TREE ASSESSMENT

European Tree Assessment Standard

European
Arboricultural
Standards

European Arboricultural Standards

EUROPEAN ARBORICULTURAL COUNCIL EAC

EUROPEAN ARBORICULTURAL STANDARDS

Tree Assessment Standard	2025

BG: Оценка на състоянието на дърветата
CS: Hodnocení stavu stromů
DA: Trævurdering
DE: Baumkontrolle und Baumuntersuchung
EL: Αξιολόγηση δένδρων
EN: Tree Assessment
ES: Inspección de árboles
ET: Puude hindamine
FI: Puiden kunnon arvioiminen
FR: Diagnostic de l'arbre
GA: Measúnú crann
HR: Prosudba stabala
HU: Favizsgálat
IT: Valutazione degli alberi
LT: Medžio būklės vertinimas
LV: Koku vērtēšana
MT: Kejl tar-riskju mis-siġar
NL: Boomcontrole
PL: Ocena drzew
PT: Avaliação de árvores
RO: Evaluarea copacilor
SK: Hodnotenie stavu stromov
SL: Ocena stanja drevesa
SV: Trädbesiktning
UK: Оцінка стану дерев

We are very grateful for all the comments and support from national arboricultural representatives and individual arborists across Europe, who responded to the call for cooperation on the text of this standard.

This standard is intended to define the approaches to assessing amenity trees.

Co-funded by the Erasmus+ Programme of the European Union

The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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Recommended reference:
European Tree Assessment Standard (2025). EAS 04:2025. European Arboricultural Standards (EAS), Working group “European Consulting Standards in Tree Work (ECoST).

EAS 04:2025 (EN) – European Tree Assessment Standard.

If you want to translate text of the standard to other languages, please contact the project leader on info@arboristika.cz

Contents:

1. Purpose and content of the standard

1.1. Purpose

1.1.1 This standard was published by the working group of the ECoST project (European Consulting Standards in Tree Work) in cooperation with the EAC (European Arboricultural Council) and has become available in February 2025.

1.1.2 In the text of the standard following formulations are being used:
- where the standard says „can", this refers to possible options,
- where the standard says „should", this refers to a recommendation,
- where the standard says „must", this refers to mandatory activities.

1.1.3 The purpose of the standard is to present the common procedures, requirements and methods related to tree assessment. Aim is to maintain trees, manage related risks in order to support biodiversity and other tree benefits and values. The standard presents common fundamental practices used among European countries.

1.1.4 The standard provides methodological guidance for persons engaged in consulting in arboriculture. It serves as a reference for safety requirements for those engaged in general consulting services in field of tree work.

1.1.5 Each person shall be responsible for his or her own safety on the job site and shall comply with the appropriate federal or state professional safety and health standards and all rules, regulations that are applicable to his/her own action.

1.1.6 The authors of this standard do not assume any responsibility for the actions taken by individuals based on the information provided in this standard.

1.1.7 In tree assessment and the subsequent tree management, each party involved has a well -defined role to play:
- The tree owner or manager should take reasonable and proportionate action to keep his/her tree safe and fit for delivering its ecosystem services. The tree owner makes the final decisions about management actions to be undertaken.
- The tree assessor must apply appropriate assessment methods and propose appropriate recommendations for management (if any). As and when necessary, specialists and/or tree workers must be consulted to complement his/her competences, observations, and analysis.
- The tree worker/arborist must execute the proposed management recommendations. If his/her observations or analysis differ from the assessors' observations or conclusions, consultation with the assessor or the tree owner/manager is required for clarification.

1.1.8 **Tree inventory** is an essential task which precedes the tree assessment and informs several of the assessment process. Information, gathered by tree inventory is listed in Appendix 1 and in national annexes.

1.1.9 Tree inventory includes the recording of following parameters:
- Tree identification (positioning, tagging)
- Taxonomic data (tree species, cultivar)
- Dendrometry (dimensions of stem and crown).

1.1.10 Tree assessment usually takes place in the following steps depending on the input of the tree owner/manager and the complexity of the subject of assessment:
- Basic tree assessment,
- Advanced tree assessment.

1.1.11 The three steps (tree inventory, basic and advanced tree assessment) can be performed in one action if applicable/necessary.

1.1.12 **Basic tree assessment** is the process of evaluating the physiological condition or mechanical integrity of trees in order to identify tree value, potential risks, or other issues that may require attention. It is caried out for individual trees, from ground level and from all possible angles using visual and other sensoric methods and simple tools, allowing immediate interpretation. The main objective of tree assessment is to determine the current state of the tree as well as to identify any factors that could impact its value, health, or safety.

1.1.13 If needed, **advanced tree assessment** takes place as a follow-up stage of the basic tree assessment. It can take the form of either a more detailed and complex visual assessment, modelling and calculation methods, device-supported methods, specialist deployment, etc. The advanced tree assessment can follow right after the basic tree assessment and by the initial assessor (if he/she has sufficient competence) or by an assessor with specific competences if needed.

1.1.14 The tree assessment process is divided into several phases, as shown in diagram 1. These phases may or may not be formalised. However, it is important that they are carried out in the order shown.

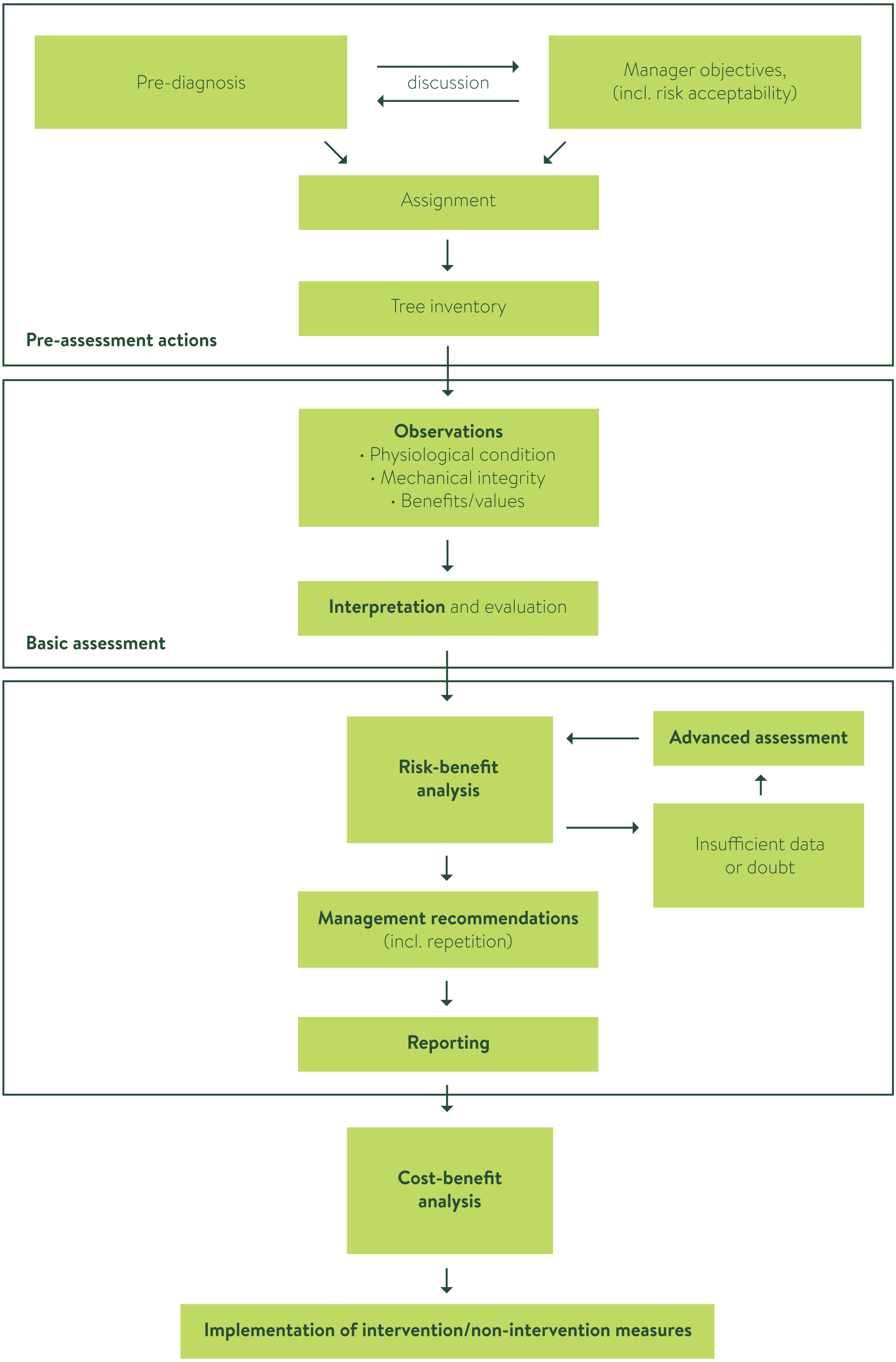
1.1.15 The outcome of the tree assessment is a report to guide tree care or management decisions.

1.1.16 **Tree risk assessment** is a systematic process to identify, analyse, and evaluate the risk associated with the tree. It can be part of tree assessment but is not a synonym of it (see chapter 7).

1.1.17 **Worksite inspection** is a visual observation of a tree and work area, not the full tree assessment. It is conducted by a tree worker prior to starting work for his/her own safety. If serious defects or conditions of concern are identified, a different work plan may be implemented. The purpose of a worksite inspection is to communicate site and/or tree conditions that may affect the scope of work, work procedures, and/or tree worker safety. Observations from the inspection that affect the scope of work or worker safety should be communicated to the supervisor and other workers on the site.

1.1.18 Arborist's worksite inspection before starting work, drive-by survey or tree inventory are not considered to be tree assessment as defined in this standard and are thus not within the scope of this standard.

Diagram 1: General overview of the tree assessment process



1.2 Main objectives

1.2.1 The main objective of tree assessment is to specify management to maintain trees as long as reasonably possible in best possible conditions, for the benefits they deliver.

1.2.2 It is impossible to maintain trees completely free of risk; some level of risk must be accepted to experience the benefits that trees provide. According to the NTSG[1] five key principles should be considered for managing tree safety in the public interest:

- Trees provide a wide variety of benefits to society.
- Trees are living organisms that naturally lose branches or fall.
- The overall risk to human safety is extremely low.
- Tree owners have a legal duty of care.
- Tree owners should take a balanced and proportionate approach to tree safety management.

Additionally, trees provide habitats for a wide variety of associated species.

1.2.3 Given the unique nature of trees as living organisms, not all practices can be uniformly applied. The selection and application of procedures and techniques should be chosen and implemented based on necessity, while considering what is reasonable and proportionate to the distinct conditions and circumstances of each tree.

1.3 Biosecurity

1.3.1 Biosecurity requirements in tree assessment refer to the measures that are taken to prevent the spread of pests, diseases, and other harmful organisms that can impact the health and survival of trees.

1.3.2 Biosecurity measures in tree assessment can include:

- **Inspections:** Regular inspections of trees and surrounding areas can help to identify and control the spread of pests and diseases.
- Integrated pest management: sustainable biological, physical, and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
- **Movement control:** This can involve restrictions on the movement of trees, plant material, and soil to prevent the spread of harmful organisms between locations.

1.3.3 By implementing these biosecurity requirements, tree assessors can help to protect trees and the environment from the harmful effects of pests and diseases and ensure the long-term health and survival of the trees they assess.

1.3.4 People who are professionally involved in working around trees are inherently at high risk of transmitting pests and diseases between trees and worksites and thus should apply appropriate biosecurity procedures to limit this risk.

1.3.5 To reduce the risk of transmitting pests and diseases, the cleaning of tools and other equipment must be part of daily maintenance. All equipment should be cleaned and disinfected after use on each site. Follow the manufacturer's guidelines.

1.3.6 When work is carried out on and around trees with a high probability of being infected with contagious pests and diseases, increased biosecurity standards must be applied. National legislation applies.

1.3.7 If symptoms of quarantine diseases or pests[2] are found, finding must be reported to the national plant health authority.

1 The National Tree Safety Group, https://ntsgroup.org.uk

2 Regulation (EU) 2016/2031 of the European Parliament and of the Council of 26 October 2016 on protective measures against harmful organisms of plants.

1.4 Limitations of tree assessment

1.4.1 Tree assessment has a temporal limitation and refers to the current tree condition (at the time of the inspection) but does not consider changes and features that have occurred after it.

1.4.2 Not all characteristics and damages are possible to detect, and not all risks are predictable, which may be due to, for example, methods and tools used during the tree assessment or conditions during the assessment period.

1.4.3 In normal weather conditions, tree damage can often be predicted and prevented by systematic and expert assessment. However, any tree, whether it shows any signs of weakness or not, can be damaged by exceptional external forces, e.g. a gust of wind, heavy snowfall etc.

1.4.4 Tree assessment is not able to analyse the complete tree structure and features. Every assessment should contain specification and justification on what has been evaluated or assessed.

1.4.5 Stability of trees during basic assessment can be evaluated only by atributes that can be detected using available methods (sensoric, simple tools). The uprooting resistance is considered only partially on the basis of observable signs.

1.4.6 For a tree of great importance, the removal decision should never be based on a single diagnosis or method.

1.4.7 A level of certainty can be given to the results of the tree assessment. Where there is a high degree of uncertainty about the results of assessments, this should be clearly expressed and communicated to the owner/manager.

1.4.8 **Visual limitations.** Roots or the high zones of the crown (especially when structures are obscured by leaves/needles) may be inaccessible for performing basic tree assessment. In justified cases it may be necessary to apply methods of advanced assessment (see chapter 6).

1.4.9 Not all features are present (visible) throughout the year. Some specific (non-visible) features must be known in advance by their frequency in a given species or circumstances. For example, fruit bodies of fungi can be temporal, some fungi species don't fructify easily, but certain species has a quite known host species relationship.

1.4.10 Assessment and its results cannot be extrapolated to other similar trees around based only on the same species or dimensions.

1.4.11 Important limitations to all human judgments are bias and noise.

- **Bias** is a systematic deviation in judgments, with identifiable causes (e.g. risk aversion in tree assessment).
- **Noise** is random scatter in judgments, without any identifiable cause (e.g. multiple assessors coming to different conclusions for the same tree or the same assessor coming to different conclusions for the same tree when re-assessed).

1.4.12 Professionals involved in tree assessment must be aware of potential bias and noise in their assessments and strive to limit these through methodical approaches.

1.4.13 Scope, methods, and limitations of the tree assessment must be communicated with the tree owner/manager.

2. Normative references

2.0.1 This standard is complementary to other EU standards and national/regional regulations.

2.1 Qualification

2.1.1 Tree assessment is a professional activity that should only be performed by suitably trained and experienced professionals.

2.1.2 From the perspective of arboriculture these are examples of qualifications on international (EU) level, which can help with tree-related questions connected with tree assessment:
- European Tree Technician (EAC),
- VETcert Veteran Tree Specialist (Consulting level),
- ISA Board Certified Master Arborist.

2.1.3 Meeting the standards of professional qualification includes continuous professional development/lifelong learning[3].

2.1.4 Advanced tree assessment can be conducted by competent individuals who possess updated skills and knowledge through refresher training. The competencies necessary for advanced assessment extend beyond those required for basic tree assessment, encompassing a broader range of knowledge and skills. It is essential for individuals performing advanced assessments to have the appropriate expertise and training to effectively carry out this specialized level of evaluation.

2.1.5 National qualifications reference may be recognized locally. These are listed in the national annexes to this standard.

2.2 Professional posture

2.2.1 When performing tree assessment and defining management recommendations, a professional must be aware of the role he/she is taking, as this will influence the assessment process, the interactions, and the outcome of the assessment. Two following main professional postures an assessor can take:
- advisory posture,
- decision-making posture.

2.2.2 In some cases, an advisory posture is more appropriate, while in other circumstances (e.g. court cases) a decision-making posture is more appropriate and could be defined in the assignment.

2.2.3 When uncertain or unsure about a specific situation or decision, it is always advisable to seek further investigation (second opinion) or specialist advice. Consulting with another knowledgeable individual or seeking guidance from an expert in the field can provide valuable insights and help in making informed choices.

2.3 General safety requirements

2.3.1 Traffic and pedestrian control around the job site must be established prior to the start of all arboricultural operations incl. assessment (especially in case of device supported tests).

2.3.2 Arborists and other workers exposed to risk of roadway traffic must wear high-visibility safety apparel meeting the requirements of national regulations.

2.3.3 Tree assessors may encounter various circumstances that could present potential hazards. Prior to commencing the assessment, it is recommended to carefully observe and assess the tree and its surroundings for any notable risks, such as hanging branches or precarious trees.

2.3.4 If an immediate danger is identified, the assessment should be stopped, site should be secured if applicable and appropriate services (e.g. Fire Brigade) should be called.

2.3.5 Tree assessments should not be conducted during severe weather conditions (e.g., thunderstorms, strong winds, heavy rain, or snow), and the assessor's working environment must be safe.

[3] Example of qualification framework was developed in the framework of Erasmus+ Tree Assessor international project "Partnership for the development of training standards for tree diagnosticians in Central and Eastern Europe".

3. System of tree assessment

3.1 Introduction

3.1.1 Within the context of this standard, tree assessment, which occurs after conducting a tree inventory, comprises two primary elements:
- Basic tree assessment
- Advanced tree assessment.

3.1.2 Tree assessment comprises of tasks carried out at two levels: the site level and a detailed analysis of the specific tree under investigation.

3.1.3 The evaluation of all parts of the tree and its surroundings constitutes the core of tree assessment. This evaluation encompasses the following parameters:
- Physiological condition
- Mechanical integrity
- Benefits/values

3.1.4 Furthermore, it includes a final risk/benefit analysis, the formulation of management plan, and concludes with a cost/benefit analysis (refer to Diagram 1).

3.1.5 In general, it is advisable to rely on established methods when collecting and interpreting data about symptoms during the tree assessment process.

3.1.6 In cases where the assessor encounters evident signs of primary failure (e.g., partially broken or uprooted tree) that have occurred recently and where it is impossible to determine the timeframe before secondary (complete) failure, it is imperative to promptly inform the tree owner/manager. Additionally, a proposed course of action should be provided for addressing the situation (also see 2.4.4).

3.2 Timing of tree assessment

3.2.1 Tree assessment should not take place in periods and circumstances, when conditions obstruct good observations (for example: snow coverage, stem cover by climbing plants etc.).

3.2.2 Physiological condition can be assessed throughout the year, but the actual methods must be adapted to the situation.

3.2.3 Identity of ephemeral fruiting bodies of wood colonising fungi can be determined only in their typical season of appearance (typically late summer — autumn).

3.2.4 The presence of associated organisms might vary throughout the year.

3.2.5 To ensure an accurate assessment of the physiological condition following a recent disturbance such as fire or intensive thinning, it is recommended to wait for a period of 2-3 years before conducting the initial assessment. This waiting period allows sufficient time for the tree to respond and exhibit any relevant reactions.

3.2.6 It may be necessary to conduct a mechanical integrity assessment soon after a recent disturbance, or at shorter intervals than originally planned. This proactive approach ensures that potential safety hazards resulting from the disturbance are promptly identified and addressed.

3.3 Symptoms

3.3.1 Symptom is an observable feature that may attest to the tree itself, but also can be related to a dendromicrohabitat or the conditions on the site where the tree is growing. Symptoms must be identified, assessed, and evaluated in the tree assessment process as they supply information of importance in regard to tree's physiological condition or mechanical integrity.

3.3.2 In this standard, the term "symptom" is employed to describe a feature, or characteristics observed in a tree, which is distinguished from the concept of a "defect" used to evaluate wood quality. This differentiation acknowledges that various wood defects are natural attributes that impact the appropriateness of wood for specific economic purposes but may not hold significance when assessing the physiological or mechanical condition of the tree itself.

3.4 Legal tree status

3.4.1 **Heritage trees** (tree monuments) are trees that has been identified as having exceptional cultural, historical, or ecological value. These trees are recognized for their unique features, such as their size, age, beauty, or historical significance. They are protected by law in many countries, and efforts are made to preserve them for future generations to enjoy.

3.4.2 Heritage trees can be found in a variety of settings, including parks, gardens, forests, and urban areas. They may be associated with important historical events, landmarks, or cultural traditions, or they may simply be admired for their natural beauty.

3.4.3 In some cases, heritage trees are given special recognition and protection through government or community initiatives, such as tree conservation programs or heritage tree registries. In several countries they enjoy legal protection (see national annex).

3.4.4 **Tree species protection** refers to the conservation and preservation efforts aimed at protecting individual species of trees from extinction or endangerment. This can include a variety of measures, such as the protection of critical habitats, the regulation of harvest and logging, the introduction of species in new areas, and the implementation of breeding and replanting programs. The goal of tree species protection is to ensure that future generations will be able to enjoy the ecological, economic, and cultural benefits that trees provide. It is also important for maintaining biodiversity and the overall health of ecosystems.

3.4.5 Protected species of trees are listed in national annexes.

3.4.6 **Invasive tree species**. Some tree species are listed in the Invasive Alien Species Regulation[4] and approach to them must be modified during the tree assessment and definition of management plan.

4 The Invasive Alien Species Regulation (Regulation (EU) 1143/2014) includes a set of measures to be taken across the EU in relation to invasive alien species. The core of the Regulation is the list of Invasive Alien Species of Union concern (Union List). The species included on this list are subject to restrictions and measures set out in the Regulation. These include restrictions on keeping, importing, selling, breeding, growing and releasing into the environment.

4. Site description

4.1 Growing conditions

4.1.1 Site conditions encompass various spatial, physical, chemical, and biological factors specific to a particular location, which directly impact the growth, survival, and risk analysis associated with trees.

4.1.2 Site factors significantly influence the genetic strategy of tree colonization in terms of space and soil. The environment's deficiencies prompt trees to develop adaptive survival mechanisms. Conducting a thorough site study is crucial for comprehending the tree's structure, potential tendencies, and consequences.

4.1.3 **Soil:** Factors such as soil type, quality, condition, fertility, water retention capacity, pH and soil ecosystem significantly influence the conditions of a given location.

4.1.4 Root depth and distribution can influence the stability of trees. For instance, in well-watered grass areas or locations with a high water table, root distribution may be more superficial, while physical barriers like compacted soils can alter the shape of tree roots. Trees typically adapt to these conditions. However, compacted soils impede root growth, and the absence of roots in certain areas can compromise tree stability under extreme conditions or in the presence of new diseases.

4.1.5 **Root system architecture:** Roots primarily grow for physiological reasons before transitioning into mechanical roots. Therefore, the availability of nutrients, oxygen, and water determines the spread of roots. For example, long-term watering systems near the trunk can result in a healthy yet unstable tree.

4.1.6 **Topography:** The land's shape, including slope, aspect (direction), and elevation, affects sunlight exposure, wind patterns, and water drainage, all of which impact trees.

4.1.7 **Light:** Trees require light for photosynthesis and energy production, with different species having varied light requirements. Light distribution affects physiological conditions and crown geometry. Analysing light conditions and their effects is crucial for assessing a tree's physiological condition, slenderness, excessive lateral growth, and more.

4.1.8 **Water:** Adequate water supply is essential for tree growth, and the availability and quality of water in a specific location influence the patterns of tree development.

4.1.9 **Wind** is the most important mechanical stress associated to tree failure. The effect of wind on tree structure varies widely. Meteorological data should be collected in order to determine the average wind speed and wind direction. Some of the most important factors that influence wind and its effects on trees are:

- Presence of prevailing directions of winds that generate growth adaption (e.g. asymetric crown development or excentric trunk developement).
- Orography[5] of the environment that can reduce or concentrate winds in a certain point (tunnel effect). Protection due to buildings or other trees.
- Branches protected or exposed by tree crown configuration.
- Typical maximum wind speed of the zone must be considered[6].
- Mismatch caused by winds against the habitual direction, loss of protection (exposure), excessive pruning etc.
- Tree aerodynamics and damping capacity mitigate the wind impacts. These strategies must be evaluated.
- The aerodynamic coefficient (drag coefficient) is very difficult to determine but references and guidelines can be found in litterature. Using different values can be used only in justified cases. Increments of wind impact are substantial, e.g. in trees with higher aerodynamic coefficient, by branches reaching out of the crown volume.
- Special features of the tree structure can make a tree more sensitive to increased wind stress (e.g., slenderness).

5 Orography refers to the description of the physical geography of mountains and hills, including their shapes, heights, and arrangement. It involves analyzing the topographical features and landforms associated with elevated terrains.

6 Consult the national annex to EN 1991-1-4 - Eurocode 1: Wind actions on structures.

4.1.10 **Influence on root system:** Particularly in shallow soils, mechanical root injury might increase the likelihood of uprooting. An investigation must be carried out, managers questioned, and the appropriate zone must be evaluated for signs of current or previous construction works during the tree assessment. For instance, the ground level rising or falling, trenches, etc.

4.1.11 The effect of these works on the condition of the roots varies substantially with their distance from the trunk of the tree being assessed. See EAS 06:2025 – European Tree Protection Standard.

4.2 Site usage

4.2.1 Site usage is an important parameter that enters the general risk assessment as a definition of a **target**. Targets are people, property, or activities that could be injured, damaged, or disrupted by a tree failure. Targets include people, buildings, animals, power lines, infrastructure, vehicles, landscape structures, and other property.

4.2.2 Target can be expressed as a quantified, probabilistic estimate of the prevailing parameter of the tree site.

4.2.3 The **target zone** is the area that the tree or tree part is likely to land if it fails. The target zone can vary by failure mode. For example, the target zone may be much larger if considering whole-tree failure than it would be for failure of a single dead branch. When determining the target zone, the assessor considers the direction of fall, the height of the tree, crown spread, topography, wind, potential for dead branch shattering, or other factors that might affect spread of debris.

4.2.4 It is preferable to consider targets in consultation with the tree risk manager, so that targets that are not present at the time of the assessment may be included, and assessor can gain information about the amount of time various targets are present. The frequency/intensity of target zone occupancy can vary considerably with time of day, day of week, inclement weather, etc. and the tree risk assessor's perception of occupancy rates can also be affected by the length of time they spend onsite performing the assessment.

5. Basic tree assessment

5.1 Development phase

5.1.1 For the purposes of this standard, development phases of trees are defined in Table 1. The scale presented below is consistent with other European Arboricultural Standards, in particular EAS 01:2025 - European Tree Pruning Standard. The scale is based on tree's ontogenetic characteristics and its visible morphological features. Characteristics of development phases may vary between tree species. Individual development phases may be distinguished by the tree assessor if needed considering national/regional specification.

Table 1: Basic development phases of trees

Development phases	Description
Youth	Characterised by strong apical dominance and prevalent height growth. Crown structure may be transitional between the temporary and permanent crown (in the case of the need to maintain clearance) and can be made subject to crown-shaping measures. It is usual for this phase to continue for up to 20 years after planting.
Maturation	An acclimatised tree which shows expansion of the crown even as clear apical dominance remains. Where trees have been shaped, this will be the time at which there is achievement of the target height for the lowest point of attachment of crown branches.
Maturity	The tree has attained or is close to attaining its maximal crown dimensions (given the species, location, and site type) in which apical dominance is now weakened. The structure of the crown is also now of a more permanent nature (it is not temporary).
Ancient (veteran)	A tree that has reached an age exceptional for a representative of its species, often manifesting this in greater trunk thickness than would be typical. Where species are long-lived, this phase may prove the longest in a tree's life. It is quite possible that the crown will manifest peripheral dieback, with a secondary crown taking shape at a lower level (in a phenomenon otherwise known as crown retreat). Such trees are often of high natural and cultural value. This phase sees the interior of the trunk featuring many flaws, scars, wounds, and hollowed-out areas, all of which can provide microhabitats for other species.

5.1.2 Within the framework of this standard, an **ancient (veteran) tree** is characterized as a tree that:

- has reached significant size for the given species,
- has reached significant age for the given species, taking into account its growing conditions and location,
- shows significant increases in biodiversity value (cavities, wood decay etc.),
- may show changes in the crown architecture and a gradual process of natural crown retrenchment (transition from the primary to a secondary crown lower down on the stem and main branches).

5.1.3 Ancient (veteran) trees often enjoy formal protection in given country or region. During pruning and related operations, any changes in site conditions must be carefully considered and minimised if possible.

5.1.4 **Chronological age** does not correlate strongly with developmental phase, except in young trees.

5.2 Life expectancy

5.2.1 The life expectancy of a tree is a projection of its lifespan. Life expectancy is associated with physiological and mechanical condition that lets the tree react to physiological and mechanical stress.

5.2.2 In the relation to cost/benefit analysis, useful life expectancy expresses the time horizon when the tree will have a positive cost/benefit balance.

5.2.3 Determination of the useful life expectancy is important to provide the correct actions derived from the tree assessment process.

5.2.4 Life expectancy is a subjective conclusion of the assessor based on professional estimate.

5.2.5 **Interactions.** All conflicts with adjacent objects and interactions with surrounding trees must be taken in account in the process of tree assessment together with their effect on the expected life expectancy.

5.3 Physiological condition

5.3.1 Physiological condition of a tree within scope of this standard is based on visual analysis of crown structure, leaf density and quality, signs of dieback and regeneration and defines a tree's capacity to go on living (but also to develop and grow and regenerate).

5.3.2 Physiological condition assessment is independent of that involving mechanical condition.

5.3.3 Different parts of the same tree may display differentiated physiological condition, the principle applied involves assessment of the upper part of the tree crown. It is also necessary for physiological conditions to be understood in the context of a tree's development. Different parts of a veteran tree (functional units) may require separate physiological condition assessments.

5.3.4 Note that all the above characteristics differ between tree species, development stage and location. The assessment must focus on the deviation from what would be considered normal for that tree species and development stage on that specific location.

5.3.5 The terminology used to describe the physiological functioning of trees varies among countries, including terms such as *condition*, *vitality*, *vigour*, and others. Additionally, the definitions of these specific terms may differ across regions. Some terms refer to the current physiological state or diagnosis of the tree, while others are used for prognostications of its future physiological state, such as *resilience*, *retrenchment*, or processes of *decline*.

5.3.6 The ability of a tree to react and respond is influenced by factors like species, developmental stage, individual genetics, and others. Assessing the reaction potential of a tree is generally considered challenging, either because the potential has not yet been expressed or because the signs are difficult to interpret. In any case, it should be supported by one or more specific methods in order to avoid a tendency to subjectivity and a strictly intuitive appreciation.

5.3.7 In addition to environmental characteristics, the physiological condition of trees is also influenced by the occurrence of pests and diseases. Their occurrence is part of the record of associated organisms. If signs of quarantine diseases and pests are found, the National Plant Health Service must be contacted.

5.4 Mechanical integrity

5.4.1 A mechanical analysis is mainly focused on the assessment of the structural condition of the roots, trunk and crown, each of which can be weakened or damaged independently of the others. An observation of symptoms must be performed in a systematic manner (clinical approach). These symptoms are qualified positively or negatively, using analytical reasoning based on the combination of the severity of the observed features and the level of adaptation of the tree.

5.4.2 A structural analysis can be composed of several possible observation actions:

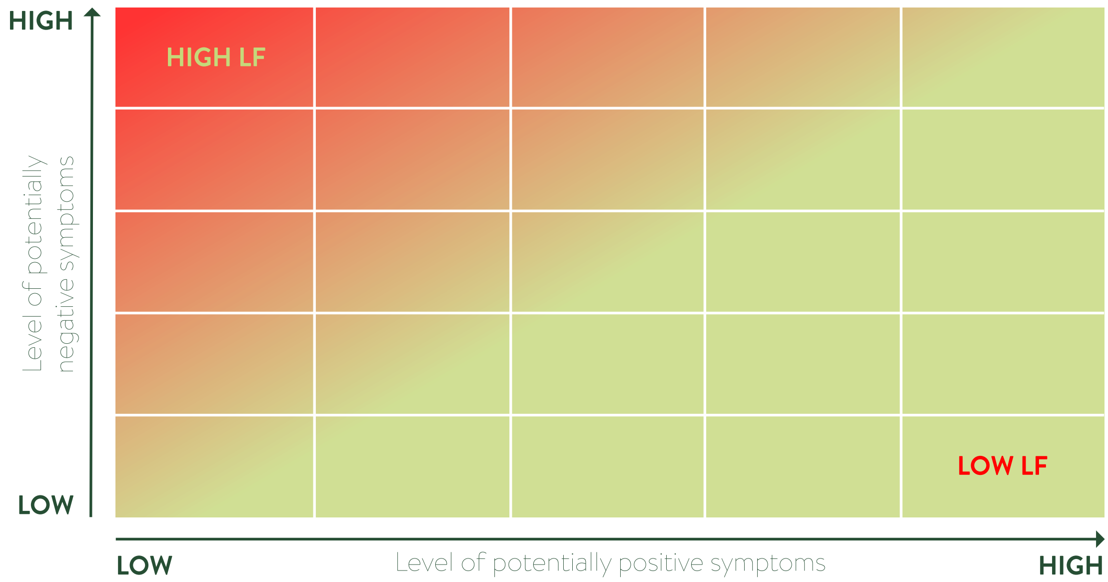
- **Visual observation:** then if the observations justify it, an examination phase based on methodical actions,
- **Sound test:** through the search for differences by tapping by mallet, allowing the identification of cavities, bark peeling or some other symptoms,

- **Motion:** which is the action of physically moving a trunk, a branch, or a fork, in order to identify a stiffness changes, an anchoring particularity, etc.,
- **Simple additional examination:** using of a probe, a rough excavation of the root collar, a tool to remove dead bark or to reveal wound wood, etc.

5.4.3 This assessment, carried out with the help of specific simple tools, allows the assessor to gather objective, and immediately interpretable conclusive information and data, which are sufficient to make a diagnosis in most situations.

5.4.4 The combination of positive and negative factors is used to assess the likelihood of failure (LF) of the tree or its parts. In case of difficulties, doubts, or a high LF, it is recommended to use additional assessment methods and tools such as flowcharts, matrix, or scores.

Figure 1: Example of combination of potentialy positive and negative symptoms to estimate likelihood of failure (LF)



5.4.5 The LF must always be adjusted according to certain criteria:
- experience with tree species (positive or negative),
- recent change in surroundings (favourable or unfavourable),
- load reduction or increase.

5.4.6 Following list provides reasons to consider which can **increase LF**:
- recently isolated (exposed) tree,
- excavations close to the trunk,
  - root damages,
  - technical and building infrastructure close to the tree (and possibly indicating damage to roots),
- imundation of the ground.

5.4.7 Possible **moderations** can be following:
- long time since the event,
- reduced load, artificially or naturally (breakage)
- dominated tree and/or high roughness,
- very low slenderness factor.

5.4.8 The presence of deadwood must also be carefully observed. In the crown of a tree, dry branches and limbs are referred to as deadwood. These are sometimes expected to fail soon. In the case of some species with true heartwood, dry limbs may be durable and may last for decades.

5.4.9 The result of the diagnosis is a qualitative or quantitative evaluation of the likelihood of failure of a part of the tree. To determine the LF of the tree, the different LFs are not averaged, but the most severe one is used.

5.5 Benefits and values

5.5.1 The expression of tree benefits and values is essential for determining the balance between associated risks and benefits. It serves as a critical tool to counteract a solely "risk-oriented" perspective that may lead to unnecessary tree removals.

5.5.2 **Benefit value.** The extent of the current and future benefits estimated of a tree to its environment, including both tangible and intangible benefits, all elements that go beyond the general basic value of the tree as a biological element and that represent an obvious increase in the biological or sociological potential (fulfilment of positive benefits) of the tree.

5.5.3 Assessing the value of tree benefits involves analysing the ecosystem services provided by the tree, identifying, and evaluating dendromicrohabitats, as well as assessing the significance of associated organisms. This evaluation can be conducted using scoring methods to determine the importance and impact of these factors.

5.5.4 Note, that in certain circumstances the benefit value of a tree in question can be very low, for example due to the invasive potential of given tree species.

5.5.5 **Tree ecosystem services** are advantages that come from trees for both people and ecosystems. These include many areas (see Table 2).

Table 2: Overview of tree benefits

	Main areas of tree benefits
Regulation services	o Climate regulation o Disease regulation o Water cycle regulation o Water purification o Pollination
Cultural services	o Spiritual and religious o Recreation and ecotourism o Aesthetic o Inspirational o Educational o Sense of place o Cultural heritage
Support services	o Soil formation o Prevention of erosion o Nutrients cycling o Biodiversity support
Provisioning services (products obtained from trees)	o Food o Fuelwood o Fiber o Biochemicals o Genetic resources

5.5.6 The efficacy of trees in providing benefits is frequently quantified in monetary terms, leading to the concept of tree value.

5.5.7 Tree value is used to get to know the assessed tree better, to raise awareness of its presence, to prevent damage, and to sanction in case of damage. Methods of tree value calculation are described in EAS 05:2025 - European Tree Valuation Standard.

5.5.8 All trees should be considered as a unique and indispensable ecosystem. This is one of the main reasons to keep trees as long as possible.

5.5.9 Most valuable trees for biodiversity are often old or ancient /veteran and their management requires special attention and sensitive management.

5.5.10 Presence of **dendromicrohabitats** should be noted during the tree assessment.[7]

5.5.11 Each dendromicrohabitat provides very specific conditions depending on its characteristics: size, shape, position in the tree, degree of decomposition of the surrounding wood, state of the bearing tree (living or dead), exposure to sunlight, etc.

5.5.12 Each associated species prefers a specific type of dendromicrohabitat. The more diversified the microhabitats in a stand, the greater the variety of species that can find the right conditions to thrive there. Since dendromicrohabitats have a limited life span, the more often the same type of microhabitat occurs in a stand, the easier it is for its associated organisms to colonize a new microhabitat when their previous support disappears.

5.5.13 **Associated organisms**. Ideally, all organisms directly associated with the tree should be listed. The analysis can be done indirectly through the microhabitats present or directly listing the organisms present. The visual assessment usually shows aspects of the tree to assign a basic biodiversity category.

5.5.14 Mosses / lichens: can be easily seen on the bark. Their identification however can be difficult and needs specialized professionals. Some mosses / lichens are protected. In these cases trees can't be affected (or its environment or conditions) or cut down without taking in consideration its biodiversity.

5.5.15 Plants / ferns: can be easily seen on the surface of stem or branches. The tree (or its environment or conditions) can be affected for example by shading of the lower parts of the crown.

5.5.16 Wood and bark harbour a diverse array of insects. Detecting their presence is often indirect, indicated by secondary signs such as sawdust, small hollows, and more. Identifying these insects can be challenging and may require the expertise of specialized professionals.

5.5.17 Mammals are not easy to be detected in trees. Indirectly some aspects can indicate their presence. Indirect identification often needs specialized professionals.

5.5.18 Bird nests are readily observable on trees, while nests of nocturnal birds pose a greater challenge, requiring indirect identification methods. When conducting management activities related to tree risk, it is crucial to consider the nesting season and take appropriate precautions.

5.5.19 Evidence of associated organisms includes not only species important for biodiversity, but also diseases and pests of trees with the potential to disturb their physiological or mechanical integrity.

5.6 Metadata

5.6.1 Metadata or 'data about data' gives information on other data collected within the tree assessment process. Metadata should describe the context in which the data is collected. From metadata, users should be able to understand how the data was collected, and its spatial and temporal coverage.

5.6.2 The **date of the tree inventory** or last update (check) must be included in the record for each tree[8]. The collection date should be updated on each resurvey.

5.6.3 **Tree planting date**. It is preferable to note the precise year (day) the tree was planted in its permanent habitat when this information is available.

5.6.4 Where applicable, the tree assessment report should include the **date of the tree removal**. Format of the record is in accordance with 5.6.2.

7 For generally used system of microhabitats classification see https://informar.eu/tree-microhabitats or www.wsl.ch/fg-trems.
8 It is advisable to store the date in the EN ISO 8601 format (DD-MM-YYYY).

5.6.5 **Photograph of tree**. Photographs often serve as a reliable source for validating tree information due to the extensive data they provide, which can be evaluated by human inspectors or processed through machine learning algorithms.

5.6.6 Photographs should be focused on the topic (general view at the tree, detail of symptom, detail of associated organism etc.), crisp, clean of fingers, and as close to the subject as possible while yet exhibiting the entire subject. If at all feasible, a scale-indicating item of roughly known size can be used. Photos shot from the same viewpoint across time are best for documenting change.

5.6.7 It's recommended to store digital images along with their associated EXIF files[9].

5.6.8 Necessary content of tree assessment metadata is set of identification and dendrometry data about assessed tree, which is described in Appendix 1.

5.7 Simple tools for basic tree assessment

5.7.1 Various simple tools can be used during basic tree assessment process, depending on the attribute. For example, a knife, chisel, or a pointed hammer can be used to determine the extent of dead bark areas and sometimes reveal wooundwood hidden by dead bark. A probing stick can be used to determine the depth of a cavity. In addition, a flashlight can be helpful to better identify the attribute, for example, among the roots at the base of the trunk.

5.7.2 The **sound test with a mallet** can provide insights into the potential size of a cavity or similar features within the trunk. The part of the tree that is suspected of having a cavity is hammered from top to bottom and all the way around. Intact wood produces a sharp and obfuscated sound with a high pitch. In contrast, a rather deep sound is usually heard when cavity is present. With appropriate experience, the presence and extent of the phenomenon can be localized and assessed based on the sound. However, it is not possible to precisely determine the remaining wall thickness of sound wood with the sound test.

5.7.3 Each mallet used has its own specific sound. Even when inspecting trees with special equipment and procedures, the previous sound test with the mallet is necessary. This must be used to determine the areas where the further examination procedures are to be used.

5.7.4 In trees with thick bark or in the presence of cracks in the wood body, the sound test is often difficult to interpret. A noticeable sound may occur around cracks without the presence of extensive decay. Detached bark can also result in a distinct hollow sound. This phenomenon occurs for example with *Robinia pseudoacacia*. Neighbouring buildings or multiple trunks that create a reverberation can also lead to misinterpretation. In some tree species, for example *Tilia* spp., a noticeable sound can often be detected even without the presence of defects. Some tree species also tend to form board roots, such as the *Populus nigra* \`Italica\` or *Ulmus* spp., which lead to a deep sound in the sound test.

5.7.5 **Metal probes** can be used to determine the depth of cracks and to analyse the condition of the base of the stem below the soil surface. The probes are used to test the integrity of the superficial wood layers and can also be used to detect the presence of surface fungi decomposition and to sample the soil compaction.

5.7.6 Various instruments can be utilized to measure the dimensions of woundwood and compensatory growth (using 3D scanning), quantify the magnitude of cracks (fissurometer), or track the gradual tilt (via an inclinometer or 3D scanning).

9 EXIF (short for Exchangeable Image File Format) is a specification for the metadata format embedded in files by digital cameras (including smart mobile phones), scanners and other image processing devices or programs, or audio files.

6. Risk/benefit analysis

6.1 Introduction

6.1.1 In order to define management recommendations (incl. non-intervention), the potential adverse effects must be weighed up against the potential beneficial effects of intervention. This is done during risk/benefit analysis.

6.1.2 Depending on the tree and its environment, risk/benefit analysis can take many forms ranging from a formal and consultative analytical process to an instant mental exercise performed on site by the assessor.

6.1.3 The risk/benefit analysis must take into account multiple aspects, which may be interlinked. The main aspects to consider, are:
- Benefits and values of the tree (see chapter 5.5.),
- Likelihood of tree decline and/or collapse (risk of tree loss),
- Risk of harm.

6.1.4 Apart from these main aspects, risk/benefit analysis should also take into account other aspects, such as:
- Negative and positive impact of potential interventions on the tree and its benefits,
- Potential disadvantages associated to the tree (e.g. damage to infrastructure) etc.

6.1.5 Tools like scores or matrixes can be used for performing the risk/benefit analysis.

6.1.6 Risk/benefit management can be approached through conservation or preservation. Conservation involves strict protection and human intervention when necessary. Preservation aims for minimal intervention, allowing ecosystems to adapt autonomously.

6.2 Likelihood of tree decline and/or collapse

6.2.1 Tree decline and tree collapse can lead to tree death and/or the partial or complete loss of the tree and its benefits.

6.2.2 The likelihood of tree decline and/or tree collapse result from the interpretation and evaluation phase of tree assessment (see 5.4) and may be included as such in the risk/benefit analysis (e.g. loss of benefits) or they may feed into other aspects of the analysis (e.g. risk of harm assessment).

6.2.3 When analysing the loss of benefits, it is important to consider not only the current value of benefits provided by trees but also the potential future benefits that they can offer.

6.2.4 Defining the growing context and assessing relevant factors are important in considering the benefits associated with a tree.

6.3 Risk of harm

6.3.1 Evaluating the risk of harm is crucial in managing amenity trees. It can be done by the tree assessor or the tree manager/owner.

6.3.2 To address assessment limitations, it is advisable to utilize established methods rooted in the probabilistic approach and ISO 31000, incorporate two-person assessments or peer reviews, and implement systematic monitoring to track the evolution of risks. These recommended tools can help overcome limitations and enhance the effectiveness of the assessment process.

6.3.3 The acceptability of risk and the need for risk reduction should be determined by the manager, and critical review of results is essential.

6.3.4 The first step in the process aims to **define the elements of the context**, according to which the tree risk will be considered. This context differs from one situation to another and influences risk tolerability and management decisions.

6.3.5 The second step in the process is the level of **risk of harm assessment** which is the identification, analysis and evaluation of several parameters which influence risk of harm. These parameters are typically target sensitivity and impact potential (vulnerability), size of the part of the tree that may fail and the likelihood of failure.

6.3.6 To reduce bias and noise and to ensure repeatability and objectivity, the analysis of these parameters should be done by using tools such as scores or matrices. Various methods are available for risk of harm assessment in arboriculture, by quantification and/or qualification.

6.3.7 A target conceptually refers to people, property or activities that could be injured, damaged or disrupted by a falling tree (see chapter 4.2.).

6.3.8 The outcome of the risk of harm assessment is a level of risk, that feeds into the risk/benefit analysis. The level of risk is weighed up by the manager against the level of need to preserve the tree in order to determine risk acceptability.

6.4 Risk/benefit balance

6.4.1 The risk/benefit balance is a tool for tree management and decision-making. It combines environmental and conservation concerns with the need to manage public safety requirements. Thus, the risk/benefit balance is composed of:

- The objective extent of benefit value (positive impact) that the tree brings to its context, in addition to its role in supporting biodiversity. These values can be expressed in terms of 'natural capital' or 'ecosystem services' (see 5.5).
- The consequences of losing the tree or parts of it because of decline and/or collapse.
- The level of risk of harm (negative impact) associated to the tree, which is assessed by analysing the consequences of the failure of the tree or one of its parts (see 6.3).

6.4.2 The risk/benefit balance has no absolute value. It is evolutive and depends on the context, the expectations of the managers made by subjectives elements, and the level of conservation issues.

6.4.3 The image below illustrates the different parameters involved in the decision making based on the risk/benefit balance.

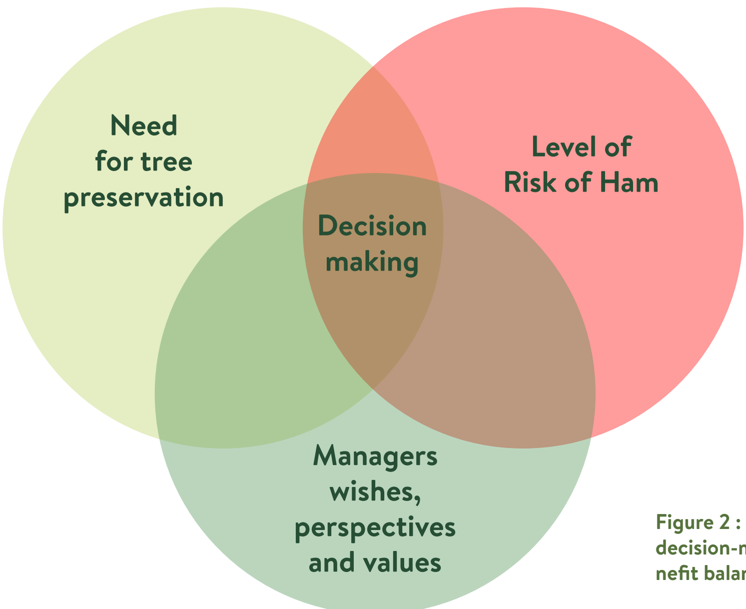


Figure 2 : Conceptual diagram of the decision-making process for risk-benefit balance establishment

6.4.4 Achieving a balance between tree benefits and risks to public safety is essential.

6.4.5 Reducing tree risks may have negative effects on benefits, and interventions should be justified by clear positive outcomes.

6.4.6 Non-intervention must always be considered as the first valid management option.

6.4.7 The risk/benefit balance provides an opportunity, to compare the negative effects of the proposed management solutions with the advantages of the intervention. It is necessary to identify the issues that the recommendations could involve and their unwanted effects, which can sometimes be counterproductive with risk management and conservation of the tree. The image below illustrates the consequences of our level of intervention on trees.

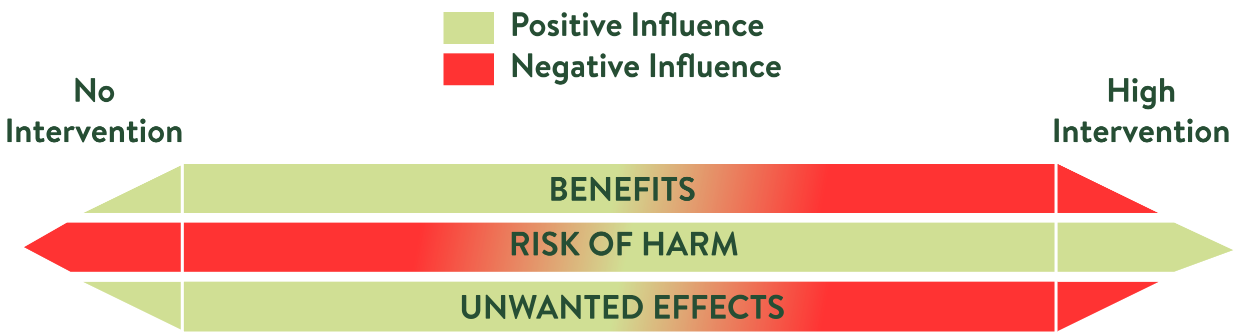


Figure 3 : Consequences of the level of interevention on trees.

6.4.8 The use of appropriate methods to represent the conclusions of the risk/benefit balance is important to facilitate the understanding and use of the results.

7. Advanced tree assessment

7.1 Introduction

7.1.1 If doubts remain about the assessed parameters of the tree during the basic tree assessment, an in-depth examination can be required. Advanced tree assessment usually goes beyond a purely sensoric inspection. An in-depth examination is carried out to deliver data and analysis not possible to obtain with basic tree assessment techniques and tools and necessary to conduct risk/benefits analysis and prepare final recommendations for the assessed tree.

7.1.2 If basic tree assessment is carried out regularly, advanced assessment is usually only necessary for a small number of trees.

7.1.3 If needed a choice of an appropriate advanced assessment method (or set of them) is based results of basic assessment, gaps in the observations and conclusions and also specific competences of tree assessor as well as their possibilities, limitations, strong and weak points of different methods and tools.

7.1.4 Measurements made and analyses carried out require documentation prepared in a way allowing further verification or comparisons in the future.

7.1.5 The use of examination equipment should be as tree friendly as possible and should produce the information that provides the greatest possible gain in knowledge for the evaluation of the tree.

7.1.6 The utilization of device-assisted techniques does not eliminate the requirement for an appropriate initial tree evaluation and thorough examination of the causes and unique aspects of each situation.

7.1.7 Every system has its limitations, and all parties must be aware of them. These limitations should also be communicated to clients and other decision-makers. It is important to note that figures in reports, generated by software interpretations and models, can create a false sense of accuracy. Although they may appear precise, they do not always reflect reality and must be interpreted by a competent assessor.

7.2 Methods and tools

7.2.1 Advanced assessment may include one or more methods and tools, for example:

- aerial tree inspection,
- assessment of root system,
- special calculations or simulations of tree stability,
- an instrument-based diagnostic with special electronic devices,
- detailed assessment of the site condition including soil and its features (incl. mycorrhiza),
- specific investigation into dendromicrohabitats and associated species,
- phytopathological study (pests and diseases),
- sampling and laboratory analysis,
- tree value calculation.

7.2.2 In-depth visual assessment. The specialist assessment entails detailed analysis and evaluation of a tree or parts of a tree, using different methods.

7.2.3 **Aerial tree inspection:** An aerial inspection involves assessment of the upper parts of a tree, which are inaccessible and/or invisible from ground level. Main method is similar as in basic tree assessment from the ground with special attention to symptoms in branch junctions; the presence of decay, holes, cavities, splits or fissures; and any situation in which parts of a tree have become overgrown, for example by mistletoe or ivy. Samples may be taken for further analysis.

7.2.4 **Assessment of root system**. Excavation tools are used to uncover root system or single roots. Usage of the tools must be carried out with respect of the tree and its environment. Root detection devices can be used to visualise spread of root system.

7.2.5 **Special calculations and simulations**. Specialized software tools have been developed to assess tree reactions, particularly regarding the resistance of the tree trunk to fracture or leaning. These tools utilize data gathered from tree inventories, including additional measurements of the tree and photographic documentation. By inputting this information into the software, it becomes possible to analyze and evaluate the tree's response to external forces.

7.2.6 Device-supported methods for mechanical integrity assessment. There are different devices that serve three main purposes: checking the internal wood structure, assessing tree stability in the ground, and examining the structure of the root system. Special devices can also be used to assess the physiological functions of a tree, such as chlorophyll content. All these tools rely on digital sensors and, usually, dedicated software. The tree assessor should use the latest version of the software and certified tools with approved sensors. These devices and procedures can be applied individually or in combination. Such investigations should be carried out by specialists with extensive knowledge of trees, tree biology, and tree physiology, and who are properly trained in these methods. An overview of specific device-supported methods is listed in Appendix 2.

7.2.7 Detailed assessment of the site condition including soil and its features. This assessment can be done before planting to check soil and site conditions for new trees or in the rooting area of established trees, to check chemical, physical and biological features of the soil (eg. pH, nutrients, compaction, soil ecosystem incl. mycorrhiza, etc.). This assessment can feed into the assessment of physiological condition or the management recommendations.

7.2.8 **A specialist surveying of co-occurring species**. This area of advanced examination can be integrated into the assessment process to check for the presence of protected species associated with the tree or other species that may significantly impact the tree's condition. The tree assessor should be aware of various tree-related groups of organisms and the specialists responsible for surveying them, consulting these specialists for further expertise when necessary. Destructive sampling can reduce the quantity and longevity of microhabitats and negatively affect populations of species of interest.

7.2.9 **Phytopathological studies.** This kind of analysis should be used in case of confirm hypothesis of presence of pathogens influencing the condition of the assessed tree and the competences of main tree assessor are limited. External laboratories can be used to conduct the examination, the role of assessor is to evaluate the meaning of the results of analysis and include in the risk/ benefit analysis and further recommendations. It is essential to implement biosecurity protocols when necessary.

7.2.10 **Mycological assessment.** This kind of analysis can be used to confirm the presence of fungi (both wood decay fungi, saprotrophic or mycorrhizal fungi) in the tree or its environment, influencing the physiological or mechanical condition of the assessed tree.

7.2.11 Various devices and procedures can be used individually and in combination.

7.2.12 Such investigations should be performed by specialists with extensive knowledge of trees, tree biology, tree physiology and who are properly trained to work with such specialist equipment.

7.2.13 Overview of specific device supported methods is listed in Appendix 2.

8. Management plan

8.1 Introduction

8.1.1 The maintenance of trees in urban areas, including streets, parks, landscapes, and gardens, is essential. The primary objective of a tree management plan is to ensure the continued health and sustainable preservation of trees. This involves paying attention to the following aspects:

- risk of harm,
- likelihood of benefit loss,
- tree biology.

In relation to the:

- function of the tree,
- tree location,
- tree species,
- tree development phase,
- physiological condition and mechanical integrity of tree,
- feasibility of achieving a set goal.

8.1.2 The focus of management plan, the technologies used, and their extent should correlate with efforts to reduce the major risks addressed in the tree assessment process.

8.1.3 It is necessary to integrate in the choice of operations not only the expected benefits but also the likely consequences of the operation. It is therefore essential to identify these consequences when they have a strong impact on:

- the mechanical integrity or physiological condition of the tree,
- the landscape,
- the environment,
- the tree-related budgets, etc.

8.1.4 Interventions on trees should therefore be limited to cases where the positive effects of the operations performed clearly exceed the negative effects of the resulting consequences. Otherwise, it is preferable not to intervene.

8.1.5 The person prescribing an operation should thus provide the tree owner/manager with relevant guidance based on two major management approaches:

- non-intervention (in a passive management strategy),
- intervention (in an active approach).

8.2 Recommendations for tree work

8.2.1 Not intervening must always be considered as the first valid management option.

8.2.2 Overview of activities that could be taken:

- Pruning; see EAS 01:2025 – European Tree Pruning Standard for pruning interventions.
- Cabling / Bracing; see EAS 02:2022 – European Tree Cabling/Bracing Standard.
- Soil/site improvement interventions (watering, mulch application, “halloing”, moving target etc.
- Felling the tree if there are no reasonable alternative solutions to keep the tree and resolve problems detected during the tree assessment process.

8.2.3 Other areas of mitigation techniques should not be overlooked to solve defined problems (risks) to the tree and its environment.

8.2.4 Designed tree work recommendations must have a **priority, staging** or **execution time** based on their emergency or importance.

8.2.5 The final staging of the works to be done is set by the tree owner/manager.

8.2.6 Where the assessor is dealing with obvious primary failure features or other imminent risks that have emerged very recently, information must be provided to the tree owner/manager immediately with proposed definition of necessary action.

8.3 Repetition of assessment

8.3.1 Tree assessment must be repeated regularly. Repetition of tree assessment depends on the symptoms found and the possible consequences that can be expected. A request for the next assessment (in years or months) should be included in the report if necessary.

8.3.2 Some arboricultural interventions require their own control regime (e.g. installed cabling/bracing systems). This type of inspection can be part of a routine tree assessment.

8.4 Cost/benefit analysis

8.4.1 The costs of operations and their monitoring must be integrated into decision-making. If there is a significant disproportion between the costs of mitigating risks or conducting further investigations and a low or broadly acceptable level of risk, it may not be reasonable to pursue further risk mitigation. Where the risks are insignificant compared to the costs, these operations should be reconsidered and only performed in cases where the risk is reduced to As Low As Reasonably Practicable (ALARP).

8.4.2 Final cost/benefit analysis is carried out by tree owner/manager.

8.4.3 The communication of the results of tree assessments can be done either in a directive form, with recommendations for tree management, or in a non-directive form, by informing about the results and delegating the management decisions to the manager.

9. Reporting

9.1 Reporting details

9.1.1 The findings of the tree evaluation must be provided in a way that the information is presented clearly and in accordance with a predetermined pattern, preferably in a tree management system so that history is built up about the tree in question.

9.1.2 To ensure accurate and unbiased results, it is essential to separate collected data from their subsequent analysis and interpretation. This separation is crucial in maintaining the integrity and reliability of the findings.

9.1.3 As a basis, the metadata should be provided (see chapter 5.6.)

9.1.4 The report should allow the next assessor to repeat the interpretation based on presented data.

9.1.5 Report should contain the scope and methods of the assessment.

9.1.6 Photos and other supplementary data are of great importance and should be included as part of a report. Including visual elements in a report can enhance the understanding, credibility, and overall impact of the information presented.

Appendix 1 - Tree inventory

Tree identification

Each tree is identified with a number that is unique at least within the site.

Location of an individual tree is done using a point with defined coordinates, optionally accompanied with a symbol or depiction of the tree crown projection. The basic type of geographic location is the determination of the coordinates (point containing the latitude and longitude) of a point close to the centre of the tree. The geographic location point should use the European Terrestrial Reference System[10]. For latitude/longitude coordinates it is a good practice to specify the format (i.e. degree, minute, second or degree, decimal minute, or decimal degree). Location of trees in the field can be made easier by using installed **identification tags** or chips. These are secondary identification tools with a unique numerical series within the assessment area. A tree tag may be installed using a single pin or nail, with this driven into the wood to such a depth that permits further growth in girth of the tree. It is recommended that young trees only be tagged in a short-term fashion, with labels fixed to the bark, or with some kind of band either around the bark or attached to the stakes driven into the ground that help stabilise a newly planted sapling. Tagging should be carried out at a height 2 – 2.5 m above the ground, in order that reading off of the details remains relatively straightforward. A tree tag should be permanent, its content readable and weather resistant. By agreement with the client, it is possible to use temporary tags only, installed in tree bark, tied to planting poles or numbers sprayed on the trunk with paint.

Species determination

The report shall specify the genus, species and intraspecific unit, if any, of the assessed tree using its scientific name. Citing the author of the scientific name is not necessary if the bibliography source is quoted in the assessment methodology.
The formal appearance of the taxon names should follow the International Code of Botanical Nomenclature, the All entries should be in accord with the Botanical Society of Britain & Ireland complete list of taxon names[11].
In justified cases of simplified inventories, or in tree assessments outside the growing season, it is possible, by agreement with the client, to use simplified taxon determination, which only specifies the tree genus. Incomplete taxon determination or wrong classification into species for genera with difficult determination cannot be regarded as a fundamental assessment error.

10 European Terrestrial Reference System 1989 ETRS89 (EPSG:4258). A coordinate reference system is used to locate geographic data. It specifies a datum and a coordinate system. A datum is a model or approximation of the shape of the Earth. A coordinate system describes how to identify points on the Earth's surface. The open standards for government guidance and the INSPIRE Directive (https://inspire.ec.europa.eu/inspire-directive/2.) specify the coordinate reference systems for all exchange of location points from generic GIS data.

11 https://bsbi.org/taxon-lists

Dendrometry

The **trunk dimensions** can be identified as trunk diameter (thickness) or circumference. Mutual conversion between the parameters is possible. The result is rounded to entire centimetres. The trunk dimensions are measured at breast height 1.3 m above ground[12], perpendicular to the trunk axis. The trunk dimensions are determined using adequate instruments, such as a diameter calliper or a circumference tape. The parameter must be determined by measurement, not estimated.

In cases when the trunk is uneven at breast height (bumps, wounds, etc.), the dimension is read above or below the uneven spot to measure a representative value of the required parameter without any effect of root taper or branching. In case the tree grows on a slope, the breast height is measured from the top edge of the trunk-ground contact. If the tree branches below the breast height, the trunk dimensions are measured below the branching where it is not significantly affected by root taper or branch taper. If not possible, the procedure is that for measurement of multiple-trunk trees.

In multiple-stem trees, dimensions of thickest stems are measured (see Figure 4). Depending on requirements on further processing, the client may require measurement of all stems. It is recommended to specify the number of stems in the remark.

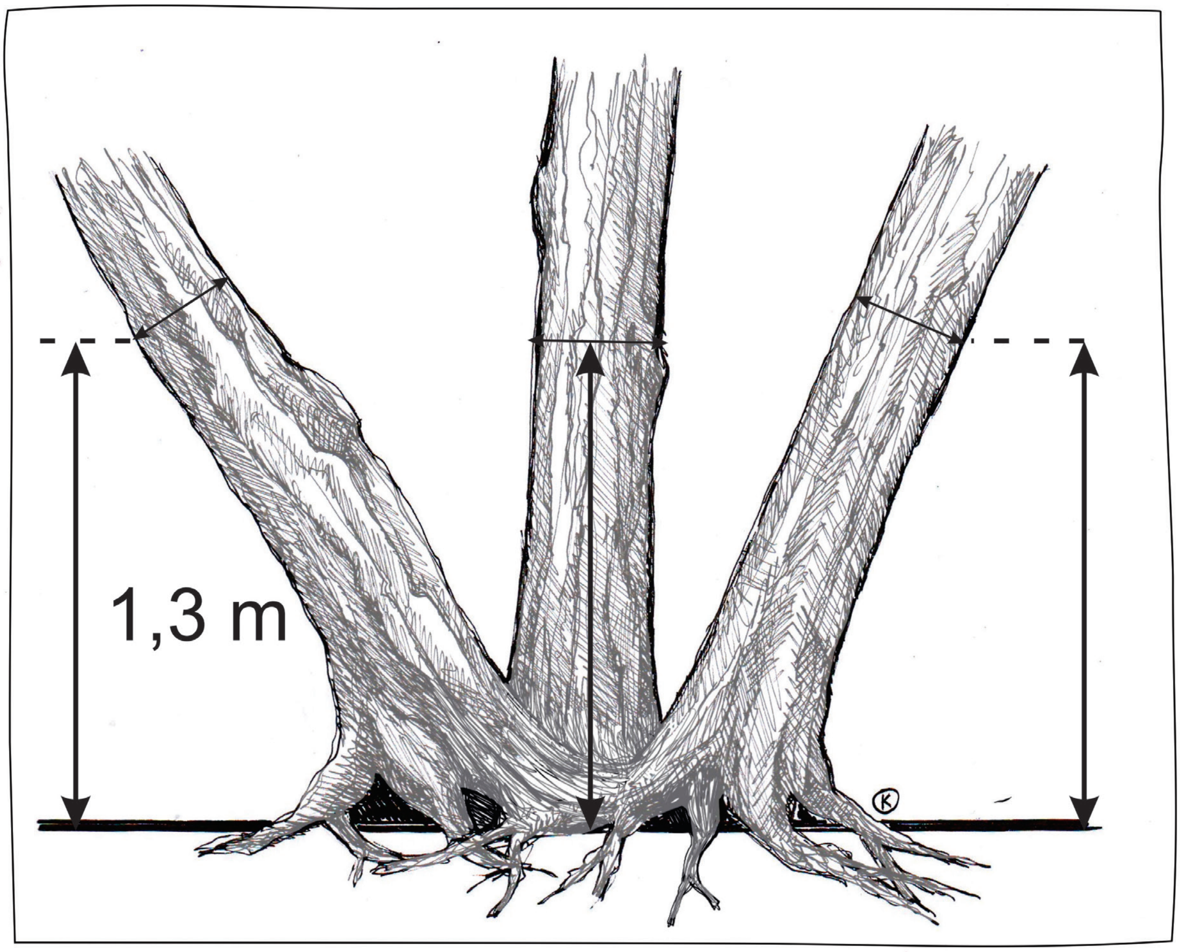


Figure 4 : Determination of DBH for multistemmed trees

12 National differences apply. See the national annex for details.

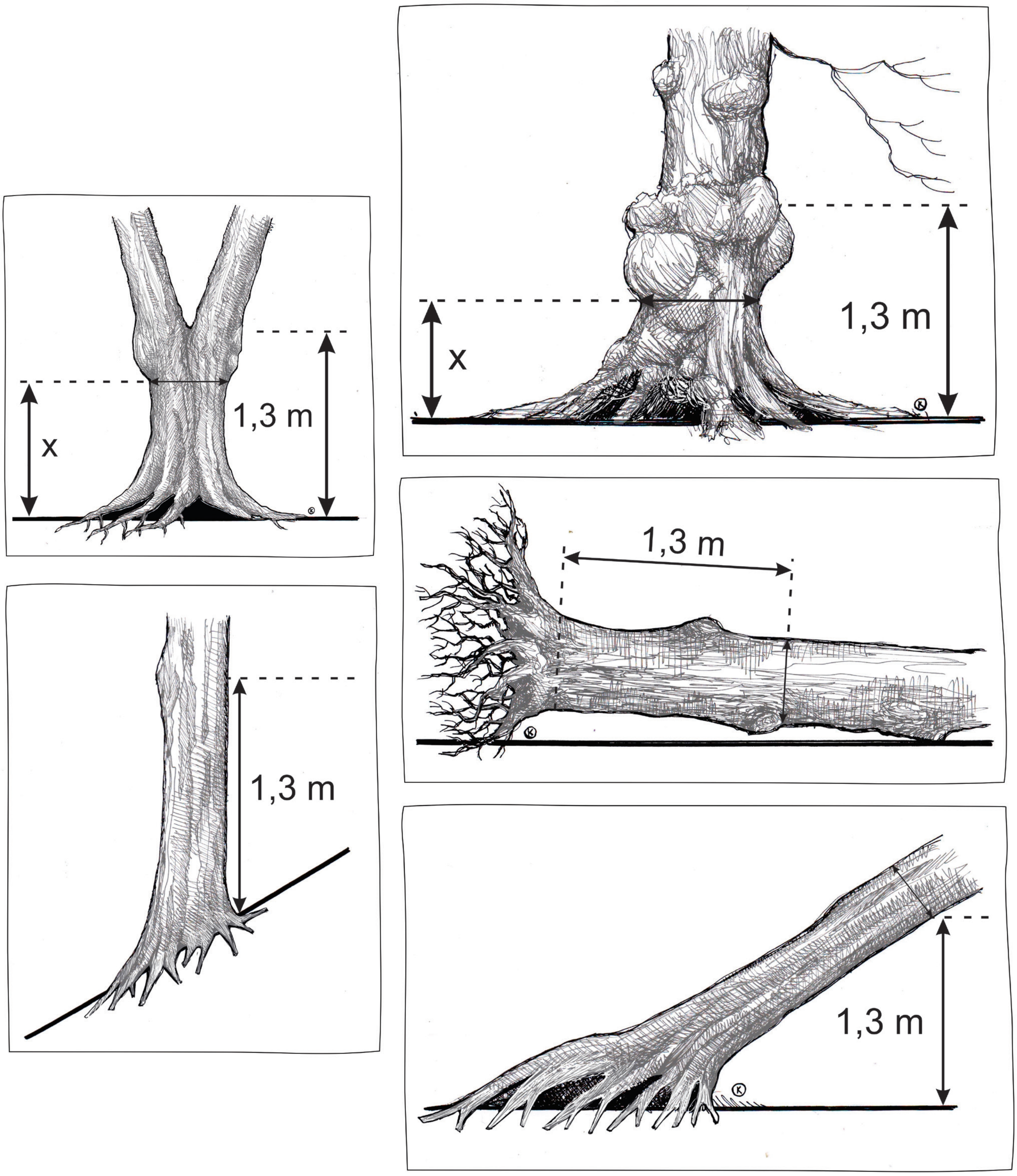


Figure 5 : Determination of DBH in variable situations.

Tree height is determined by the distance between the stem base and to the tip of crown (alive or dead). It is given as rounded to 1 m. Tree height can be determined by direct measurement of each individual or estimate. Even when estimating, however, a direct measurement of the height of one representative tree in each area is made, as well as at least every 50th individual to make the estimate more accurate.

The parameter used for characterising the **crown volume** or wind-sail area of individually assessed trees is the crown bottom height or crown height, as the case may be (difference between the tree height and the crown bottom height.

The **crown bottom** height is given as the distance between the trunk base and the place where the main volume of branches and assimilation organs starts. It is determined considering the fact, that its purpose is subsequent representative calculation of crown volume or wind-sail area.

Crown width characterises the representative diameter of the crown projection onto a plane perpendicular to the tree height. It is determined as the arithmetic mean of two mutually perpendicular directions (or the sum of two mutually perpendicular radii). In the case of a significantly asymmetric crown, one measurement is made along the longest axis and one in the perpendicular direction.

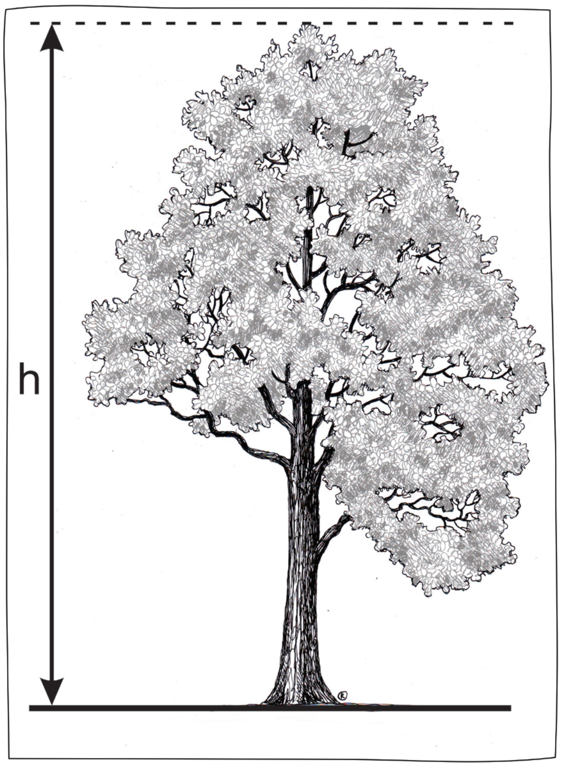


Figure 6 : Representation of tree height

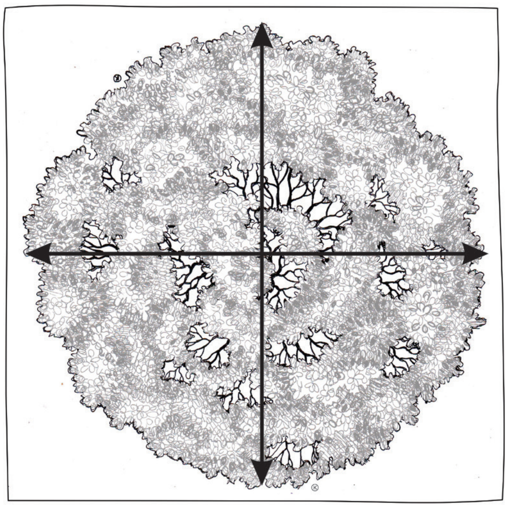


Figure 7 : Representation of crown width

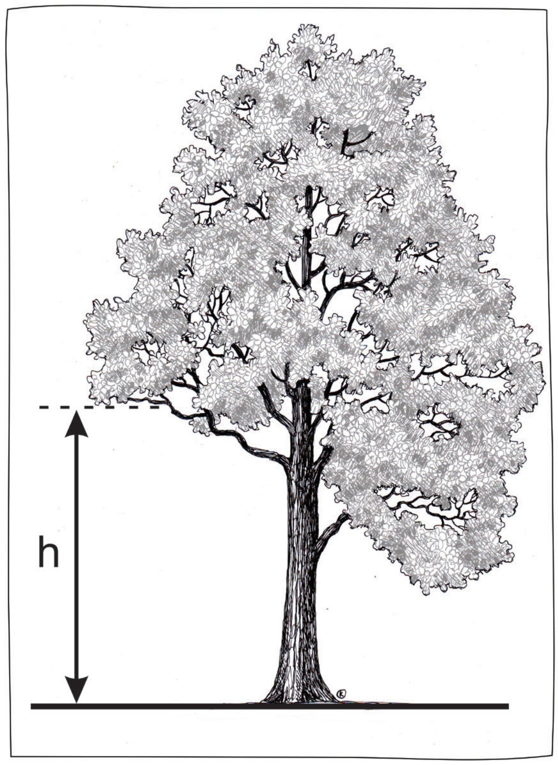


Figure 8 : Representation of crown bottom

Metadata

Basic part of the metadata relates to manage geospatial data. Adherence to this format ensures compliance with the INSPIRE framework[13].
It is recommended practice to send metadata with all tree data records. For example, data stored in different coordinate reference systems can be easily transformed using standard GIS and database software provided the original reference system is known.

13 INSPIRE is a pan-government initiative to improve spatial data sharing and compliance is a legal obligation for all EU public bodies. https://inspire-geoportal.ec.europa.eu

Appendix 2 - Advanced tree assessment areas and main methods description

Frequently used/commissioned methods

Frequently used/commissioned methods or areas of assessment	Purpose and scope of the assessment	Method of implementation / details
Wood decay in trunk and branches	the existence/extent of wood decay or the presence of cavities which are not visible or difficult to assess externally.	specialised electronic or mechanical tools: - sonic tomography (usually combined with a calculator that calculates the safety factor for stem fracture) - see description A) - electric/ impedance tomography B) - resistance drilling - see description C)
Overall stability of the tree	resistance of the tree to wind throw (pulling test)	specialised methods based on electronic devices which measure the reaction of the root ball and stem deformations to the wind load on the tree: - static load test - wind force simulated by mechanical load - see description D) - dynamic load test – reactions to actual wind force – see description E).
Aerial tree inspection of the crown	collection of data on crown structure of forks, symptoms of weakening, assessment of the strength of the crown parts, microhabitats may include instrumental assessment, e.g. examination of wood structure	access to the crown (by rope, platform or with use of drones) with aim to closely inspect important symptoms/features, possible usage of specialised equipment for specialist assessments (e.g. wood decay detection); evaluation principles and tools as for a ground-based inspection
Evaluation of cabling / bracing or other tree reinforcement	inspection of the condition of existing systems/ props, including assessment of the preservation and/or correctness of the installation	conducted from ground level or from a rope/platform, may require physical contact with the system; for details consult EAS 02:2022 – European Cabling/ Bracing Standard.
Calculators for the analysis of tree stability	calculation of the safety factor - SF (in terms of stem breakage or uprooting)	electronic tools in which calculations are carried out according to physical formulas and theoretical models using dendrometric parameters and sensor indications during instrumental tests (e.g. load tests, tomographic examinations), picture analysis, 3D scans etc.

Description of most frequented methods

A. In **sonic tomography**, the objective is to measure and compare sound run times within the wood body. To achieve this, a dense network of sensors is strategically placed across the measuring area. To feed in and capture the sound, slender measuring pins are inserted through the bark and into the wood. The variations in material quality, such as decay or cavities, within the stem impact the sound runtimes. An algorithm is employed to visualize these changes in colour, producing a tomogram. By analysing the cross-sectional image at the measurement level, one can infer the location and size of the internal features (wood decomposition, cavity).

B. **Electric/impedance tomography** involves the measurement of resistance and voltage across different cross-sectional areas. From these measurements, the distribution of conductivity or resistance within the cross sections is computed. This distribution is influenced by humidity and the presence of free ions. Interpreting the results requires understanding the conductivity distribution in the cross sections of a healthy individual, as different tree species exhibit variations, making it impossible to establish a universally applicable interpretation rule.

C. The **drilling resistance measurement** involves using a drilling needle, approximately 2 mm thick, with a drilling tip approximately 3 mm wide, to penetrate the wood. By assessing the penetration resistance, a measurement profile is generated, displaying the variations in wood density at various depths along the measurement line. The purpose of this method is to identify damage when suspicious symptoms, such as unusual tomograms, are present or to determine the remaining wall thickness of sound wood at the specific measuring point.

D. The **static pulling test** involves applying a static wind load equivalent to the tree using a winch. While subject to this load, the tree‘s responses are measured, specifically the inclination of the stem base and/or the elongation of the outer edge wood fibres. These measurements yield force inclination curves, which are used to assess the tree‘s stability, or force-elongation curves, which are used to evaluate its resistance to fractures. By conducting wind load analysis, the expected load during a windstorm is estimated and compared with the extrapolated data obtained from the pulling test. This comparison helps to assess the tree‘s ability to withstand wind-related stress.

E. The **dynamic load test** involves detecting tree reactions under real wind conditions using specialized sensors that measure tree inclination, stem deformations, and wind speed. These collected data are then utilized to calculate safety factors for the tree, employing digital models as the basis for these calculations.

Less frequently used methods

Subject of advanced assessment	Purpose and scope of the assessment	Method of implementation / details
Tree architecture assessment	tree structure/ morhophysiology analysis in the context of the development phase	visual assessment from ground level based on expert observation and models of the development of the tree‘s architectonics in different life phases; 3D tree imaging tools can be used
Veteran and ancient trees monitoring	assessment of the value and condition of older trees - mainly with a view to preparing an individual tree care plan	assessments according to specialised forms, incl. identification and counting of individual microhabitats according to their inventory catalogues, specialised forms/applications
Associated organisms' evidence (including protected species)	assessment of colonisation and presence of other organisms, especially for fungi, lichens, bird nests	sensory evaluation, cameras, endoscopic cameras, specialised ultrasound detection tools, laboratory sampling
Physiological parameters	evaluation of selected parameters of tree physiology usually chlorophyll, gas exchange	specialised equipment for on-site measurements, e.g. chlorophyll meters, fluorimeters, quantification of transpiration flow dynamics, gas exchange measurement systems, pressure chambers (water potential measurement)
Structure and development of the root system	evaluation of the extent, location of tree roots - mainly structural, but also the presence and development of root hairs (usually without reference to the assessment of the stability of the root system)	samples submitted to laboratories specialised tools for root detection e.g. by ground penetrating radar, shock waves, mechanical soil excavation methods using low intervention systems (by air or water)
Pests and diseases	phytopathological evaluation of biological agents harmful to the tree; identification of species and their importance for the tree	observation, sampling of both pests and diseases and their effects (e.g. leaves), expert evaluation, laboratory tests
Value of the tree	expression of the value of a tree - either as a whole or in selected areas: usually ecosystem services, historical, natural or social values	specialised calculators and methods (→more in EAS 05:2025 – European Tree Valuation Standard Standard) based on collected tree or tree-related parameters, specialist historical research, nature assessments, habitat, social
Habitat conditions with particular emphasis on the soil	evaluation of the tree‘s habitat and surroundings, including shade, wind pressure, assessment of group growth, irrigation, restrictions on root development evaluation of physical, chemical, biological soil parameters in and around the root ball, soil profiles	conducted on site using instruments to assess soil density, soil structure; external data are used, e.g. meteorological, hydrological, geotechnical measurements, sunshine analyses - using appropriate methods and tools soil samples are taken both for in situ testing and for further laboratory analysis using probes, augers etc.
Dendrochronology	precise determination of tree age and growth conditions.	evaluation of annual rings using boreholes or cross-sections, conducted either manually or with the aid of specialised equipment, taking into account historical methods and climatic factors

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