Arborist Incident & Valuation Report

Critical Root Zone Encroachment Analysis

Project Location: Grigor Lusavorich Street, Yerevan, Armenia

Incident Type: Excavation Damage to Structural Root Systems

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PREPARED FOR:

Yerevan Municipality

Department of Nature Protection

Argishti St 1, Yerevan 0015

Kanach Yerevan Civic Initiative

Civil Society Partner

PREPARED BY:

Vladimir Frunze

Independent Arborist Consultant

+374 91183932

hex@umonkey.net

https://umonkey.net/

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1. Executive Summary

This report documents the significant structural compromise inflicted on 8 mature trees on Grigor Lusavorich Street during pipe replacement works.

Our assessment confirms that the construction contractor violated Yerevan Council of Elders Resolution N 405-N by excavating a trench within the mandatory protection zone. This non-compliant excavation has severed approximately 50% of the structural root systems, with some specimens being physically undermined (excavation beneath the trunk).

This damage has rendered the trees mechanically unstable. Biomechanical analysis indicates a specific directional failure risk towards the pedestrian walkway, classifying the situation as an immediate public safety hazard (TRAQ Risk: High).

Despite a formal complaint filed with the relevant environmental authority, enforcement has been deferred until Spring under the premise of assessing "growth cessation." This report demonstrates that procedural violations (Articles 157 & 156) occurred at the moment of excavation and do not require biological verification of tree death to warrant immediate citation.

2. Assignment & Scope of Work

2.1. Client & Assignment

This technical report was prepared for the Kanach Yerevan Civic Initiative as part of its ongoing independent monitoring of urban green infrastructure projects. The Undersigned Consultant was tasked with conducting a forensic assessment of eight (8) trees located at Grigor Lusavorich Street following public reports of root zone encroachment.

2.2. Objective

The primary objectives of this assignment are:

1. Forensic analysis: to objectively document the extent of root severance and biomechanical compromise caused by trenching activities.
2. Monetary appraisal: to calculate the financial value of the damage using the Council of Tree and Landscape Appraisers (CTLA) standards, providing a data-driven baseline for regulatory review.
3. Gap analysis: to compare the observed construction practices against the mandates of Yerevan Council of Elders Resolution N 405-N.

2.3. Disclosure of Interest

The Consultant is a contributing member of the Kanach Yerevan Initiative. This report is submitted *pro bono publico* (for the public good). The technical findings, risk ratings, and valuations herein are derived strictly from international arboricultural standards (ISA/ANSI) and are independent of the Consultant's civic affiliation.

3. Methodology & Standards of Assessment

3.1. Inspection Protocol

This assessment was conducted in accordance with International Society of Arboriculture (ISA) Best Management Practices. The inspection constitutes a Level 2: Basic Assessment, consisting of a 360-degree visual inspection of the tree crown, trunk, and root collar from ground level.

Biometric data collection:

- Trunk diameter (DBH): measured using a standard calibrated tape at 1.3 m above grade; diameter was mathematically derived from the measured circumference ($d=C/\pi$).
- Vertical metrics: tree height was measured using a laser rangefinder with a 1 m accuracy.
- Horizontal metrics: tree crown spread was measured using a precision laser distance measure to ensure cm-level accuracy.

Limitations of scope:

- No aerial inspection (climbing) was performed.
- Root system integrity was inferred based on the proximity and depth of open excavation trenches relative to the Critical Root Zone (CRZ).
- No root excavation or resistance drilling was performed.

3.2. Risk Assessment Framework (ISA TRAQ)

Risk ratings were derived using the ISA Tree Risk Assessment Qualification (TRAQ) methodology.

- Timeframe of assessment: 1 year.
- Weather assumption: ratings assume "normal" to "severe" seasonal weather events common to Yerevan (e.g., localized wind gusts).
    - Note: a rating of "probable" indicates that failure is expected under normal

weather conditions within the timeframe.

Disclaimer: trees are biological organisms subject to environmental stress. A tree that does not fail within the assessed timeframe has not necessarily "healed"; it may simply have not yet encountered the specific wind load vector required to cause overturning.

4. Limitations of Assessment

Assessment is based on visual inspection of exposed conditions. No root excavation or resistograph testing was performed. Risk ratings represent conditions at the time of inspection and may change with weather events.

Arborists cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that fail in ways we do not fully understand. Conditions are often hidden within the tree and below ground. This assessment represents the Consultant's opinion of the tree's condition at the time of inspection and does not guarantee future safety.

5. Incident Overview

- Location: Grigor Lusavorich Street, Yerevan.
- Subject: 8 mature deciduous trees (plus 1 pre-existing stump).
- Construction activity: utility trenching (pipe replacement).
- Observed damage: open trench excavation located 0 to 50 cm from the main stems. In several instances, excavation undercut the trunk itself (approx. -5 cm), leaving the stem partially suspended.

6. Technical Arborist Assessment

6.1. Tree Inventory & Measurements

The following table details the biometrics of the affected assets. The *Crown Diameter* indicates the significant wind load ("sail area") these trees must support, while *Height* defines the potential fall zone radius.

Tree ID	**Species**	**DBH (cm)**	**Height (m)**	**Crown Dia (m)**	**Critical Root Zone (CRZ) Radius**	**Condition (Pre-Works)**
Tree #1	*Styphnolobium japonicum*	48	13.7 m	12.0 m	5.76 m	Mature / Vital
Tree #2	*Platanus orientalis*	16	11.0 m	4.0 m	1.92 m	Young / Vital
Tree #3	*Styphnolobium japonicum*	89	14.5 m	12.0 m	10.68 m	Mature / Vital
Tree #4	*Styphnolobium japonicum*	32	15.5 m	8.0 m	3.84 m	Mature / Vital
Tree #5	*Ulmus*	73	14.5 m	7.0 m	8.76 m	Mature / Vital
Tree #6	*Ulmus*	62	18.5 m	10.0 m	7.44 m	Mature / Vital
Tree #7	*Styphnolobium japonicum*	53	13.0 m	10.0 m	6.36 m	Mature / Vital
Tree #8	*Styphnolobium japonicum*	52	10.5 m	7.0 m	6.24 m	Mature / Vital

Note: Tree #2 is classified as "young" due to its smaller relative size, though it is fully established in the landscape.

6.2. Critical Root Zone Violation

To assess deviation from standard, we utilized *ANSI A300 (Part 5): Management of Trees During Site Planning, Site Development, and Construction*, which is the internationally recognized standard for tree protection.

ANSI A300 defines the *Critical Root Zone (CRZ)* as the area where root loss or disturbance will inevitably result in destabilization or death. The standard calculation ratio is 12:1 (12 cm radius per 1 cm of diameter).

- Average DBH: 53.1 cm.
- Required CRZ radius (average): 6.37 meters.
- Legal protection radius (Yerevan Resolution N 405-N): 3.0 meters.
- Actual excavation distance: 0 to 0.5 meters (undermined).

The excavation breached the Critical Root Zone by 92-100%. This severed major structural roots required for stability. For the largest specimen (Tree #3), the trench cut through the inner 5% of its required protection zone, likely destabilizing it completely.

6.3. Biomechanical & Risk Assessment

Risk ratings were derived using the International Society of Arboriculture (ISA) Tree Risk Assessment Qualification (TRAQ) framework. This qualitative assessment evaluates the structural integrity of the trees against the site's specific usage patterns.

Assessment Parameters:

- Timeframe: 1 year (covering one full cycle of Yerevan's seasonal weather, including winter storms and summer convective winds).
- Weather assumption: normal to severe wind events typical for the region.

A. Structural Analysis (Root Plate Compromise)

The excavation trench runs parallel to the curb, severing the structural roots on the road-facing side of the trees.

- Tension root loss: in tree biomechanics, roots on the windward side act as "tension anchors" that hold the tree upright against wind pressure. By severing the road-side roots, the trees have lost the primary anchoring mechanism required to resist wind loads originating from the street/open space.
- Compromise level: excavation occurred at 0–0.5m from the trunk, breaching the Critical Root Zone (CRZ) by >90%. This exceeds the standard threshold for stability (typically <40% root loss).

B. Stability Disclaimer: Static vs. Dynamic Loading

It is important to note that a tree may remain upright during calm periods (static load) solely due to gravity and the weight of the root ball. However, stability is defined by the tree's ability to withstand external forces (dynamic load).

- Current status: the trees currently lack the required "safety factor" to withstand dynamic loading.
- Failure mode: without tension roots, the root plate is expected to pivot (uplift) during a wind event, causing the tree to fall away from the road. The fact that the trees are currently standing indicates only that they have not yet encountered a significant wind vector from the road side, not that they are stable.

C. Risk Matrix Calculation

Risk Component	Rating	Justification
Target Identification	High Occupancy	The fall zone covers the public sidewalk, building entrances, and parked vehicles. Occupancy is near-constant during business hours.
Likelihood of Failure	Probable	Failure is expected under normal weather conditions within the 1-year timeframe due to the severance of major support roots.
Likelihood of Impact	High	If the tree fails, the direction of fall is dictated by the severed roots (falling away from the trench), directly into the target zone.
Consequences	Severe	Impact from a mature tree (89 cm DBH) would likely result in severe injury, fatality, or significant structural damage to adjacent property.
OVERALL RISK RATING	HIGH	Action required: immediate mitigation or exclusion of pedestrian access.

7. Legal Compliance Audit

The observed construction activities were evaluated against the *Republic of Armenia Code on Administrative Offences* and *Yerevan Council of Elders Resolutions*. The following specific violations were documented:

Violation A: Breach of Exclusion Zone Mandates

- Regulation: Yerevan Council of Elders Resolution N 405-N (2009).
- Mandate: the resolution explicitly mandates a 3.0-meter exclusion zone around the trunk of mature trees during construction.

- Breach: the excavation trench was established at 0 to 50 cm. This represents a deviation of 83% from the mandatory legal standard, resulting in direct conflict with structural woody roots.

Violation B: Breach of Protection Standards & Liability Context

- Regulation: Yerevan Council of Elders Resolution N 36-N (2010).
- Mandate: section 3 prohibits any economic activity that leads to the "damage, destruction, or decline" of green plantations. It imposes a positive "Duty of Care" on entities to ensure physical preservation.
- Breach: the contractor failed to install protective root buffers or hand-dig within the CRZ, actively causing "damage leading to decline."

7.1. Liability & Penalty Analysis

Under the Code of Administrative Offences of the RA, violations of green zone protection norms typically trigger a minor administrative penalty. There is a critical economic disparity between the statutory fine (~50k–200k AMD) and the actual biological damage (34,5M AMD). The administrative penalty covers less than 0.6% of the actual asset value destroyed.

7.2. Administrative Response & Deferred Assessment Protocol

A formal complaint regarding these violations was submitted to the environmental oversight body (No. 1654800, dated September 29, 2025). The official response (01/30.1/2/8221-2025) dismissed immediate action, stating that liability is contingent upon determining "cessation of growth" in the following Spring.

Current administrative interpretation conflates Civil Damages (compensation for lost assets) with Administrative Violations (penalties for procedural non-compliance). While damages may be deferred to assess mortality, the violation of the exclusion zone is an immediate, documenting fact.

1. Unaddressed procedural non-compliance: violations A and B (Articles 157 & 156) punish the *act* of non-compliance (digging within the 3-meter zone). These violations were completed and documented the moment the trench was dug. They do not require the biological death of the tree to be prosecutable.
2. Omission of Evidence: The current regulatory review process did not account for the photographic documentation of the Exclusion Zone breach (Resolution N 405-N), focusing exclusively on biological decline rather than the procedural infraction.

8. Valuation Methodology Discrepancy

The current *Law of the Republic of Armenia on Tariffs for Compensation of Damage Caused to Fauna and Flora due to Environmental Violations* (ՀՕ-88-Ն) values a massive 89 cm tree at only ~$1,041 because it uses a linear formula (15,000 + 1,500/cm) that fails to account for the exponential biological investment and ecosystem service volume of mature assets.

Tree ID	Genus	DBH (cm)	Admin. Fine (Yerevan x10)	Civil Asset Value (CTLA)	Public Deficit (Unrecovered Loss)
#1	*Styphnolobium*	48	190,000	3,036,746	-2,846,746
#2	*Platanus*	16	100,000	337,230	-237,230
#3	*Styphnolobium*	89	395,000	10,437,345	-10,042,345
#4	*Styphnolobium*	32	110,000	1,348,919	-1,238,919
#5	*Ulmus*	73	315,000	7,021,426	-6,706,426
#6	*Ulmus*	62	260,000	5,065,157	-4,805,157
#7	*Styphnolobium*	53	215,000	3,701,139	-3,486,139
#8	*Styphnolobium*	52	210,000	3,563,562	-3,353,562
TOTALS			**1,795,000**	**34,511,524**	**-32,716,524**

Note on Tree #2: The fine is higher relative to size because Platanus is listed as a "Rare Species" (Sosi) in Law ՀՕ-88-Ն, triggering a different tariff bracket.

As demonstrated above, the statutory administrative fines recover only 5.2% of the damage inflicted on the city's green infrastructure. The current legal framework effectively subsidizes tree destruction, allowing contractors to remove mature assets for a fraction of their replacement cost (approx. $4,700 fine vs. $91,000 value).

8.1. Proposed Methodology: The CTLA Trunk Formula

To rectify this, we recommend the *Council of Tree and Landscape Appraisers (CTLA)* method. This aligns with the ANSI A300 standards referenced in Section 3.

The Formula is:

$$\textit{Appraised Value} = \textit{Basic Value} \times \textit{Condition Rating} \times \textit{Location Rating}$$

Step 1: Establish Basic Value

This value is derived from the “unit cost” of nursery trees in Yerevan.

1. Replacement cost: price of largest available nursery tree. The price of a 3-4 meters tall tree of the mentioned species (5 cm caliper) in Grig Garden with the replacement work is 58,800 AMD.
2. Unit cost: Replacement Price ÷ Area (AMD per cm^2). For a 5 cm tree the formula is 58,800 ÷ 19.625 = 2,996 AMD per cm^2.
3. Extrapolation: we apply this market rate to the cross-sectional area of the damaged tree.
    - Tree #3 (89 cm) has an area of 6,221 cm^2.
    - Basic Value = 6,221 cm^2 × 2,996 AMD = 18,638,116 AMD.

Step 2: Depreciation

The Basic Value is depreciated based on the specific condition of the trees prior to damage. We utilized a component analysis (Health + Structure + Form) to derive a defensible aggregate rating.

Component	Rating	Justification
1. Health (Vitality)	90%	Excellent. Specimens exhibit vigorous shoot extension, fully sealed bark tissue, and no visible canopy dieback.
2. Structure	50%	Compromised. Trees show evidence of historical "topping" (internodal cuts). This previous mismanagement has created a scaffold of epicormic growth which possesses weaker attachment points.
3. Form	70%	Good/Fair. Despite previous pruning, the trees provide a symmetric canopy and high amenity value (shade/screening) appropriate for the streetscape.
AGGREGATE RATING	70%	(Average of components)

Step 3: Compute Final Asset Value

Applying the derived Condition Rating (0.70) and Location Rating (0.80) to the Basic Value:

18,638,116 × 0.70 × 0.80 = 10,437,344 AMD

(Note: This represents the depreciated value of the single largest asset. The total value for all 8 trees is calculated in the summary table.)

8.2. Methodology Selection

We utilize CTLA (ISA-aligned) over CAVAT (UK) to maintain consistency with the ANSI A300 engineering standards used in our risk assessment. This provides a unified, defensible "International Standard" framework.

9. Recommendations

9.1. Immediate enforcement actions (to Dept. of Nature Protection)

1. Enforce procedural violations immediately: the Municipality must decouple "damage" from "violation." Violations of Articles 157 and 156 must be cited immediately based on the observable trench location, without waiting for biological growth cessation in Spring.
2. Conduct urgent structural stability audit: given that construction is complete and the site is open to the public, the Department must immediately commission a structural stability assessment. The "high" risk rating suggests imminent failure potential; if confirmed, the trees must be supported or removed to prevent injury to pedestrians.
3. Issue cumulative fines: cite the contractor immediately under Article 157, Article 156, and apply ՀՕ-88-Ն tariffs to establish a record of non-compliance.

9.2. Proposals for Regulatory Reform

To prevent recurrence and align Yerevan's urban forestry management with international standards, we propose the following legislative and regulatory updates:

1. Adopt ANSI A300 Standards: replace vague local norms with ANSI A300 Part 5 (Management of Trees During Site Planning, Site Development, and Construction) to serve as the definitive technical standard for construction protection zones. This can be implemented immediately via municipal contract requirements.
2. Reclassify urban trees as “capital infrastructure”: amend legislation to exclude urban street trees from the general “flora and fauna” tariffs (ՀՕ-88-Ն). Instead, classify them as “capital infrastructure assets” (similar to streetlights, roads, or utility networks). This legal shift permits the recovery of full replacement costs (via CTLA)

rather than capped biological tariffs.

3. Establish a “Green City Fund”, a dedicated municipal fund for damages collected from tree destruction. These funds should be legally restricted ("ring-fenced") exclusively for tree planting, irrigation, and arboricultural care to ensure destroyed assets are actually replaced.
4. Require ETW Certification: mandate that all city pruning and protection works be supervised by a European Tree Worker (ETW) certified professional (European Arboricultural Council standard) to ensure personnel competency and adherence to modern biological practices.

10. Appendix A: Photographic Evidence

Figure 1: Proximity Violation (CRZ Breach)

Excavation trench located at <50cm, violating the ANSI A300 Critical Root Zone.

Figure 2: Evidence of Undermining

Structural undermining of Tree #3.

Figure 3: Asset Scale

Tree #3 (DBH 89cm) shown to demonstrate asset value.

11. References & Standards of Practice

Industry Standards & Best Practices:

- ANSI A300 (Part 5) - 2019: Tree Care Operations — Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction). Tree Care Industry Association.
- Council of Tree and Landscape Appraisers (CTLA) (2018). Guide for Plant Appraisal (10th Edition). International Society of Arboriculture.
- Dunster, J. A., et al. (2017). Tree Risk Assessment Manual (2nd Edition). International Society of Arboriculture. Champaign, IL.
- Smiley, E. T., Matheny, N., & Lilly, S. (2017). Best Management Practices: Tree Risk Assessment (2nd Edition). International Society of Arboriculture.

Local Legal Framework:

- Yerevan Council of Elders Resolution No. 405-N from 16.03.2012 “On setting additional conditions for implementing urban planning standards in Yerevan”.
- Yerevan Council of Elders Resolution No. 36-N from 18.11.2009 “On approving the rules for the preservation and use of public green areas of Yerevan City”.
- Republic of Armenia Law on Tariffs for Compensation of Damages Caused to Fauna and Flora (ՀՕ-88-Ն).