sign of this fungus should be removed.

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APPENDIX 22 - Guidelines on Tree Preservation during Development

Guidelines on Tree Preservation during Development

Greening, Landscape and Tree Management Section
Development Bureau
The Government of the Hong Kong Special Administrative Region

April 2015

CONTENTS

1. Introduction

1.1 Trees are important elements in the city landscape and valuable assets in the community. They are dynamic living components of the urban ecosystem and their growth and structural stability change over time and environmental conditions. Infrastructure development both in reforming and modifying the cityscape is common. Trees are thus often subject to potential impact of new development and renovation of existing roads, utilities, facilities and other structures.

1.2 Tree preservation is necessary because trees play an important role environmentally and culturally. It is an integral part of a development project and requires careful planning in all stages from planning, design, construction to post-construction. Preserving the right trees and protecting them from damage can maintain greenery and minimise subsequent costs for the rehabilitation of a tree or its ultimate removal.

1.3 The 'Guidelines on Tree Preservation during Development' (the Guidelines) provides general reference for preserving trees which are subject to construction activities. It offers guidelines on proper practice for managing trees throughout different stages of the development. The objectives of the Guidelines are to identify the suitable trees for preservation, suggest appropriate tree preservation measures and integrate tree management with development activities in a sustainable manner. The Guidelines are relevant to those who are involved in the planning, design, management and supervision in different aspects of a project sharing the common concern on tree preservation.

1.4 The Guidelines should be read in conjunction with the prevailing circular(s) and relevant document(s), e.g. 'Tree Preservation' (Development Bureau Technical Circular (Works) No. 10/2013)[1], Contract Provisions for Preservation of Existing Trees (with or without Old and Valuable Trees)[2] Guidelines on Tree Transplanting[3] and other tree protection practices during construction promulgated by the Greening, Landscape and Tree Management

[1] Source: http://www.devb.gov.hk/filemanager/technicalcirculars/en/upload/327/1/C-2013-10-0-1.pdf
[2] Source: http://devb.host.ccgo.hksarg/en/tree_preservation/PPET_Content_Frame.html and http://devb.host.ccgo.hksarg/en/tree_preservation/PPETwOVT_Content_Frame.html
[3] Source: http://www.trees.gov.hk/filemanager/content/attachments/Guidelines_on_Tree_Transplanting.pdf

Section of the Development Bureau which are available from the trees website at www.trees.gov.hk.

2. Background and guiding principles of tree preservation

2.1. The goal of tree preservation in a development project is to identify and preserve trees with good health, structure and form, while felling trees which are of poor health or structure, or unable to survive effects of construction and have major conflict with the designated use of the site.

2.2. Development activities can affect the health, growth and stability of trees. If the extent of change is too great, trees become weakened and may die. Likewise, their ability to acclimate to new site conditions and tolerate environmental stress declines with age/health condition. Young and healthy trees are in general more resilient to changes whereas old and mature trees or individual trees of poor health are more sensitive to stress. It is for this reason that retention of old trees during development requires special attention and a programme of long term care.

2.3. For a tree to be preserved and protected on site, due consideration should be given to provide adequate space for the function and growth of its root and canopy.

2.4. All parts of a tree can be damaged by construction. A tree that has taken many years to reach maturity can be damaged or killed by unwitting or negligent actions. Trees damaged during construction may take years to exhibit symptoms and eventually need to be treated or removed, often at great expense.

2.5. Successful tree preservation occurs when the goals of the project are achieved with minimal impact to trees designated for preservation (Matheny and Clark, 1998) and should adhere to several important principles.

2.5.1. Successful tree preservation requires the commitment and involvement of all parties involved in the project in different phases; and effective communication on tree preservation among team members is essential.

2.5.2. Members of the project team should be familiar with the rudimentary aspects of tree growth and development and understand the relationships between tree survival and construction practices. Tree specialists/arborists should be involved early to give advice on survey and tree assessment, preservation measures and on site monitoring etc.

2.5.3. Trees preservation begins in early planning stage and develops through design, construction and maintenance phases. A decision to preserve and remove specific trees should be discussed and determined at the same time when site layout and grading etc. are considered.

2.5.4. Trees differ in their ability to tolerate changes which are often constrained by the species, age, structure and vigor, both on the basis of their intrinsic characteristics and their response to potential construction impacts. Tree preservation[4] is a thoughtful process of selecting suitable trees for protection and felling trees that cannot, or should not, be preserved. Evaluation of suitability of individual trees for preservation is an important task. Trees that are to be preserved must be carefully selected in order to make sure that they will survive the construction impacts, adapt to a new environment and perform well in the new landscape. Trees that are poor in health or structure or unable to survive construction impacts are not suitable for preservation.

2.5.5. The focus of tree preservation during development is on prevention of damage as there are few remedial treatments and the ability of a tree to recover from all construction injuries is generally limited. Injury should be avoided during all stages of development in particular as construction impacts are cumulative.

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[4] Factors to be considered on tree assessment for tree preservation, transplanting and felling can be referred to the Development Bureau Technical Circular (Works) No. 10/2013 'Tree Preservation' vide
http://www.devb.gov.hk/filemanager/technicalcirculars/en/upload/327/1/C-2013-10-0-1.pdf

2.5.6. Information from the field survey is crucial to determine the construction plans and activities and to facilitate a decision on the siting of the development with its likely impacts on trees. Information therefore should be accurate for the successful tree preservation.

2.5.7. Trees require sufficient space for the growth of canopy and root systems. Adequate space should be allowed to minimise the impacts from construction, and to ensure the healthy growth of a tree over time.

2.6. The major causes of injury, which are by no means exhaustive, are:

- Root cutting or damage – due to excavation or trenching; as over 90% of the roots are located at the top 1m of soil, working around trees can easily cut roots;

- Soil compaction – results in less root growth or reduced aeration with long term implications;

- Grade changes – lowering of level leads to root removal while raising of level leads to root suffocation;

- Mechanical injury to trunk, roots and crown – injury to conductive and protective tissues, i.e. bark, phloem, cambium and xylem, reduces the capacity of trees to transport water, nutrients and carbohydrates. Injury also leads to invasion/infection of pathogens.

3. Process

3.1. During the various stages of construction, the following key points related to tree preservation should be noted.

3.2. <u>Planning</u>

3.2.1. This stage involves the initial site evaluation where the land, tree and building needs are all evaluated and defined. Trees immediately adjacent to the site that will be impacted by the construction or may affect the construction activity should also be included. Information collected is to facilitate a decision to establish the relative importance of the existing trees on a construction site which should be preserved and protected or removed. Due consideration should also be taken to avoid causing damage to trees during the site evaluation work.

3.3. <u>Design</u>

3.3.1. During the design phase, the project team sites the building and supporting infrastructure appropriately. Trees covered in the survey are assessed and determined on how they can be incorporated into the development or to be transplanted or felled.

3.3.2. The trees' location relative to the structures should be considered so that the trees have sufficient space to grow and are adequately protected during construction. It is also important that the project team should incorporate the design considerations on the future use of the areas within and/or the TPZ in relation to the future and proper growth of the preserved trees in the vicinity. Inappropriate design for the future use of the areas may have long term implications on the micro-climate and the growth environment of the trees.

3.3.3. The following should be considered for trees to be preserved.

- Tree protection zone (TPZ)

  TPZ is considered as the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's viability, and where the protection of the roots and soil structure is treated as a priority. Methods generally used include

  - the 'Dripline method', i.e. the tree canopy dripline is used to define the boundary of the TPZ and the entire area within the dripline is considered the TPZ;

  - the 'Tree height method', i.e. the circular area with the radius equal to the height of the tree; and

  - the 'Trunk diameter method', i.e. multiply the trunk diameter at 1.4 m by 6 to 18 to determine the radius of the TPZ, etc. (Fite and Smiley, 2008)

  Under general circumstances in Hong Kong, the 'Dripline method' is adopted. However, for narrow canopied trees, the 'Tree height method' would be appropriate. The 'Trunk diameter' method would be suitable for trees which are leaning or of irregular conformation.

  A bigger TPZ is usually preferred. The tolerance level of a tree may depend on tree species, age/size, health/vigor, site conditions etc. and further deliberation on factors on a case by case basis would be necessary.

  There is a need to consider factors such as site conditions, technical issues and cost effectiveness etc. to work out a balanced arrangement. There are situations in which the designation of TPZ at dripline may not be practicable, e.g. a slope with dense vegetation cover, roadside verge or trees grown on the stonewall[5]. The advice from the tree

[5] For details about the protection of stonewall trees during construction, please refer to the Management Guidelines for Stonewall Trees vide
http://www.trees.gov.hk/filemanager/content/attachments/Guilelines_for_stone_wall_trees.pdf

specialist/arborist has to be sought on adequate tree protective measures and design.

A TPZ will ensure that a tree is protected during development, has enough space for root and branch growth, and will receive adequate supplies of soil nutrients, air and water. It is also a specified area around, above and below ground and at a given distance from the trunk set aside for the protection of the root system and the crown of a tree at where it is potentially subject to damage by development.

The TPZ should be protected from construction disturbances. No grading, excavation or construction activity is to be allowed save with special consideration and approval given. Where appropriate, a cross-section showing the proposed architectural and engineering features around trees proposed to be retained should be provided to show that sufficient vertical and horizontal space can be reserved for TPZs.

- Tree protection fences

TPZ must be surrounded by strong fences sturdy enough to withstand impacts from the construction activities including vehicles and machinery at the beginning of contract including site investigation works before the construction on site. The fences should be rigid and complete and its foundation should avoid contact with the structural roots. Weak fencing such as nylon netting is not appropriate for protecting trees.

At where the erection of protective fencing is not practicable or the preserved tree grows on a retaining structure, alternative tree protective measures such as temporary protective plank armouring should be considered. If necessary, coverings should be laid on top of the temporary protective mulching to provide additional protection from soil compaction due to passage of vehicles, equipment or machinery.

Warning signs and notices are to be installed at the fences denoting the 'tree protection zone' to prohibit the entry of equipment or construction activities.

<u>Photo 1</u>
A tree should be protected by strong protective fence at the TPZ wherein construction activities are not allowed

<u>Photo 2</u>
A tree without protective fence will be vulnerable to damage caused by construction activities

- Tree preservation plan (TPP)

  Information on TPZ and the location, size and conditions of trees from the tree survey reports should be clearly shown and included in a TPP as part of the contract documents.

  The TPZ should be superimposed on a layout plan showing the spatial relationships between trees and the development. The TPZ should not be interfered by uses such as storage, parking area or vehicular/pedestrian access. The TPP should clearly indicate the location of protective fence to be erected around the preserved trees. The extent and type of ground protection or other measures to protect the roots from compaction should also be indicated.

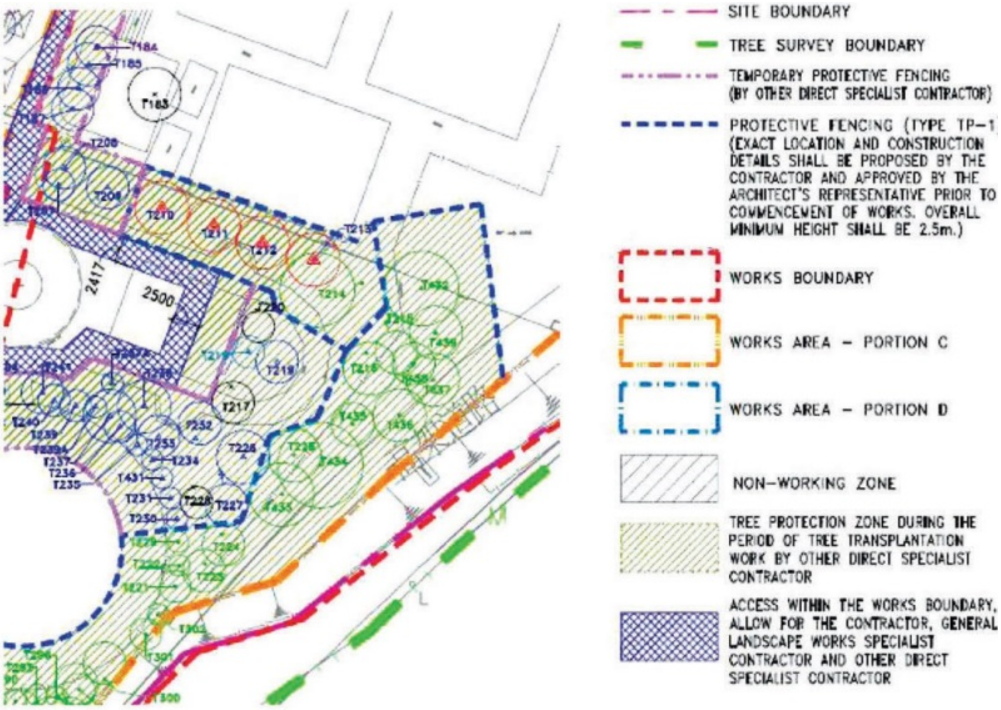

Figure 1
Tree Preservation Plan (TPP) is a part of the contract drawings: with levels, TPZ, protective fence, circulation routes indicated[6].

[6] Source: Proper Planting Practice – Design for Tree Protection Zone
http://www.greening.gov.hk/en/preservation/new/designForTreeProtectiveZone_b.jpg

<u>Photo 3</u>
A tree adjacent to the construction area is properly fenced off and protected by strong fences

- Soil compaction controls and storage areas

  Major causes of soil compaction are due to vehicular movements and the storage of heavy machinery/equipment/materials near a preserved tree.

  Soil compaction decreases soil permeability and interferes with essential gas exchange processes and percolation, and impairs drainage. Besides, the fine, absorbing roots concentrated in the upper centimeters of soil can easily be damaged or killed by heavy construction equipment travelling across or grading the site.

<u>*Photo 4*</u>
Heavy vehicles or equipment stationed in the vicinity of a preserved tree not only cause damage to the tree but also add weight to the soil causing compaction

Mechanical damage of tree trunk or surface roots or spillage of chemicals can cause irreparable damage. It is important to prevent soil compaction by diverting traffic routes and designating storage areas away from trees. Spreading a layer of woodchips on soil surface can also reduce compaction. The designation of TPZ and installation of strong protective fence can effectively prevent damage from compaction and storage.

<u>Photo 5 and Photo 6</u>
Areas in the vicinity of a preserved tree should be free from storage and dumping

- Existing and proposed utilities alignment

  Both existing and new trenches and overhead wires for utilities should be identified and marked on the plan.

  Trenching or excavation near a tree can cause substantial root damage or root loss and should be avoided as far as possible. Depending on the extent, cutting of roots will affect the absorption and anchorage of the tree, which may lead to decline of tree vigor or even tree collapse.

- Grade change

  In term of grade change, consideration on tree preservation should be given either to build "tree island" or "tree well" to encompass an area extending at least to the TPZ[7]. [Figures 2, 3 and 4]

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[7] Source: Case Study: Tree Preservation and Level Change vide http://devb.host.ccgo.hksarg/en/tree_preservation/Lesson_Learnt_Sau_Ming_Road_Bombax_change_in_soil_level.pdf

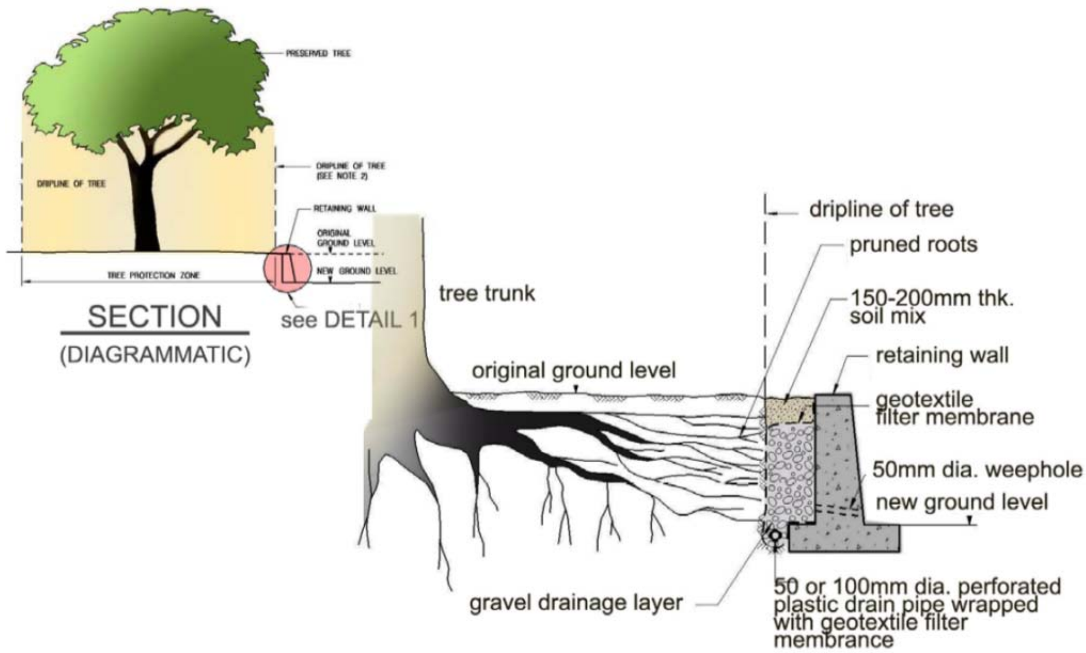

Figure 2
Construction of tree island for lowering of soil level

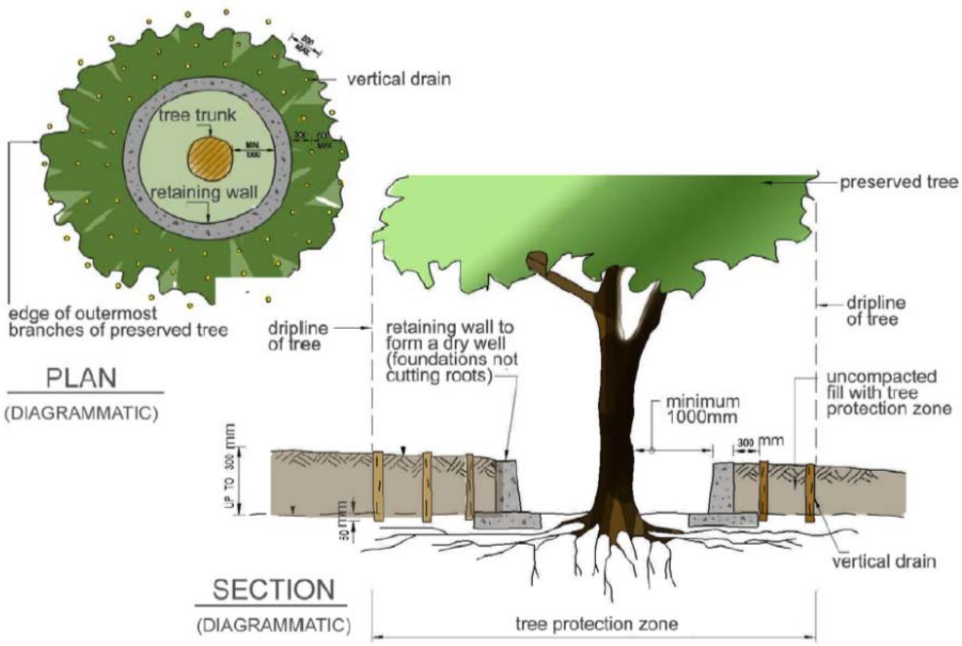

Figure 3
Construction of tree well for increasing soil level (minor to moderate rise up to 300mm)

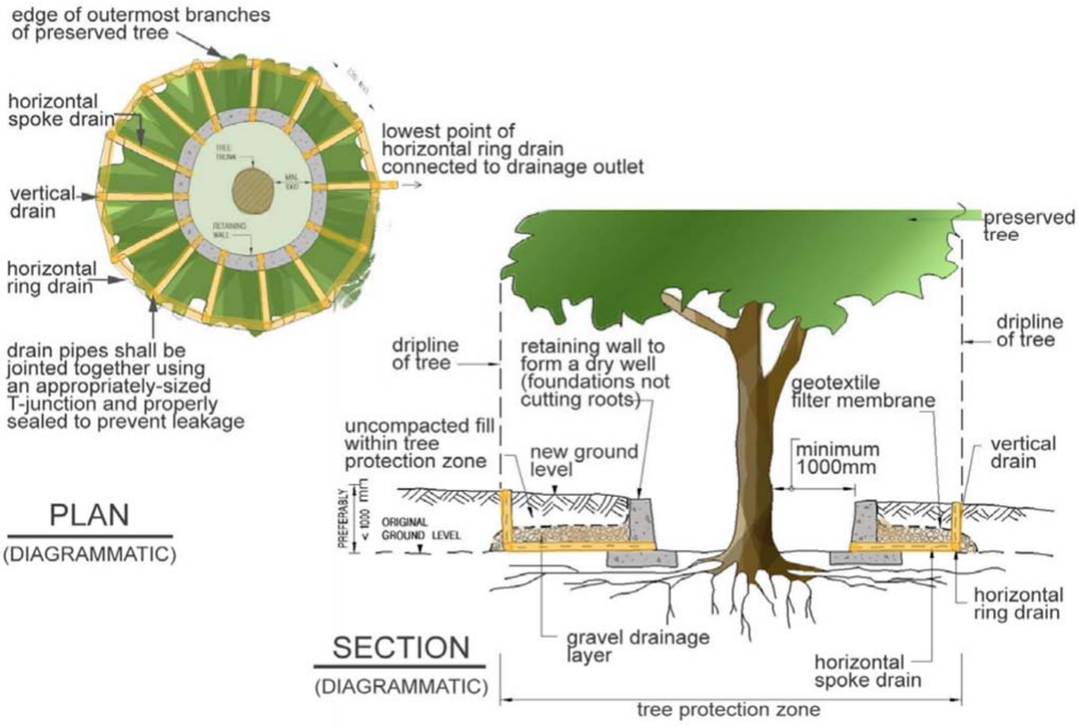

Figure 4
Construction of tree well for increasing soil level (major rise >300mm)

- Other on-site activities

  - Consideration should also be given to properly irrigate the trees and to spray water to remove the accumulated construction dust during dry season in order to lessen the chances of decline and to maintain the vigor of trees.

  - Potential change in local hydrology due to site changes should be considered and prevented as far as possible.

3.4. Construction

3.4.1. The construction phase is when most activities occur on a project site. It starts with site investigation, then site preparation and ends when building and landscaping are finished.

3.4.2. Site inspections are needed to maintain the integrity of the TPZ. The purpose is to verify that all tree protection measures are in place, followed and observed during the construction works.

3.4.3. Trees should be inspected on a regular basis to watch for signs of stresses, such as dieback, leaf loss, or general decline in tree health or appearance and to look for and prevent tree damage with symptoms of construction injury. Photographic records are necessary in order to keep track of the tree condition.

3.4.4. During construction, trees can be damaged by soil compaction, pollution from effluent water, machine petroleum or chemical spillage, grade changes, root crushing and pruning, damage to the bark, improper pruning of branches, incorrect storage of construction machinery/materials, and dumping of construction wastes (Elmendorf, Gerhold, & Kuhns, 2005). Common types and symptoms of construction injury are suggested at Tables 1 and 2[8] below.

Table 1 Types of construction injury
● Soil compaction or pollution
● Root removal and wounds
● Disruption of mycorrhizae and other beneficial soil organisms
● Trunk and butt wounds
● Branch wounds
● Leaf injury
● Unwarranted tree removal

Table 2: Symptoms of construction injury (Soil destruction)
● Reduced canopy density
● Reduced leaf size
● Lighter green colour of the foliage
● Branch/canopy dieback
● Development of early fall colour or leaf drop
● Suckers or epicormic shoots from damaged roots
● Long term decline in health

3.4.5. Landscape installations, e.g. irrigation or lighting installation are a common cause of tree root damage. Monitoring of these activities is essential.

[8] Source: Elmendorf, Gerhold, & Kuhns, 2005

- Appropriate measures on proper tree care should be in place which include corrective pruning when trees exhibit signs of stresses.

- Temporary trunk or branch protection is sometimes required. Warning signs are also required if branches are spanning across the TPZ to reach the vehicular passage.


Photo 7
Appropriate sign is required to indicate the spanning of tree branches which require special attention

3.4.6. Monitoring and moderating the construction activities is essential for the success of the project. Site meetings and reporting are necessary in order to keep all parties in the construction team informed about tree related activities and to reinforce the importance of tree protection activities. Any foreseeable damage should be reported through the prescribed chain of command and corrected as soon as possible.

Table 3 Do and Don't[9]	
- Do install strong protective fencing at the TPZ before construction on site - Designate specific sites for equipment/disposal of debris - Do appoint qualified and trained personnel for works and monitoring - Designate vehicular/foot paths and storage areas away from TPZ - Do monitor the tree conditions and report on anomalies	- Don't girdle a tree with wire - Don't nail anything into a tree - Don't stockpile around a tree - Don't undertake works within the TPZ - Don't top a tree - Don't use trees as anchor - Don't work with machines near a tree - Don't cut, trench, excavate/raise soil level within TPZ - Don't pollute the soil - Don't allow traffic over root system - Don't sever main roots near the trunk

3.4.7. Level of compliance and condition of the trees should be well monitored. In the event of damage to fence or trees, the damage should be properly reported and rectified quickly.

[9] Source: Tree Care during Construction at http://www.trees.gov.hk/filemanager/content/attachments/Tree_Care_during_Construction.pdf

3.5. Post-construction

3.5.1. The post-construction phase begins when the construction and landscape installation have finished.

3.5.2. Tree health and structure should be thoroughly evaluated again to determine if any changes have occurred during the construction process. If there is any observed deterioration of tree health and/or structure, remedial treatments should be recommended and implemented. The findings of inspections and evaluations should be included in a management plan for the maintenance party.

3.5.3. Once construction is complete, the TPZ fencing may be removed, but monitoring by the tree specialist/arborist should continue. Monitoring should include managing soil moisture, maintaining mulch, assessing tree damage, and inspecting for insect pests and disease pathogens. Treatments should be prescribed when problems are detected. Trees known to be hazardous should be felled in order to reduce long term management, liability and risk elements.

3.5.4. It is important that all construction materials, such as hoardings, barriers, tree labels, etc., should be removed before a construction project is considered to be satisfactorily completed. Arrangement on handing over of the facilities and the trees between the project proponent department and the department responsible for the subsequent maintenance should be arranged. All defects or irregularities to be followed up after the handing over and during the defect liability period should be properly recorded.

4. Treatment of trees damaged during development

4.1. Despite the best intentions and most stringent tree protection measures, trees may still be injured during construction. Construction damage can be permanent and often irreversible. There are few remedial treatments to improve injured trees.

4.2. Some trees decline slowly over years while others may die instantly. During construction, trees can be damaged by causes such as soil compaction, water/petroleum pollution, grade changes, root crushing and pruning, damage to the bark, improper pruning of branches, incorrect storage of construction machine/equipment/materials, and dumping of construction wastes. The following maintenance care should be taken into consideration.

- Branches that are split, broken, diseased or dead should be removed.

- If branches or tree trunks need additional support, evaluate the benefits of installing cables or other means of supports. Likewise, in case if there are damage of the tree roots and the tree structure is likely to be affected, appropriate means of support is required.

- Adequate but not excessive irrigation can help the trees to recover from stresses. A long, slow soak over the entire root zone is preferred than frequent and shallow watering.

- Mulch covering the root system can enhance root growth, moderate soil temperatures, maintain moisture and reduce competition from weeds and grass.

- Traditional wound dressings, once thought to accelerate wound closure and reduce decay, are not substantiated by research[10]. They are primarily used for cosmetic purposes and are neither required nor recommended in most cases.

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[10] There are researches on trial use of biological control agents as wound dressing material for fungal decay control but no conclusive findings have been published as of to date.

- If a wound is found on the tree trunk, carefully cut the loose bark to form a clean, smooth surface of healthy wood and bark. Take care not to damage healthy tissue and do not widen the wound more than necessary. Jagged edges can be cut away carefully with a sharp knife, taking care not to cut into the living tissues.

- Fertilization is usually not necessary. It should only be applied after laboratory tests of soil samples to understand the deficiency.

- Applying herbicides/fungicides/insecticides only if it is necessary and appropriate for the purpose.

- Soil compaction and grade increases deplete the oxygen supply to tree roots. To improve soil aeration, vertical mulching[11] and radial trenching[12] are techniques used to improve conditions for root growth. Use of air excavator has proven effective for soil aeration and radial trenching.

Photo 8
Vertical mulching can improve soil aeration and root growth

[11] Vertical mulching involves making holes in the ground with a drill or an air tool and the holes may be filled with organic material such as compost or other materials to improve aeration.
[12] Radial trenching is made in a radial pattern throughout the root zone and should extend at least as far as the dripline. The trenches are backfilled with native soil and compost and sometimes other amendments are added.

- Soil that has been polluted should be removed and replaced, where feasible/appropriate. Polluted soil near trees should be removed carefully as far as practicable with hand tools to avoid further damage to roots. Quality soil mix can be applied to improve nutrient deficiency due to the prolonged period of construction activities.

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APPENDIX 23 - Design for Tree Protection Zone

Proper Planting Practice

Design For Tree Protection Zone

For effective tree protection on site:

- the knowledge and understanding of tree protection and active participation of all levels of the project management, design and construction team is required.
- team work is essential.
- planning and demarcation of an adequate tree protection zone at the initial planning and design stage is essential; not as an after thought.
- the objective is to prevent damage rather than undertake remedial work afterwards since most damage is irreversible and cumulative.
- the major threats to trees in works areas are compaction, root damage and change in level. Robust protection fence shall be installed at the beginning of the construction phase and last through out the construction to protect trees.
- no dumping, storage of materials, change in level, excavation, cutting of roots/ branches or parking is allowed within the fenced area of the tree protection zone.
- regular inspection to check the health and structural condition of trees in construction site is required.
- contractors shall be reminded of their responsibilities under the contract to protect trees in construction site. Poor performance in tree works / protection should be reflected in contractor's performance reports.

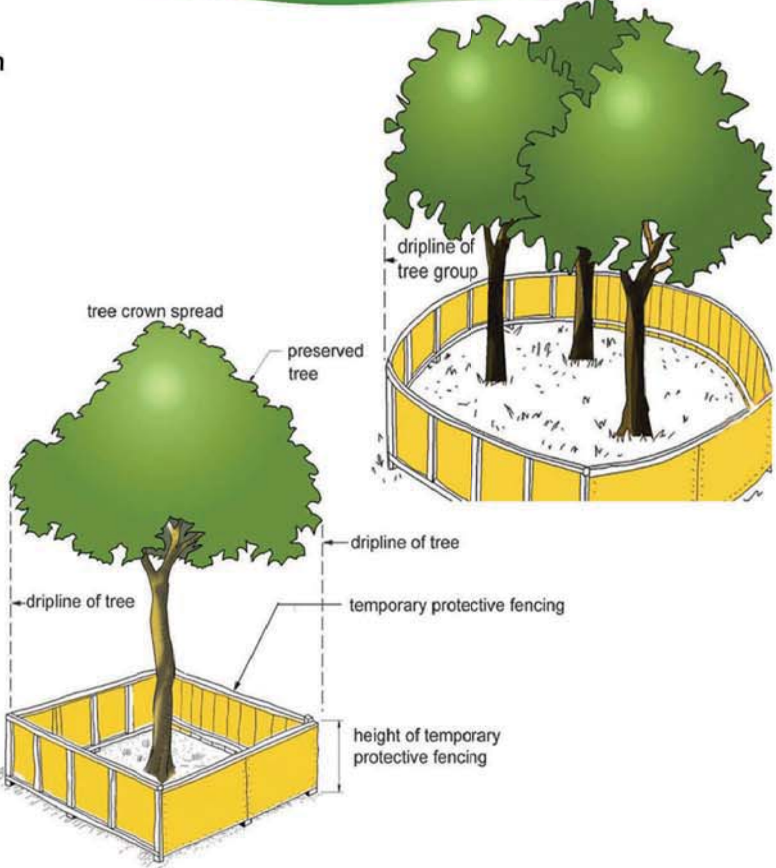

Diagram 1 Installation of robust fencing at tree protection zone throughout the construction period is required. (dripline is a good reference though consideration of larger zone is required for older trees)
No construction activity, dumping, storage of material and parking is allowed within the fenced area.
(Multiple trees above, Single tree below)

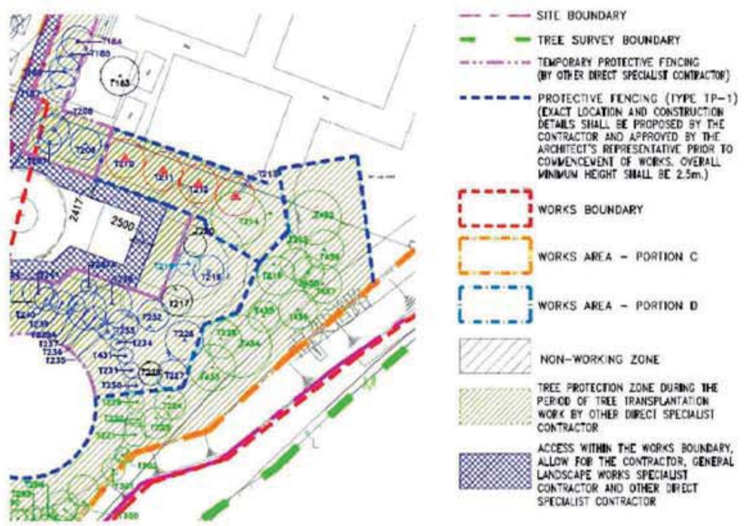

Diagram 2 Tree Protection Plan is a part of the contract drawings: with levels, tree protection zone, circulation routes indicated.

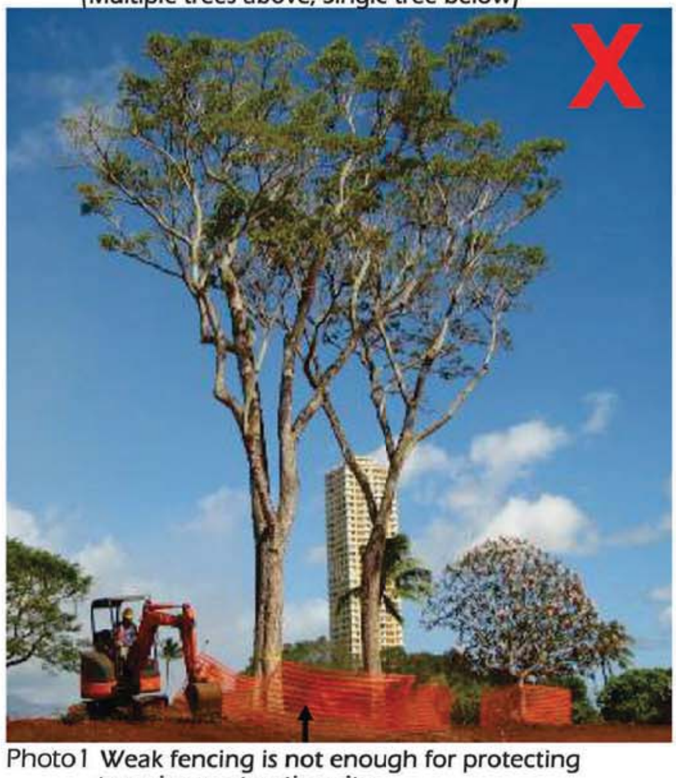

Photo 1 Weak fencing is not enough for protecting trees in construction site.

APPENDIX 24 - Guideline on Pavement Renovation Works and Tree Stability

Guideline on Pavement Renovation Works and Tree Stability

Greening, Landscape and Tree Management Section

Development Bureau

The Government of the Hong Kong Special Administrative Region

April 2013

Contents

1. Introduction

There is a keen competition for space in urban area. Trees are often found growing in tree pits or planters surrounded with concrete in paved area, with solid paving very close to the tree trunks. These trees often suffer from restricted growing space and the lack of air and water under impermeable surfaces. In some cases, tree roots grow vigorously and even uplift the pavement. While in other situations, roots may be cut off or damaged during pavement repair work.

A way to improve the growing environment of existing trees in paved area with confined growing space is to increase the area of permeable surface for better water and air movement to roots by removing or opening up the impermeable hard paving in a timely manner. However, precautionary measures have to be appropriately planned and implemented to ensure the stability of trees before works are undertaken.

2. Root Biology

Tree roots serve the primary functions of anchorage, storage, absorption and conduction. Larger roots play a major role in anchorage, storage, and conduction. Absorbing roots are small, fibrous, primary tissues that grow at the ends of and along the main, woody roots which are important for water and mineral uptake. Roots grow where moisture, nutrients and oxygen are available in soil. As a result, most absorbing roots as well as the horizontal, lateral roots grow near the soil surface. As roots need oxygen for growth, they do not penetrate into the compacted, oxygen-poor soil under impervious paved surfaces.

3. Ensuring Tree Stability for Pavement Renovation Works

Trees are highly adaptable to the surrounding environment. When roots come in contact with a hard surface, such as a concrete footpath or kerb, they tend to grow along the hard surface and sometimes even integrate with features such as tree grilles when tree pits are not enlarged or tree grilles not removed / adjusted in a timely manner. (Fig. 1).

For some tree species with aggressive roots, they may lift the paving when their roots grow under the paving (Fig. 2).

To ameliorate the situation, pavement renovation is sometimes undertaken to enlarge the space or opening at the root crown. It would be comparatively simple to remove paving blocks in areas with flexible paving. However, in locations with inflexible concrete pavement and / or kerbs around tree pits or planters, when the rigid concrete is removed, the sudden loss of the support provided by the hard surface could lead to toppling of trees. It is therefore important to plan ahead for the works, assess the site situation and stability of the trees, provide additional support as appropriate before the works commence, and implement the work with personnel of suitable expertise under proper supervision.

Fig. 1 The tree roots grow along hard surface

Fig. 2 Pavement lifting caused by root growth

4. Lessons Learnt from Past Incidents

4.1 Case 1

A *Ficus microcarpa* (Chinese Banyan) collapsed after removing the adjacent concrete paving (Fig. 3). It was revealed that the concrete tree pit and the structural roots were bound together. There was no additional support provided to the tree before the removal of paving.

Fig. 3 *Ficus microcarpa* collapsed during repaving

4.2 <u>Case 2</u>

Another *Ficus microcarpa* (Chinese Banyan) collapsed during tree pit enlargement works when the surrounding pavement around the tree pit was removed (Fig. 4).

Fig. 4 *Ficus microcarpa* collapsed during tree pit enlargement works

Both trees in the above cases grew in small tree pits and most roots were confined in the small, restricted growing space. The rather large trees with wide crown spread had inadequate anchorage. The concrete rims of the tree pits were held in place by the adjacent rigid concrete paving, and in turn provided support to the trees. Once the concrete paving adjacent to the trees was removed, the sudden loss of the support induced the collapse.

5. Precautionary Measures for Renovation / Works or Removal of existing hard surface around trees

For trees growing in confined pits surrounded by rigid hard paving instead of flexible paving, the stability of the tree may be adversely affected if the hard surface is removed suddenly. The following precautionary measures are recommended:

(i) Planning

It is necessary to plan ahead before works. The site situation and condition of the tree including the pattern and distribution of roots should be checked. The rigid paving material such as *in-situ* concrete surrounding the trunk base might have provided some degree of support to the tree. Therefore the potential effect of the works on the stability of the tree has to be assessed. The extent of the work may have to be adjusted accordingly. Contractors should employ competent personnel with arboricultural knowledge to plan and implement works around trees. Site supervisory staff involved should also be trained and briefed of the precautionary measures.

The need of a permanent and robust support system should also be considered in the long run in particular for trees with large canopies and have been confined in restricted tree pits with rigid paving for a prolonged period.

(ii) Temporary support

Proper temporary support by means of either staking, guying or propping should be provided before commencing the works. The temporary support may be removed subsequent to the work after the stability of the tree is ascertained.

(iii) Site work and supervision

It is advisable to hand dig the hard surface, instead of using machinery, in phases around a tree. After the removal of hard surface, if soil backfilling or mulching cannot be arranged immediately, exposed roots should be covered by clean and moist hessian to prevent desiccation and to protect the roots from rapid temperature and moisture changes. No roots should be cut without the supervision of personnel with arboricultural knowledge.

6. Other Recommended Practices

For long term healthy growth of trees in paved area, the following practices are recommended:

(i) Design for sufficient space for tree growth

For the healthy growth of trees in the long run, providing a planting area with sufficient space for tree roots to grow is generally preferable to growing trees in pits with limited space (Fig. 5).

Fig. 5a & 5b Healthy tree growth in planting strips

In situations with site constraints, and tree pits or planters are used, their sizes should be maximized as far as practicable to allow sufficient space and drainage for tree growth. Several tree pits can be joined together to form a larger planting area.

Adjacent paving design is also important for providing a desirable environment for tree growth, keeping the tree in good health condition, and avoiding future maintenance problems. In general, a tree should not be surrounded by concrete around the root collar (Fig. 6). Sufficient space should be allowed at the base of trees (Fig. 7). Permeable paving which allows penetration of air and water in general is recommended.

Fig. 6 A bad example showing a tree surrounded by concrete around the root collar

Fig. 7 Adequate unsealed space around the base of trees

(ii) Right tree for the right place

Choosing the right tree to match a particular site is the fundamental principle of tree selection. Sufficient space both above and below ground has to be provided for the ultimate size of trees. Large canopy trees are suitable for a site that have sufficient space for the mature size of the trees and are not appropriate for narrow pavements. Trees with aggressive roots / buttress roots such as *Ficus* species are in general not suitable for planting in confined tree pits (Fig. 8) and along narrow pavements.

Fig. 8 Trees with aggressive roots in confined tree pits

(iii) Adequate unsealed space around the base of trees

Adequate unsealed space should be provided around the base of trees for infiltration of water and air into the root zone.

(iv) Expandable tree grilles

Expandable tree grilles with adjustable panels or flexible and permeable paver blocks on sand base (Fig. 9) that can be easily removed / adjusted to allow for growth of trees should be used. They should be adjusted in a timely manner.

Fig. 9 Permeable paver blocks on sand base

(v) Soil corridor / Soil vault

The use of soil corridor and soil vault may also be considered to provide adequate soil volume underneath the pavement for healthy growth of trees.

(vi) Soil Quality

In general, it is necessary to ensure that the soil composition and quality in the planting area are suitable for tree growth. Soil may be ameliorated as appropriate before planting.

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APPENDIX 25 - Sample of Tree Maintenance Record

APPENDIX 25 – SAMPLE OF TREE MAINTENANCE RECORD

Tree Maintenance Record

General Location: Inland Lot No. XYZ, ABC Building

Specific Location: Podium Garden

Month / Year: July 2015

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri
Weather (e.g. sunny, cloudy, raining, typhoon, etc.)																																
Maintenance Item	**Remarks**																															
(a) Pruning	(e.g. Cleaning for T2)														X																	
(b) Watering			X				X			X				X							X			X				X			X	
(c) Fertilising																																
(d) Weeding				X							X							X							X							X
(e) Mulching				X																												
(f) Staking	(e.g. Adjust staking)						X																									
(g) Pest and Disease Control																																
(h) Others	(e.g. Inspection after inclement weather)										X																					

[Mark 'X' if action taken]

Remarks: __________

Attachement : ☐ Tree record photo(s) ☐ Tree Layout Plan(s) ☐ Other(s) __________

Prepared by: __________ Signature: __________ Post: __________ Date: __________

Reviewed by: __________ Signature: __________ Post: __________ Date: __________

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