Kenneth A. Knight Consulting LLC
Registered Consulting Arborist #507
69 Calaveras Avenue Goleta, CA 93117
H (805) 968-8523 W (805)252-1952
kennethknight@cox.net www.goletaarborists.com

December 1, 2015

Codie Blea
Urban Forestry Supervisor
1300 W. Laurel Avenue
Lompoc CA 93438-8001
C_blea@ci.lompoc.ca.us

City of Lompoc H Street Italian Stone Pines Level Two Tree Risk Assessment

Assignment
I was contracted to do a Level Two risk assessment of the 50 Italian Stone Pines in the 200-400 blocks of South H Street. The risk assessment was conducted according to the standards identified in the American National Standard Institute (ANSI) Standard A300 (Part 9) Tree Risk Assessment Standard, and the companion publication "Tree Risk Assessment – Best Management Practices" 2011 edition published by the International Society of Arboriculture. The Level Two Risk Assessment provides the support for a Level 3 risk assessment of the pines as needed.

Summary of findings

Risk Rating	
Extreme	0
High	0
Moderate	46
Low	4
Total Existing Trees	50
New Sites	10
Total Existing and New	60

Details of these ratings are included in an attached spreadsheet.

Limitations of this report

1. Not all potential structure and stability concerns associated with trees can be predicted or eliminated.

2. Sudden branch drop is the sudden, unanticipated failure of a tree branch with little or no discernible defect, often associated with long, horizontal branches and warm temperatures. There is no current means of predicting sudden branch drop.

3. Crown reduction is one method of reducing risk by reduce the weight of long, usually horizontal scaffold extensions with little taper and most of its foliage at the end. Crown

reduction can reduce the weight on a branch but not guarantee the avoidance of limb drop. Crown reduction does increase the likelihood of infection and disease entering cut areas of older trees, permanently disrupts their character, and increase their long term maintenance needs. General crown reduction to reduce risk liability is not recommended in this report, although specific scaffold and branch reductions are recommended.

4. The Level Two Assessment is an analysis of tree structure and stability and not a thorough health assessment. A healthy tree may look good but still be structurally unsound. However a healthy tree may be better able to withstand certain diseases and insects. A tree health assessment is a separate process that can provide additional information about the health of the trees and recommendations on how to insure that trees survive and thrive. Generally the trees along H Street are healthy with normal vigor and no evidence of pine bark beetles.

5. A Level Two analysis provides some indication of the interior structure of the tree, and to the amount of wood supporting the tree. A Level Three analysis can provide more specific information on the location and amount of structurally supportive wood within a tree. This information could be used for more exact recommendations on the extent of mitigation necessary to maintain a tree in a lower risk category, and possibly avoiding the reduction or removal of more of the tree than necessary.

Observations:

1. All trees in this area are being stressed by long term drought conditions. Although native trees can withstand normal summer dry periods, this area is in the midst of the fifth year of severe drought conditions.

2. The Italian Stone Pines along H Street were planted in the 1930's and 1940's, which makes them approximately 75 to 85 years old. Under optimum conditions, these trees could live to be several hundred years old. Theoretically these trees have another 50 to 100 years in their lifespan.

3. There does not appear to be systematic written guidance given to adjacent residents about the proper care of the trees in the parkway adjacent to their homes. Italian Stone Pines thrive in our Mediterranean climate. Their care is similar to our native Coast Live Oaks in that they are drought tolerant, they like a 2 to 3 inch layer of native leaf mulch under their canopy, and summer watering increases the tendency for root diseases. There are a number of adjacent residences who have installed spray irrigation in the City parkway that irrigates frequently during the summertime and in many cases sprays the tree trunk. Most residents remove the native mulch regularly, and in many cases have replaced it with grass, stones and pavement.

4. Over the years, foot traffic has compacted the soil around the trees. Most trees, including Italian Stone Pines, do not thrive when the soil around their roots is compacted.

5. The original trees planted did not have a systematic structural pruning program to encourage a single straight trunk, and may not have had a root pruning program at the time of planting.

6. The Britton Fund Fall 2015 tree failure profile for Italian Stone Pines attached to this report identifies the following notable issues;

   - Root failures comprise 41% of total failures, trunk failures 30% and branch failures 29%.
   - The most common tree defects are dense crown, multiple/codominant trunks, and leaning trunks.
   - The majority of branch failures occurred at the point of attachment.
   - The majority of trunk failure defects are due to multiple trunks/codominant stems, dense crowns, and leaning trunks.
   - The most common root failure defects were lean, kinked or girdling roots, and dense crown. Root failures were associated with wind and precipitation/saturated soils.
   - Decay was not present in the majority of branch, trunk and root failures.

7. The 2015-16 tree replacements on South H Street calls for tree replacements at 210, 224,231, 303, 310, 323, 331, and 400 H Street. I identified two additional locations for tree replacements at 236 and 326 H St., the site of removed trees.

8. New tree sites have had the stumps removed and in some cases ground down below surface level. However a large amount of root mass still remains within 15 feet of either side of the previous tree trunk. The old root system will likely interfere with the development of new trees planted in the same spot.

9. Branches that are under stress usually present a bulge or a crack on the top of the branch within 3 feet of the attachment to the trunk. While I did not see any instances of potential problems while conducting this review, the best vantage point to conduct a survey is in an aerial platform, or with the aid of a video drone.

Process

The format and definitions included in this report are from the 2013 International Society of Arboriculture Tree Risk Assessment Manual and Tree Risk Assessment Best Management Practices. Additional definitions can be found in Appendix A at the end of this report.

I first reviewed the three previous arborist reports about the H Street trees prepared by Consulting Arborist Michael T. Mahoney dated September 12, 2003, November 17, 2009, and September 2, 2013. Mr. Mahoney's reports are well documented and provided insight into the history of tree failures along H Street, and the efforts to preserve the trees. Of particular note is the January 2010 efforts to reduce all of the canopies of the trees to reduce the weight and density of the canopies. Mr. Mahoney notes in 2013 about the 20010 work;

"Work ensued on the west side of 201 South H Street, proceeded south on the west side of the street, and returned north on the east side. These measures were intended to be sufficiently aggressive to alleviate potential instability due to end weight, yet sufficiently restrained to maintain biological health functions of each tree. As crews proceeded down the west side these aggressive measures moderated until the point of return back up the east side where end weight reduction was abandoned and thinning and raising techniques prevailed."

The conclusion I drew from this account is that aggressive reductions are not a workable method of dealing with weight issues on long horizontal limbs. This is consistent with the City of Santa Barbara approach to maintenance of their 81 Italian Stone Pines on Anapamu Street planted from 1919-1921. The City does light thinning and deadwood removal only every five years, although since power lines run through the trees, Edison does their version of reduction.

Between November 12 and 25, 2015, I conducted a Level Two detailed assessment of 50 trees and reviewed 10 new tree sites. A Level Two analysis is a detailed visual inspection of a tree and its surrounding site using binoculars, sounding mallet (for determining extent of hollow areas of decay within a trunk), probe (for determining extent of decay), magnifying glass (insect and fungal identification), diameter tape, and arborist's trowel (for removing soil at base of trunk).

Information on the Level Two tree assessment is listed on an attached Concise summary spreadsheet. Additional information in a one page per tree Word document more information than the Concise Report and including photographs), an Urban Forest Metrix File Maker File, and a Google Earth file will be sent separately by Dropbox.

Conclusions:

1. Small branches less than 2" in diameter falling from a tree onto a residence below will generally have minor consequences. Branches less than 2" are not addressed as a risk management maintenance issue in this report, although they may be a maintenance issue for aesthetic purposes. However, branches of 2" diameter or more falling from 20' or more onto a residence can have significant consequences depending upon the level of protection. Maintenance of dead branches 2" in diameter or greater are addressed in this report.

2. Drought conditions predispose trees to attacks by insects, fungus, parasitic vegetation like mistletoe, as well as a proliferation of burrowing animals such as gophers and squirrels). Stressed trees are more likely to fail at their point of defect. Ninety year old Italian Stone Pines along Santa Barbara's Anapamu Street under similar conditions to Lompoc's H Street trees have been extensively attacked by boring beetles. While no insect infestation is present on the H St trees, a program to keep the trees healthy is a good defense.

3. The compaction of soil underneath and around the canopies of the trees by decades of pedestrian activity, and the extensive use of non-permeable surfaces in the parkways limits the ability of the trees to extract air and water from the soil, further stressing the trees.

One positive impact of the drought is that root rot from the common Armillaria fungus, which prefers moist conditions, is not as prevalent here as it would likely to be given the soil conditions.

4. Bark Beetles, the Polyphagous Shot Hole Borer, and other are invasive non-native insects have already destroyed thousands of trees) in California and they are moving towards the Central Coast. The most likely way it can be introduced to this area is through bringing firewood from infected areas. Another possibility of bringing in unwanted insects is through newly transplanted trees.

   There is not an effective treatment for these insects once established except to maintain the trees in a healthy condition. Dead trees, firewood and chips can harbor these beetles for months, allowing additional trees to be infected. Wood removed from trees identified with beetle activity should dispose of the wood as trash or have the wood solarized on site. Newly planted trees should receive a close inspection. For more information, see Bark Beetles, Pest Notes Publication 7421 from the University of California Agriculture and natural Resources, November 2008 http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7421.html.

5. An inventory of all trees to be managed is needed, particularly new, small trees that require systematic maintenance and structural pruning to insure they will grow into single trunk, low-risk trees.

Recommendations:

1. **Risk Ratings** - In order to maintain the trees for future use, the trees should be managed to urban conditions for the health of the trees and the safety of residents. Of the 50 trees reviewed, 4 have a low risk rating, 46 have a moderate risk rating, and none have a high risk or extreme risk rating based on a time frame of two years from the date of this report. Since most trees have multiple levels of risk, the failure mode having the greatest risk is being reported as the overall tree risk rating.

2. **Mitigations to reduce risk** - After reviewing the above risk ratings, I recommend mitigations to reduce risk which include;

   a. When feasible, **moving the target** of risk, such as a picnic table or play equipment
   b. **Tree removal** if the tree is dead/not able to be made structurally stable/or not likely to recover from disease or injury. Removal of a live tree is considered a last resort.
   c. **Dead Scaffold/branch removals of between 2 and 10"** –Trees with large dead or seriously defective scaffolds and branches within the canopy that present a probable, high or extreme risk to campers underneath. This should be part of a systematic review of all tree hazards.

      Removal of branches less than 2" is generally not necessary from a risk management or tree health perspective. Tree care specifications should be written to avoid 'cleaning' a tree of all live and dead interior branches, resulting in 'lion tailing'. As in the case of a lion's tail where there is just a tuft of hair at the end, a lion tailed branch removes all foliage, leaving canopy only at the tip. This type of pruning results in structurally unstable trees.

d. **Branch/Scaffold Reductions** – Specific branch/scaffold reductions are one method of attempting to reduce risk levels. Trees recommended for reductions should receive specific canopy reductions to reduce weight load on parts likely to fail. General risk reductions are not recommended for risk reduction as there is no guarantee that reduced canopies will not fail.

e. **Level 3 Tree Risk Analysis** -

46 trees are recommended for a level 3 method of analysis using tomography to more clearly identify cracks, voids, and the extent of decay. By identifying the amount of structurally sound wood in a tree trunk, we can provide more evidence to support taking aggressive actions, or no action at all, in order retain large, valuable trees.

The tomographic analysis of most trees is an extra level of effort to identify potential tree defects. The tree failure profiles indicate that decay is not present in a majority of Italian Stone Pine failures. Tomography will help identify cracks at junctures that could develop into more serious issues. Trees with scaffolds leaning towards residential structures are the highest priority for review, including the following 29 trees;

2,4,8,11,17,18,19,22,24,25,26,27,28,31,34,37,46,47,49,50,51,53,56-61

f. **Maintain trees in a healthy and vigorous status**. An essential element of a tree risk management program to avoid tree failures is to maintain trees in healthy and vigorous growing conditions. This maintenance program could include;

- *Deep watering* during drought periods, once a month to a depth of 2 feet at the outer edge of the canopies.
- *Installation of 3-4" of mulch* under tree canopies (6 inches from and not touching trunks). This can best be accomplished by letting fallen needles lie under the trees.
- *Soil aeration* under canopies to de-compact soil and stimulate root growth. Consider investing in an air spade/soil knife due to the large number of trees requiring this process
- *Use of tree growth regulators* to encourage lower bushier growth
- *Risk Avoidance Programs* - Consider actions to improve the health of all trees and avoid future tree risk by;
    - Participate in campaigns to only use firewood collected from this area. Avoid importing firewood from areas that could include invasive killer insects.
    - Provide a class to staff on current young and mature tree planting, pruning and maintenance standards
- *Conduct a Level Two Update Biannually* - Conduct a Level Two Assessment of the same trees in November 2017. The current assessment reviewed

likelihood of occurrences within two years. The large number of large mature trees would benefit from a biannual risk assessment, as well as a systematic, ongoing structural tree maintenance program for young and newly planted trees.

- *Consider using special software to monitor your trees* -- Should you choose to, I can download all the information I have collected onto your own version of the Urban Forest Metrix System.

3. **Risk Priority** – Determining the priority of actions to reduce risk based on the risk ratings is the responsibility of the City of Lompoc. Based on my knowledge of these trees, I provided a four stage priority ranking for the trees, with one being the most important and 4 being the least important. There are ten priority one trees, forty three priority two trees, four priority 3 trees and three priority four trees. These priorities do not supersede the risk rating results, but provide some guidance to the City in making their own priority system.

Sincerely,

Ken Knight

Ken Knight, Registered Consulting Arborist #507
ISA Risk Assessment Qualified

Attachments

1. Three Google Earth Maps of H Street tree locations
2. Tree Risk Assessment Definitions – International Society of Arboriculture Best Management Practices
3. Fall 2015 Western Arborist Article: Tree Failure Profile-Italian Stone Pines
4. Concise Summary Risk Assessment of 50 trees and 10 potential planting sites
5. Sent by Dropbox - One Page Assessment 61 pages, Google Earth Map file of sites, and Urban Forest Metrix file (requires Filemaker Pro to open)

Attachment 1. Three Google Earth Maps of H Street tree locations

Hickory to Cypress

Olive to Hickory Drive

Locust to Olive Drive

Attachment 2- **Tree Risk Assessment Definitions – International Society of Arboriculture Best Management Practices**

Risk- the likelihood for conflict or tree failure occurring and affecting a target, and the severity of the associated consequences—personal injury, property damage, or disruption of activities. Categorized as Low, Moderate, High, and Extreme.
Hazard—situation or condition that is likely to cause harm (injury, damage or disruption).
Hazardous tree—a tree identified as a likely source of harm.
Residual risk—risk remaining after mitigation.
Likelihood of Failure –The potential for tree or branch failure within a specified time frame. Based on species, extent of defect, anticipated loads and response growth. Categories based on the time frame established in the report are:
Improbable—failure not likely in normal or severe weather conditions within time frame.
Possible—failure unlikely during normal weather conditions (expected in severe weather).
Probable—failure expected under normal weather conditions within specified time frame.
Imminent—failure has started or is most likely to occur in the near future, regardless of weather.
Likelihood of Impact- The potential of the failed tree or branch impacting a target. Based on target location, occupancy rate, anticipated fall direction, and target protection factors. Categories are:
Very low— chance of impact is remote.
Low—not likely that the failed tree or branch will impact the target.
Medium—may or may not impact the target, with nearly equal likelihood.
High —will most likely impact the target.

The likelihood risk matrix is used to estimate the likelihood of a tree failure impacting a specified target

Likelihood of Failure	**Likelihood of Impacting Target**			
	Very low	*Low*	*Medium*	*High*
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Consequences—effects or outcome of an event, including personal injury, property damage, or disruption of activities. Based on target value, tree part size, fall distance, and target protection.
Categories are:
Negligible - low-value property damage (replace/repair), & don't involve personal injury.
Minor -moderate property damage, small disruptions of traffic/or utility, or minor injury.
Significant -high value property damage, considerable disruption, or personal injury.
Severe -serious personal injury or death, high-value damage, or disruption of important activities.

Likelihood of failure and	**Consequences**			
	Negligible	*Minor*	*Significant*	*Severe*

impact				
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Loads on Trees

Arborists are good at identifying defects in trees; including the impact of loads on the Likelihood of failure. "Load" is a generic term describing forces acting on a structure. The two natural forces that exert loads on trees are gravity and wind. Gravity acts as a constant pull on the mass of the tree, generating load from self-weight and the weight of water (rain, snow, or ice). Energy from wind exerts a dynamic force on the tree.

Loads on a tree lead to internal stresses. Strength is the ability to withstand stress without failure. Strength is a species-specific property of wood as a material, and of the tree as a structure. Breaking stress is the magnitude of stress sufficient to cause failure. Tree failure occurs when stress exceeds strength.

Factors guidelines to consider and their impact on stress are presented below;

Factor	**Higher Stress in Tree**	**Lower Stress**
Tree height/branch length	Tall/long	Short
Exposure	Full exposure, funneling Sudden changes in exposure such as removal of adjacent trees/structures	Protected
Architecture	Excurrent	Decurrent
	Over-extended branches	
	Abrupt bend in branch/trunk	
	Unbalanced crown	Balanced crowns
	Leaning stems	Straight stems
Crown	Dense, many epiphytes	Sparse or thin
	Large	Small
	Few interior branches (no damping)	Normal Interior branches
	Low live crown ratio (LCR<33%), Lions-tailed	High live crown ratio (LCR>33%
	Trunk Codominant	Straight
	Missing wood (decay, canker)	Solid wood
Diameter	Small for height	Larger
Weather within time frame	Heavy ice, snow/ high wind (>50mph)	Rain, light snow/low wind (<50 mph)
Recent or planned changes	Greater exposure to wind	Less exposure

Structural failure profile: Italian stone pine (*Pinus pinea*)

L. R. Costello, J. Tso, and K. S. Jones

EACH YEAR, THE STRUCTURAL FAILURE OF trees in urban and forested recreation areas results in personal injuries and property damage. A key objective of a tree management program is to reduce the potential for failure to the extent possible. One important element of failure reduction strategies is to prevent or mitigate conditions that may lead to failure, such as pruning branches weakened by wood decay, cabling or bracing, and avoiding root damage.

All tree species do not fail in similar ways, however. Some are prone to fail as a result of weak architecture, such as codominant stems. Others have a greater propensity to fail because they develop large end-weights on branches — exceeding the load tolerance of the wood. Knowing the particular failure patterns of species can help tree managers identify key defects that may lead to failure.

By collecting detailed information following the failure of a tree, data can be compiled and then used to develop structural failure profiles for species. Such a profile has been developed here for Italian stone pine (*Pinus pinea*) using data from the California Tree Failure Database (CTFD). Arborists and foresters can use this information to develop structural management strategies for Italian stone pine. The development of this profile was commissioned by the Britton Fund of the Western Chapter of the International Society of Arboriculture.

Figure 1. Italian stone pine is a relatively common landscape tree in California. Typically, it has a rounded crown and multi-stem structure. *Photo: K. Jones.*

By collecting detailed information following the failure of a tree, data can be compiled and then used to develop structural failure profiles for species.

Italian stone pine distribution

Italian stone pine is native to southern Europe and Turkey, but has become naturalized in many regions with a Mediterranean climate. It is a relatively common landscape tree in California, being found in both public and private landscapes (Fig. 1).

General statistics

There are a total of 170 reports in the CTFD for Italian stone pine, the majority of which are for root failures (41%). Trunk failures comprise 30% of reports, and branch failures make up the remaining 29%.

Reports came from 22 counties, but the majority (75 reports) are from Contra Costa, San Francisco, and Santa Clara Counties. Italian stone pine failures are slightly more common in winter than summer, with 52% of failures reported from December to February. General statistics for all failure types can be found in Table 1.

Table 1. General statistics for all failure types.

Variable	Mean
Age	43 years
Height	47 feet
DBH	32 inches
Crown spread	44 feet

Figure 2. Many Italian stone pine branch failures occur at the attachment, rather than along the branch. Heavy lateral limbs (end weights), dense crown, and multi-stem structure were reported to be associated with branch failures. *Photo: C. Rippey*

Most failed trees were found in a group (57%), in high use areas (59%), and in residential areas (36%). The most common defect for all failures was dense crown, observed in 21% of reports, followed by multiple/codominant trunks (20%) and leaning trunks (15%).

A. BRANCH FAILURE

Branch failure was reported in 50 cases, or 29% of all reports.

Branch failure location

The majority of branches failed at the attachment (60%) (Fig. 2). Failures along the branch occurred largely within 3' of the trunk (40%), with diameter of the break highest in the 5-12 inch range (60%). The majority of trees with branch failures were between 26 and 50 years old (59%).

The main structural defects observed in trees with failed branches are heavy lateral limbs (observed in 43% of cases), dense crowns (21%), and multi-stem structure (15%) (Table 2).

Decay and branch failures

Decay was reported in only one branch failure case, less than 25% of the cross-sectional area was decayed, and a sporophore was not found. All other reports, comprising 98% of total cases, reported no decay.

Table 2. Defects reported associated with branch failures.

Defect	Frequency
Heavy lateral limbs	43%
Dense crown	21%
Multi-stem	15%

Wind and branch failures

Although more failures occurred in low wind conditions where wind speed did not exceed 5 miles an hour (35%), failures were distributed quite evenly across low, moderate, and high wind speeds (Table 3).

Table 3. Wind speed and branch failure.

Wind speed	Frequency of occurance
Low wind (<5 mph)	35%
Moderate wind (5-25 mph)	32.5%
High wind (>25 mph)	32.5%

Precipitation and branch failures

The majority of branch failures occur during dry conditions (62%), while the remainder occurred during a precipitation event.

Pruning and branch failures

Pruning had not been done in 63% of branch failure cases, while 28% of cases indicated that the tree had been thinned. The remainder of reports did not indicate whether pruning had been done or not.

B. TRUNK FAILURE

Trunk failures accounted for 30% of Italian stone pine failures. Most occurred above ground level (55%), while the remainder (45%) occurred at ground level. Trunk diameter at the point of failure ranged from 7 to 54 inches, but the majority (44%) were between 13 and 24 inches in diameter. The primary defect associated with trunk failure is multiple trunks/codominant stems, observed in 44% of cases, followed by dense crown (28%) (Table 4 and Fig. 3).

Decay and trunk failure

Decay was not present in 76% of trunk failure cases (Fig. 4). In 90% of cases where decay was found, less than 50% of the cross-sectional area was decayed. Sporophores were observed at the point of failure in only two trees, or 4% of cases.

Table 4. Defects reported associated with trunk failures.

Defect	Frequency
Multiple trunks/codominant stems	44%
Dense crowns	28%
Leaning trunk	8%

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Figure 3. (Above) Codominant stems and multiple trunks were the most commonly reported defect causing trunk failure in Italian stone pine. Here, a large comdominant stem failed at the point of attachment. Embedded bark is not commonly found in such failures in *P. pinea*.

Figure 4. (Below) Decay was not present in 78% of trunk failures, but dense crown was reported to be a key factor. Here, an Italian stone pine with a dense crown failed at a point high on the trunk. No decay was evident.

Precipitation and trunk failures

Slightly more than half (54%) of trunk failures occurred during wet conditions, while the remainder of cases occurred during dry conditions.

Wind and trunk failures

Trunk failures most commonly occurred during low wind conditions between 5-25 mph (40%), but distribution was fairly even across low, moderate, and high wind conditions (Table 5).

C. ROOT FAILURE

Root failure is the most common failure type, with 69 reports, or 41% of the total (Fig. 5). Trees experiencing root

Table 5. Wind speed and trunk failure.

Wind speed	Frequency of occurance
Low wind (<5 mph)	40%
Moderate wind (5-25 mph)	28%
High wind (>25 mph)	32%

Figure 5. (Above) The most common type of failure in Italian stone pine is uprooting. Although dense crown is frequently associated with root failures, decay is not. *Photo: C. Llata.*

Figure 6. (Below) Girdling roots are reported to contribute to a number of failures in Italian stone pine. Here, a girdling root occurring at ground line was linked to the failure of this Italian stone pine. *Photo: C. Rippey.*

Table 6. Defects reported associated with root failures.

Defect	Frequency
Leaning trunk	29%
Kinked/girdling root	18%
Dense crown	15%

Table 7. Wind speed and root failure.

Wind Speed	Frequency of occurrence
Low wind (<5 mph)	30%
Moderate wind (5-25 mph)	23%
High wind (>25 mph)	47%

failure ranged from 7 to 100 years old, with the majority (76%) aged 11-50.

Defects and root failures

The most common defects were lean (29%), kinked or girdling roots (18%), and dense crown (16%) (Table 6 and Fig. 6).

Decay and root failures

Decay was not present in 67% of root failure cases. Fruiting bodies were observed near the failure location in only 16% of trees with decay.

Wind and root failures

The majority (47%) of root failures occurred during high wind conditions, while 30% and 23% of failures occurred under low and moderate wind speeds, respectively (Table 7).

Precipitation and root failures

Precipitation was reported in 67% of root failure cases. Saturated soil conditions were reported in 32% of cases.

L. R. Costello
Oracle Oak, LLC

J. Tso
MS, UC Davis

K. S. Jones
CTFRP Database Manager

Summary of Key Findings

- Root failure is the most common type of failure in Italian stone pine (41%).
- The majority of branch failures (60%) occur at the point of attachment.
- Heavy end weight, dense crown, and multi-stem structure were key factors contributing to branch failures.
- Multiple trunks/codominant stems, dense crown, and lean were key factors contributing to trunk failures.
- Lean, girdling/kinked roots, and dense crown were key factors contributing to root failures (Fig 7.).
- Decay was not present in the majority of branch, trunk, and root failures.
- Where decay was present, sporophores (fruiting bodies) were rarely found.
- Embedded bark was reported in only 4% of trunk and branch failures.
- Root failures were associated with precipitation and saturated soils, while trunk and branch failures occurred almost as frequently during either dry or wet conditions.
- Wind played a role in the majority of root failures (47%), while branch and trunk failures were distributed fairly uniformly during low, moderate, and high wind conditions.

Fig. 7. Lean has been reported as a key factor contributing to root failure of Italian stone pine. Here, large props have been installed to reduce the failure potential of this leaning specimen. *Photo: T. Kipping.*

4. **Concise Summary Risk Assessment of 50 trees and 10 potential planting sites**

This Excel spreadsheet is a summary of information about each of the 50 trees and 10 potential new tree sites. It includes the following information where applicable:

A. **Unique Identifier Number** – each tree has a unique number from 1 to 61 (I added tree number 42 with no information, which I will address when the Level 3 report is conducted).

B. **Species- Common name** – The common name of a tree, such as Italian Stone Pine, followed by the **Species – Botanical name** – The botanical or scientific name of a tree, such as Quercus agrifolia (Pinus pinea). Since all the trees are the same species, this information is hidden.

C. **Diameter at Breast Height (DBH)** – The diameter of the tree measured at 54 inches above the ground. A diameter tape is used to measure the circumference of the tree. In the absence of a diameter tape, a standard measuring tape can be used by dividing the results by PI (3.14...) to calculate the diameter

D. **Risk Ranking** – A risk matrix is a means of combining ratings of likelihood and consequence factors to determine a level or rating of risk. Since most trees have multiple levels of risk, the failure mode having the greatest risk is being reported as the overall tree risk rating. The risk rating of the tree ranges from low, moderate, high to extreme.

Low Risk- the low risk category applies when consequences are negligible, when likelihood is unlikely, or consequences are minor and likelihood is somewhat likely. Mitigation or maintenance measures may be appropriate for some trees, but the priority for action is low.

Moderate risk – Moderate risk situations are those for which consequences are minor and likelihood is very likely or likely, or likelihood is somewhat likely and consequences are significant or severe. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree manager. In populations of trees, moderate-risk trees represent a lower priority than high-or extreme-risk trees.

High risk – High-risk situations are those for which consequences are significant and likelihood is very likely or likely, or consequences are severe and likelihood is likely. The decision for mitigation and timing of treatment depends on the risk tolerance of the tree manager. In populations of trees, high-risk trees are second only to extreme-risk trees.

Extreme risk – The extreme risk category applies in situations in which failure is imminent with a high likelihood of impacting the target, and the consequences of the failure are severe. Mitigation measures should be taken as soon as possible. In some cases, this may mean restriction of access to the target area to avoid injury to people.

E. **Residual Risk** – The risk ranking of the tree after the recommended mitigation action is completed. This ranking is the same as risk ranking- **low, medium, high, extreme**. Since a tree can have multiple defects, mitigating the highest risk defect of a tree may not affect the risk rating of a tree. This information will be developed after the Level 3 analysis is complete

Low
Medium
High
Extreme

F. **Notes** – information about the tree,

G. **Risk Mitigation Options** – Mitigation options are those that, when applied, reduce the risk for tree failure and damage. These options will be refined during the Level 3 report. Possible risk mitigation methods include;

- **Scaffold/Branch Reduction** – Pruning to remove or reduce load on parts likely to fail. Crown reductions to reduce risk on mature trees are not recommended due to potential damage to the tree's health, the substantial cost involved, and the lack of certainty that the reductions will decrease the likelihood of tree failure.

- **Dead Branch/Scaffold removal** – Pruning to remove dead or seriously defective branches 2" diameter or greater 10 feet or more above the ground.

- **Cabling** - Use of cables, braces, props, guy wires and other means of structural support. The use of cables and other support equipment on very large, and/or very decayed trees involves further specialized work, particularly if the potential able location involves examining the upper canopy of the tree. These options are not included in this report at the Request of the City

- **Tree removal** – The entire tree is either dead, structurally unstable, and/or has fungal/insect damage from which it cannot recover and should be removed.

- **Move target** – In order to preserve a tree that cannot have its risk level reduced without destroying the character and/or health of the tree, the target is recommended to be moved.

- **Additional assessment** – These trees have structural conditions, size, age, value, or other factors that have unresolved issues after a level two assessment.

H. **Work priority** – The decision as to what priority trees should be maintained is the responsibility of the owner. The ranking system presented here is based on the relative risk of the tree, with a few exceptions;

1. To be initiated at the earliest opportunity (tree planting program)
2. Moderate Risk trees – trees to be reviewed with tomography
3. Lower risk trees- Trees will actions not involving the use of tomography
4. Lowest risk trees-Usually a monitoring or low priority action.

#	DBH	Risk Rating	Notes	Mitigations Options	Work Priority
1	49	Low	439 H St. sw corner house with locust	weight reduction	3
2	51.5	Moderate	435 H St Review sw scaffold canopy leaning on tree 1 canopy for stabilization. Also review base where overwatered	reduce or remove sw scaffold, reduce irrigation	2
3	47.5	Moderate	429 H St. review crotch at scaffolds and base	move grass back from trunk	2
4	57	Moderate	423 H St south tree on boundary with 429	, reduce end weight, remove mulch adjacent to trunk	2
5	54.5	Moderate	423 H St north tree, check junctures for cracks	reduction	2
6	60	Moderate	415 H St 2013 resistograph	reduction	2
7	49.5	Moderate	411 H st south tree 2013 resistograph?	reduce further	2
8	59	Moderate	411 H St south tree - 2009 reduction, 2013 branches with twisted defects over street. Review juncture with 2 west scaffolds	reductions	2
9	56	Moderate	403 H St south tree	reductions	2
10	44	Moderate	403 H St north tree. corner, no tree to north	reductions	2
11	49	Moderate	335 H St corner house .	reduce end weight 20', remove rocks around trunk and add mulch	2
12		Low	331 h st south - new tree site	remove rocks and ground cloth, root grinding	1
13	47	Moderate	331 H St. north	reduction	2
14		Low	323 h st new tree- previous tree removed after 2009 report recommendations and August 2009 scaffold failure	root grinding	1
15	37	Low	323 H st north tree	reduction	4
16	42	Low	319 H	remove concret and black plastic, replace with mulch	4
17	51.5	Moderate	311 H street south tree- 2009 reduction, 2013 low vigor continues, check seam for decay	see root section and trunk section, additional reductions?	2
18	53	Moderate	311 H St. north tree - review scaffold heading towards house	reduce three branches 20' see crown	2
19	46	Moderate	307 H St.- check juncture of scaffold leaning towards house as precautionary measure	se e crown reduction	2
20		Low	303 h st. new tree - previous tree identified in 2003 report as one with issues failed around 2009	root grinding	1
21	57	Moderate	237 H St. nw corner at hickory st	possible review of scaffold over street, note collar and horizontal crack at base	2
22	58	Moderate	231 h st south tree-2013 decay in crotch 12", one scaffold failed in April 2013. Resistograph 2009? 48" southeast side showed a cavity at 16"with several rings of compartmentalized wood just before the entry. Review crotch	reduction	2
23		Low	231 h st new tree - tree removed after 2003 and 2009	root grinding	1

			reports		
24	58	Moderate	223 h st south - review branch leaning towards 223 h st	review codominant base of 3 scaffolds	2
25	63	Moderate	223 h st north tree - crack where south scaffold is attached 223 h st	reduction over house	2
26	50.5	Moderate	review crotch? 215 h st south tree	reduction on house side?	2
27	47.5	Moderate	215 h st- north tree. - review crotch	reduce branch leaning towards 211 h st	2
28	61	Moderate	211 h st. - review leaning scaffolds at base	reduce	2
29	59.5	Moderate	201 h street south tree - check cracks at base of east leaning scaffold	reduction	2
30	54	Moderate	201 h street north tree next to church, check seam next to burl, suspect decay	reduce	2
31	44	Moderate	200 h street museum north tree.. check burls at base of scaffolds	reduction	2
32	45	Moderate	200 h street south tree.check base of two north leaning limbs. see site pictures	reduction	2
33		Low	210 h street new tree site - tree removed in 2013 due to decay at base of scaffolds	root grinding	1
34	63	Moderate	214 h street-check base of east leaning scaffold and effects of long term excessive irrigation at base. 2013 rec additional reduction after limb failure. 2009? resistograph 36" up south side found decay 14.3" into trunk	reduction, change irrigation	2
35	42.5	Moderate	220 h st -check seam on nw scaffold		2
36		Low	222/224 h st new tree Previous tree failed around 2009 did not have any issues in 2003 report	root grinding	1
37	52	Moderate	224 h st. review crotch of east leaning trunk	monitor, consider reductions over house	4
38	20	Low	228 h st- planted in 2002	structural pruning to offset se lean and growth, remove overhead emitters hitting trunk	3
39		Low	236 h st. south new tree site-recommended for removal in 2003. tree removed in 2013 due to 5' deep cavity in center of 4 (previously 5) scaffold tree. Not on new tree list	root grinding	1
40	50	Moderate	238 h st ne corner with hickory. check gall?	south crown reduction	2
41	52	Moderate	302 se north h st hickory corner check codominant seam at south leaning scaffold	reduction	3
42					
43	46	Moderate	306 north h st. review south scaffold seam 2009? resistograph 36" up on the southwest side thru a seam showed no indication of deterioration.	remove south scaffold, which will interfere with new tree 44	2
44		Low	310 h st new tree - Previous tree, one of 4 scaffolds failed in June 2009 and tree was removed	root grinding	1
45	62	Moderate	310 h st south tree-scaffolds moving in different doirections. verify base joints	reductions, though cabling would work well here	2

46	58	Moderate	318/320 h st - check base due to house proximity. 2009? resistograph 40" up on the north side into old stub showed no significant decay	reduction over house	2
47	62	Moderate	322 h st- 2009 reduction, 2013 resistograph results, no issues at 4' up(decay at 13"), check at base	reductions	2
48		Low	326 h st new tree - Previous tree recommended for removal in 2003, tree removed in 2013 due to multiple codominant trunks with deep cavity in between. Not on new tree list.	root grinding	1
49	53	Moderate	330 h street - verify east scaffold ok?	more east reductions?	2
50	71	Moderate	330 h st - check se scaffold junction?	reduction towards 105 east olive	2
51	54	Low	105 e olive, me corner. check se scaffold for possible problems, potential root failure	added reductions	2
52		Low	400 h st - new tree	root grinding	1
53	70	Moderate	404 h st- check me juncture.	more reductions	2
54	49	Moderate	408h st.- 2013 end weight concern and vigor issue. Check east scaffold juncture.	reductions	2
55	46	Moderate	412 h st. - check base of se scaf	reduction	2
56	51	Moderate	414/420 h st - check decay at base	reduction	2
57	47	Moderate	426 h st - check e scaf juncture	reduction, remove concrete in parkway	2
58	60.5	Moderate	430 h st - check base of e scaf. 2009? resistograph 4' up the east side angled into the crotch showed no indications of decay	more reductions	2
59	46	Moderate	434 h st - check se scaf juncture	reductions	3
60	45	Moderate	436 h st - check juncture, planted 1985-95	reduce	2
61	36	Low	review juncture 436 h st.	remove e scaf	2

2015 - 2016
Tree Replacements on South H Street

210
224
231
303
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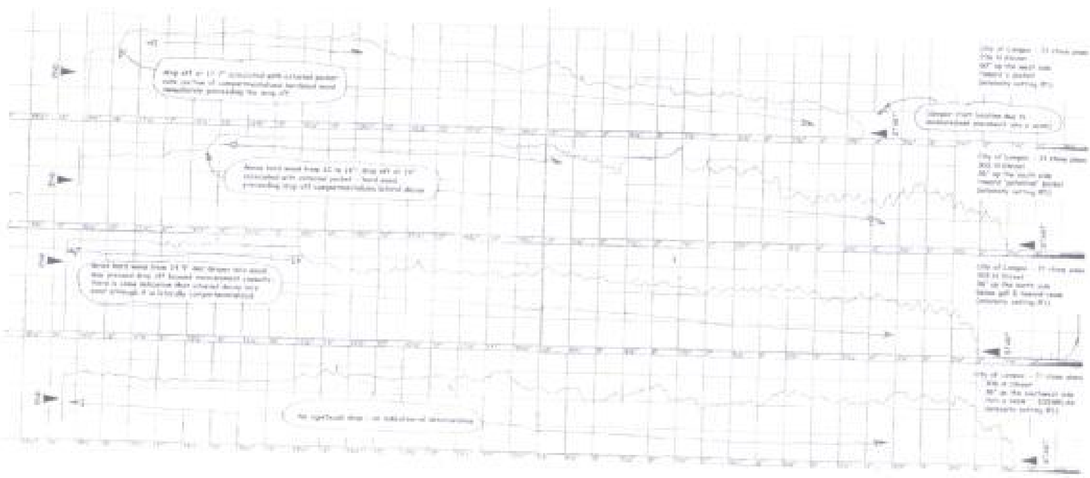
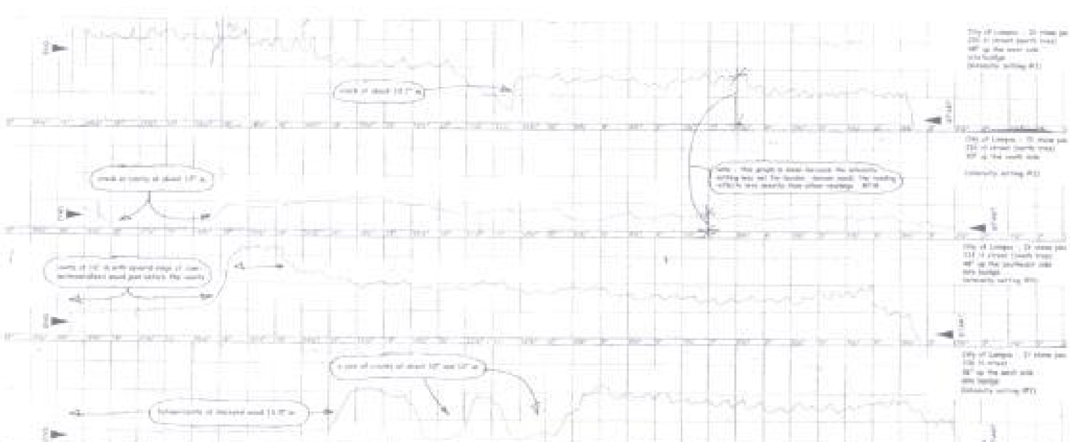
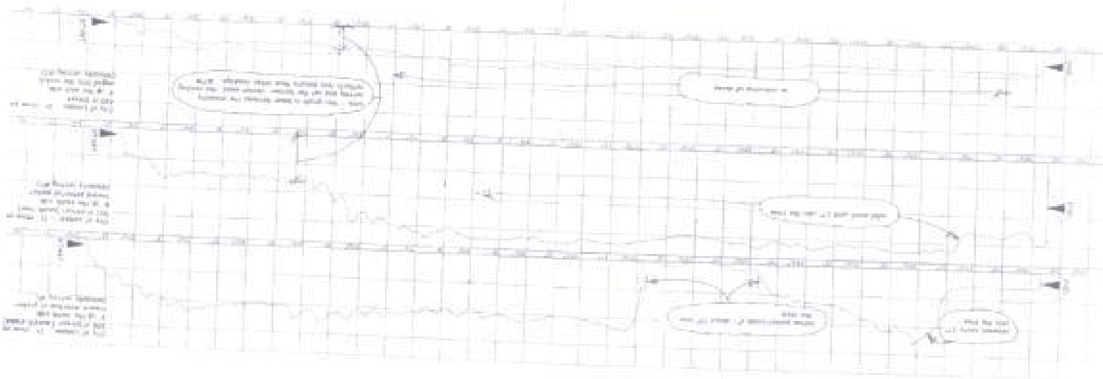






Michael T. Mahoney

Independent Consultant - Specialist in Arboriculture and Urban Forestry

425 30th Street, Suite 28 • Newport Beach, California 92663 • 949 673 5106 • Fax 949 673 5197

Cindy McCall
City of Lompoc
P.O. Box 8001
Lompoc, California 93438-8001

September 12, 2003

RE: H Street Pine Tree Assessment

Dear Ms. McCall,

This letter summarizes the results of my inspections to determine the health and stability of Italian stone pines (*Pinus pinea*) growing in the city right of way in the 200, 300, and 400 blocks of H Street and 2nd Street in the City of Lompoc. Several ancillary documents are included here, including:

- A collection of annotated photographs of selected trees on H Street
- A spreadsheet listing of 60 tree locations with attributes and assessments to express current conditions related to this study
- A collection of graphs produced in conjunction with measurements of internal wood decay and deterioration performed using a Resistograph – an instrument developed to measure decay in trees

The study arises from an incident occurring in August of 2003. In the early morning hours on a calm day one of three major scaffold limbs of the large Italian stone pine located in the public right of way at 228 H Street broke off and fell into the street. The wound produced by this broken limb exposed a combination of characteristics that appear to have predisposed the limb failure. These characteristics include:

- An external pocket that formed at the junction or bifurcation of the three codominant major scaffold limbs
- Bark extending down from the bifurcation so as to be included deep within the internal woody tissues of the tree bole (lower trunk portion)
- A cavity of decay beneath the pocket and within the bole that is associated with cracks and included bark

It may also be inferred that long horizontal limbs and heavy limb end weight intensified the condition by exerting a load amount that exceeded the mechanical 'holding capacity' of this multi-stemmed tree.

The methodology applied to this assessment included visual inspection of each tree from the ground level with attention to the planter/parkway environment and root crown of each tree, the tree trunk and noting bark characteristics and major wounds, careful investigation of the nature and character of major scaffold limb division or bifurcation, presence, if any, of specific direction of lean of the tree or extension of long horizontal limbs and their potential for impact on the surrounding environment, and the characteristics of the tree canopy. Trees with pockets at the location of scaffold limb bifurcation, or with unusual vertical bark seams and/or included bark were selected for additional study by performing one or more measurements of the internal wood density using a Resistograph 500®.

Long horizontal limbs are characteristic of Italian stone pines, and, while these conditions may have a detrimental impact on a tree's stability, it is common for the species to persist for many years (indeed, in many cases they exist a lifetime) with this typical horizontal limb pattern. Nevertheless, it is possible to reduce risk in especially conspicuous trees by applying routine pruning treatments to minimize limb length and/or reduce end weight. In this regard, several comments have been made in line item listings of the spreadsheet about long horizontal limbs and end weight, and routine pruning treatments are warranted for most of these trees whether or not specific mention has been made in the line item listing.

Three of the trees (located at 231 H Street- north tree, 236, and 326- north tree) have been found to exhibit external and internal conditions that are very similar to those of the tree at 228 H Street prior to its failure. I believe that no reasonable treatments can be performed to adequately diminish the potential risk and preserve the health, stability, and the aesthetic appeal of the tree, and that these trees should be removed to preserve public safety.

One tree (322 H Street) has many of the suspect characteristics, but was too large for investigation using the Resistograph. Measures should be taken to significantly 'unload' this tree, and artificial support mechanisms might be considered to mitigate its apparent poor structure. Consideration may also be warranted for its removal even though visible proof that the destructive features have manifested has not been provided in this study.

Seven trees exhibit characteristics indicating that harmful conditions are progressing. These trees might be treated, if desirable, or the trees may also be considered for removal. These are: 210, 214, 231– south tree, 303, 310– north tree, and 322 H Street. In addition, several trees measured with the Resistograph do not appear to be significantly impacted by these conditions at this time. These are: 306, 320, 331- south tree, and 430.

As of the time of the field study for this report, half of the trees have one or more attributes that merit attention to avoid potential risk beyond the concerns for the type of failure that occurred at 228 H Street. In many cases these attributes simply require monitoring for sudden changes or worsening of the condition. These are: 200- north tree, 200- south tree, 201- north tree, 201- south tree, 215- north tree, 220, 223, 227, 238, 302, 310- south tree, 311- north tree, 323- north tree, 323- south tree, 335, 105 Olive (corner of Olive and H – on H), 400, 403- north tree, 403- south tree, 408, 411- north tree, 412, 415, 423- north tree, 423- south tree, 426, 434, 436- north tree, 436- south tree, and 439 H Street.

Finally, fifteen additional trees do not appear to have characteristics that might result in the type of failure that occurred at 228 H Street or other significant challenges at this time (other than those indicated on the spreadsheet). These are: 211, 215- south tree, 222, 237, 307, 311- south tree, 319, 326- south tree, 330, 331- north tree, 404, 411- south tree, 420, 429, and 435 H Street. It is important to note, however, that conditions in the field are 'fluid', and those circumstances that impact tree stability may evolve and changes can occur with regard to potential risks from trees.

I hope you find this information helpful in assisting to make the important decisions about dealing with these challenging tree issues. If I can be of further assistance please do not hesitate to contact me.

Yours truly,

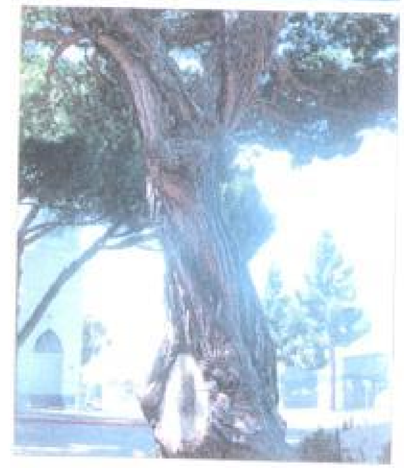
Michael T. Mahoney, registered consulting arborist

Enc: Photographic references (9 pages)
Spreadsheet (2 pages)
Annotated Resistograph graphs (5 over-sized pages)

Photo references

Above right: the tree located at 200 H Street (north tree). The upper canopy of this tree is somewhat atypical - shorter and stubbier than others. Note the twisted growth of the trunk (red arrow)

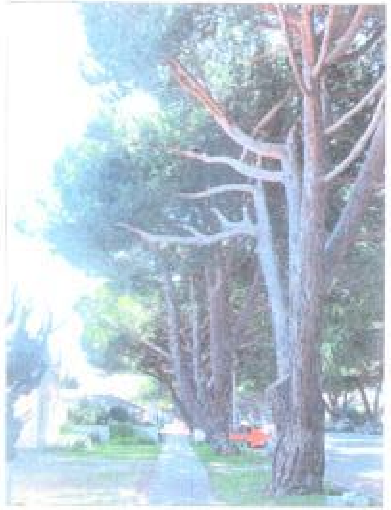
Middle right: the tree located at 200 H Street (north tree). The twisting pattern extends for the entire length of the trunk.



Below right: the tree located at 200 H Street (north tree). In addition to the twisting pattern, the trunk has significant kinks, and a large wound low in the bole. These and some of the other characteristics found in other trees along H Street are not equivalent to the conditions that led to tree failure at 228 H Street, but they merit monitoring.

Photo references

Above right: the tree located at 210 H Street. Resistograph measurements were taken of this tree at the location indicated (red arrow). Note the lopsided canopy occurring as a result of removal of one of the major scaffold limbs. That treatment has to some extent mitigated potential limb failure in the manner of 228 H Street.



Below right: the tree located at 214 H Street. The soil is excessively moist here and other challenging factors exist in addition to the presence of those conditions similar to 228 H Street.

Photo references

Above right: the tree located at 228 H Street. Photo provided by city staff.

Below right: the tree located at 228 H Street. Additional photo provided by city staff.

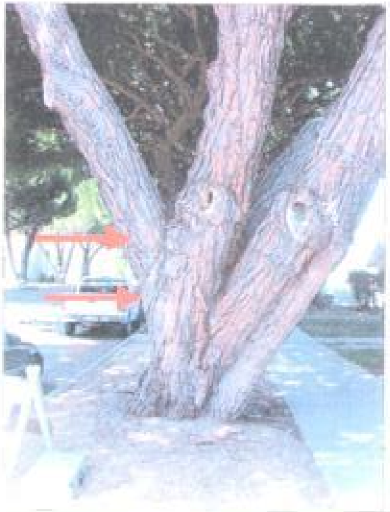
Photo references

Above right: the tree located at 231 H Street (north tree). This tree has many of the challenging characteristics of the tree that failed at 228 H Street.

Below right: the tree located at 231 H Street (south tree). The long vertical seam (long vertical arrows) is associated with a pocket of decay. One Resistograph measurement was taken

Photo references

Above right: the tree located at 236 H Street (south tree). Two Resistograph measurements were taken, as indicated.



Below right: the tree located at 303 H Street. Two Resistograph measurements were taken, as indicated.

Photo references

Above right: the tree located at 306 H Street. Note the large vertical seam (red arrow). A measurement was taken to determine if an internal crack has formed. None was found.

Below right: the tree located at 310 H Street (north tree). This tree has a significant pocket of decay and 3 Resistograph measurements (red arrows) indicate that conditions are developing that are similar to those at 228 H Street.

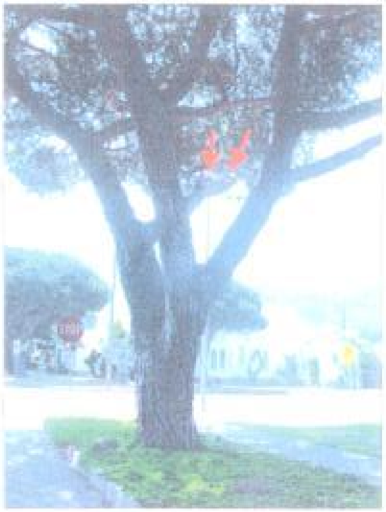
Photo references

Above right: the tree located at 310 H Street (south tree). This tree leans precariously toward the driveway. While no pocket of decay was found, it should be monitored regularly for potential root failure and other physical attributes that appear challenging.

Below right: the tree located at 322 H Street. This tree is too large to take meaningful measurements with the Resistograph. Note the suspicious seam with a pocket at its upper junction - several Coast live oak seedlings are growing in the pocket.

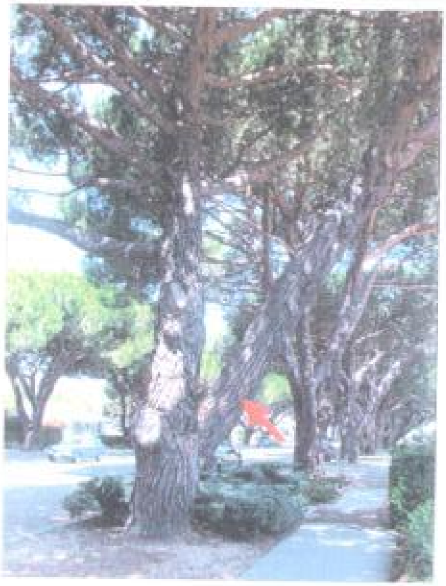
Photo references

Above right: the tree located at 326 H Street (south tree). Several of these major limbs have narrow crotches that have apparently grafted together. The associated seams in the bark pattern suggest alignment of force flow through the tree and into the root crown.



Below right: the tree located at 335 H Street. Several limbs recently broke away in the canopy of this tree. (red arrow)

Photo references



Above right: the tree located at 434 H Street and several in a row beyond, looking north. The long limb (red arrow) appears menacing as it rises toward the adjacent residence. Long limbs such as this can become destabilized when weight increases due to end weight and their cantilever away from the point of attachment.

Below right: the tree located at 436 H Street (south tree). This younger tree is somewhat unstable - pruning treatments to mitigate potential wind-throw are warranted.

Assessment of H Street Italian Stone Pines - City of Lompoc California

Summer, 2003

Tree Address (n=north s=south)	Tree (GIS) Location Number	Trunk Diameter (dbh or narrowest)	# of Major Scaffold Limbs	Large Trunk Wounds	Substantial Included Bark	Pocket Formation @ Bifurcation	Resistograph Measurement	Significant Trunk Lean	Long Horizontal Limbs	Crown Excessively Thin	Condition Comments
200n	10626	46.5	2	yes	yes	no	no	no	no	yes	twisted sinking limbs, galls
200s	8225	48.5	2	yes	yes	no	no	yes	west	no	lateral limbs appear pinched, end weight concern
201n	10628	45	1	yes	no	no	no	no	south	no	end weight concern over street
201s	8226	46.5	5	yes	no	small	no	no	west	no	end weight concern over private property
210	8224	52.5	3	yes	no	yes	2xs	no	no	no	lopsided canopy, some decay at pocket
211	8209	50	3	yes	no	no	no	no	no	no	curb taken out, some cut roots
214	8223	47	4	yes	yes	yes	yes	southeast	no	no	very moist soil, soil cracks, hollow soil, some decay at pocket
215n	8210	43.3	2	yes	yes	no	no	no	southeast	no	end weight concern over street
215s	8211	40.5	2	yes	yes	no	no	southeast	no	no	no comment
220	8222	40.5	2	no	yes	no	no	no	no	no	no comment
222	8221	48	3	yes	no	no	no	no	yes	no	moist to north, twisted trunk, hollow soil
223	8212	56	3	yes	no	small	no	south	no	no	no comment
224	8220	46.5	4	no	no	no	yes	southeast	south	no	some evidence of old root/soil failure
227	8213	46.5	3	yes	yes	no	no	no	yes	no	massive buttress roots, 2 major scaffold limbs over adjacent home
228	8219				yes	yes			west	no	end weight concern over private property
											fallen tree
231n	8214	52.5	6	yes	yes	yes	2xs	no	north	no	internal crack and decay associated with external pocket
231s	8215	48	3	yes	yes	yes	yes	no	north	no	internal decay associated with external pocket
236	8218	58	5	yes	yes	yes	2xs	east	no	no	internal crack and decay associated with external pocket
237	8216	48.5	3	yes	yes	no	no	no	no	no	no comment
238	8217	44	2	no	no	no	no	no	yes	no	heavy end weight, galls
302	8236	45.5	3	yes	no	no	no	southeast	yes	no	leans over building and street, galls
303	8227	52	5	yes	yes	yes	2xs	south	yes	no	dense, hard wood in interior of trunk, some decay at pocket
306	8235	39.5	3	no	no	no	yes	south	no	no	exemplar measurement for internal wood at vertical trunk bark seam
307	8228	41.5	2	yes	no	no	no	south	no	no	curb repaired, no other comment
310n	8234	49.5	4	yes	yes	yes	3xs	no	no	no	internal decay associated with external pocket
310s	8233	55	4	yes	yes	no	no	east	west	no	some concern for possible root failure
311n	8229	45.5	4	yes	yes	no	no	no	south	no	long horizontal limbs over street
311s	8230	45.6	2	yes	yes	no	no	no	no	no	abuts driveway apron, long vertical trunk seam
319	8231	38	1	no	no	no	no	no	no	yes	recently raised canopy
320	8232	47	3	yes	no	no	yes	hard	no	no	several long seams in trunk

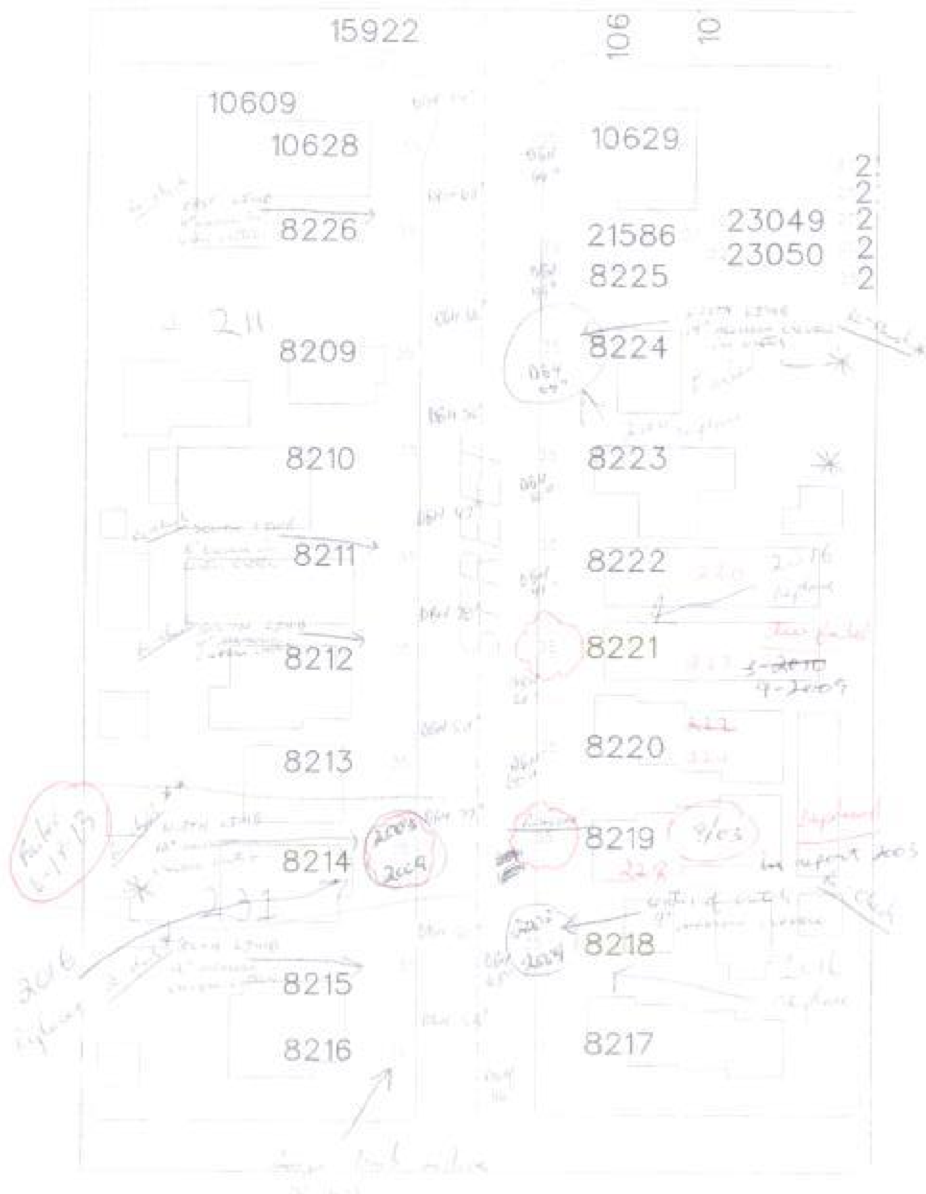
Prepared by M.T. Mahoney, registered consulting arborist

Assessment of H Street Italian Stone Pines - City of Lompoc California

Summer, 2003

Tree Address (n=north s=south)	Tree (GIS) Location Number	Trunk Diameter (dbh or narrowest)	# of Major Scaffold Limbs	Large Trunk Wounds	Substantial Included Bark	Pocket Formation @ Bifurcation	Resistograph Measurement	Significant Trunk Lean	Long Horizontal Limbs	Crown Excessively Thin	Condition Comments
322	6246	52	5	yes	yes	yes	no	no	no	no	too thick for Resistograph measurement, oak seedling in pocket
323n	8237	34.5	2	yes	no	no	no	no	yes	no	concern for end weight of horizontal limbs
323s	8238	40.5	3	yes	no	no	no	no	yes	no	long horizontal limbs over house - resident concerned
326n	8245	55	5	yes	yes	yes	yes	southeast	no	no	internal crack and decay associated with external pocket
326s	8244	43.5	5	no	yes	no	no	no	no	no	several scaffold limbs have grafted together
330	8243	52	4	yes	yes	no	no	southeast	no	no	scaffold limbs seem pinched
331n	8239	41.5	4	yes	yes	no	no	no	no	no	sidewalk displaced by roots on west side of tree
331s	8240	42.5	3	yes	yes	no	yes	no	no	no	possible pocket considered - Resistograph measurement = negative
335	8241	42	2	yes	no	no	no	no	yes	no	reduce limb end weight
105*	8242	45	4	yes	yes	no	no	south	yes	no	*on corner of Olive: some concern for possible root failure
400	7926	39.5	2	yes	yes	no	no	east	yes	no	cabled, overhangs house, soil uplifted but firm, open cavity
403n	7907	37	2	no	no	no	no	south	yes	no	concern for end weight of horizontal limbs
403s	7908	46.5	5	yes	yes	no	no	no	yes	no	concern for end weight of horizontal limbs
404	7925	47.5	4	yes	yes	no	no	no	no	no	vertical bark seams extend down trunk into the ground
408	7924	44.5	2	yes	no	no	no	no	yes	no	concern for end weight of horizontal limbs
411n	7909	42	5	no	yes	no	no	south	yes	no	concern for end weight of horizontal limbs
411s	7910	40	3	no	yes	no	no	south	no	no	driveway to south is very close
412	7923	43	2	yes	no	no	no	no	south	no	twisted limbs, galls, end weight concern
415	7911	46	3	no	no	no	no	no	yes	no	large galls on trunk at several elevations, end weight concern
420	7922	47	3	yes	no	no	no	no	no	no	cavity with brown rot, cables (too low), strong woundwood ribs
423n	7912	45.5	4	yes	yes	no	no	no	yes	no	galls at major scaffold limb bifurcation, end weight concern
423s	7913	46.5	4	yes	no	no	no	no	yes	no	galls at major scaffold limb bifurcation, end weight concern
426	7921	41	3	yes	yes	no	no	no	yes	no	recent loss of large limb, concern for end weight
428	7914	41.5	2	yes	yes	no	no	no	no	yes	dead lawn in vicinity
430	7920	51	5	no	no	yes	yes	no	no	yes	poison oak growing in pocket
434	7919	40.5	2	yes	yes	no	no	no	east	no	long horizontal limb over house, looks dangerous
435	7915	49	2	yes	no	no	no	south	no	yes	canopy thinning on south side
436n	7918	40	2	yes	yes	no	no	east	yes	no	looks dangerous, threatens private property
436s	7917	26.5	2	no	yes	no	no	southeast	yes	no	concern for root/soil stability, threatens private property
438	7916	43.5	2	yes	no	no	no	no	southeast	no	visqueen and rock-covered parkway, end weight concern

Prepared by M.T. Mahoney, registered consulting arborist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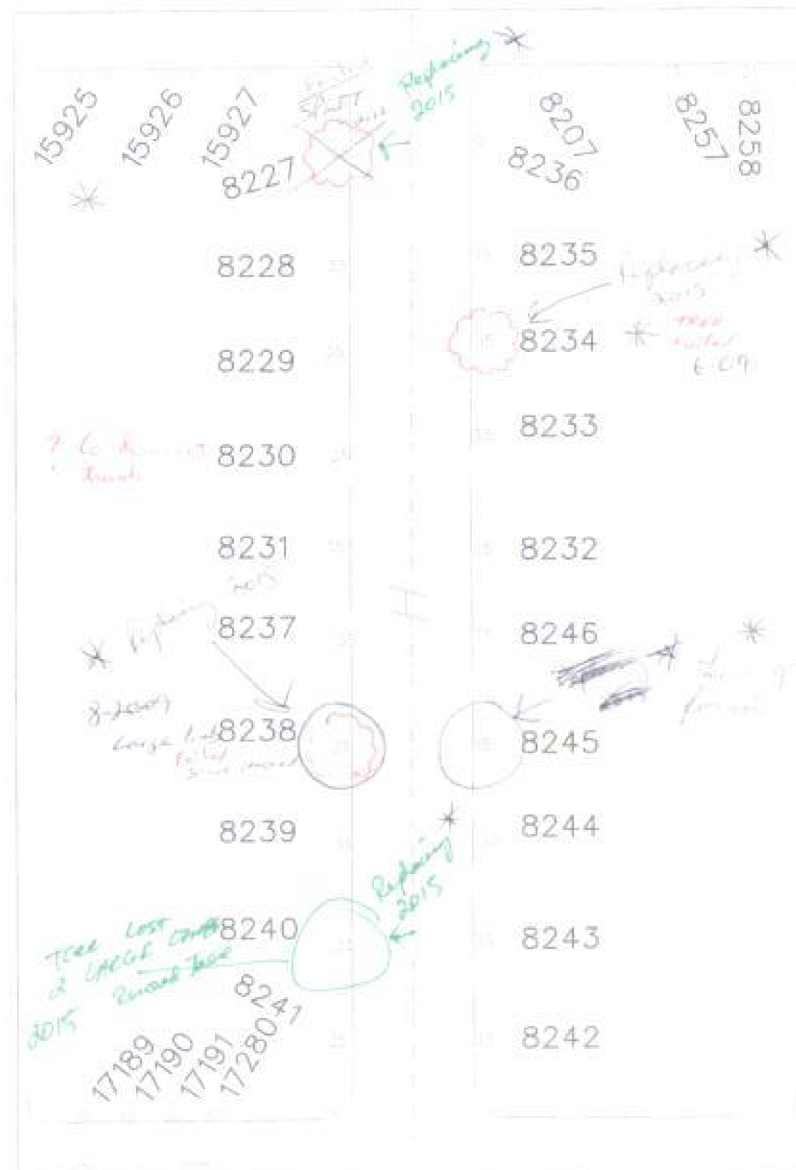
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Kenneth A. Knight Consulting LLC

Registered Consulting Arborist #507
Board Certified Master Arborist WE6394AM
69 Calaveras Avenue Goleta, CA 93117
H (805) 968-8523 W (805)252-1952
kennethknight@cox.net www.goletaarborists.com

March 1, 2017
Codie Blea, City of Lompoc Urban Forestry Supervisor
1300 W. Laurel Avenue
Lompoc CA 93436
C_BLEA@ci.lompoc.ca.us

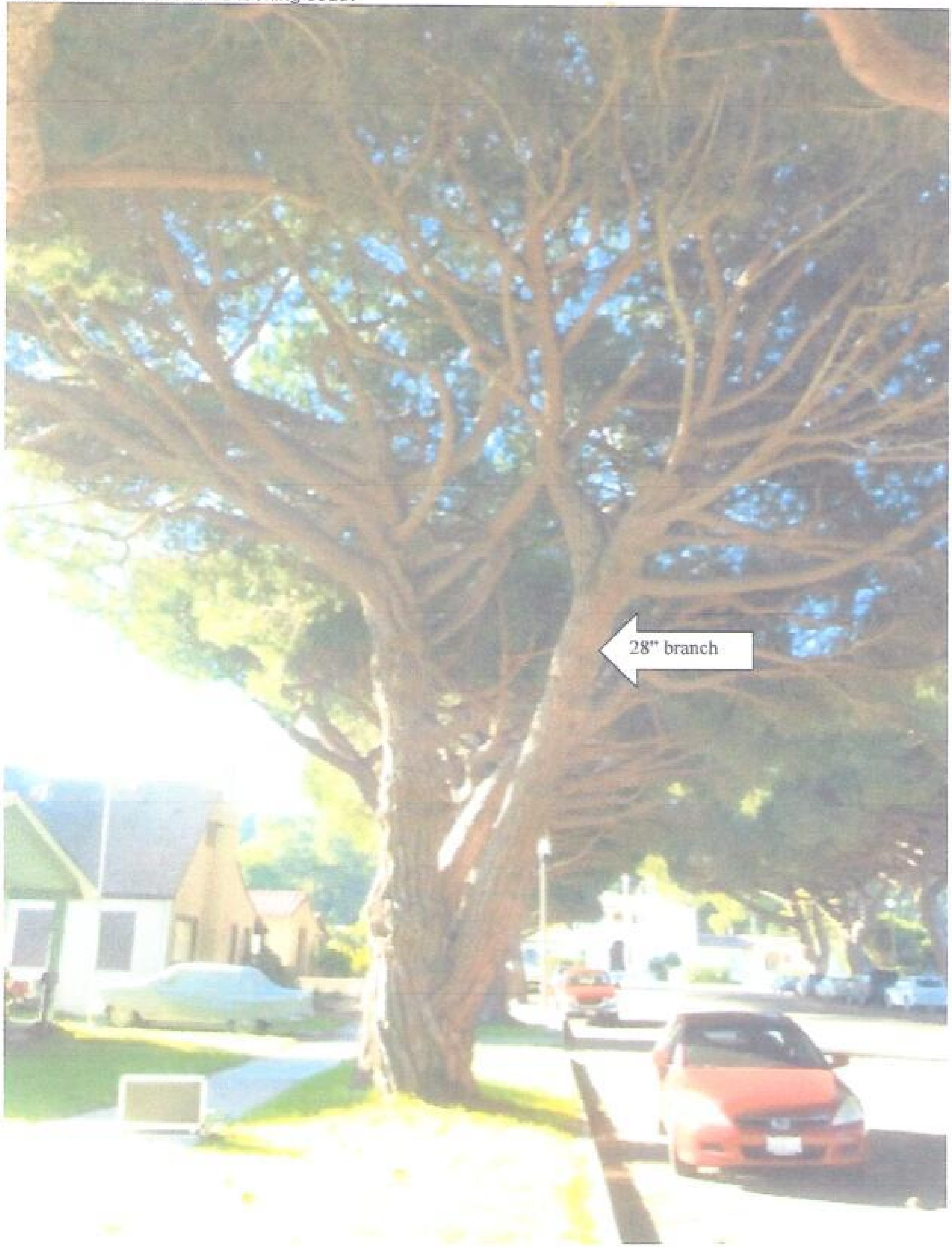
Level 3 Analysis of Italian Stone Pine at 414-16 South H Street, Lompoc CA 93436

Assignment: Conduct a Level 3 analysis of the structural stability of a 28" branch of Tree 56, a three-trunked Italian Stone Pine (*Pinus pinea*) tree in the parkway between 414 and 416 South H Street.

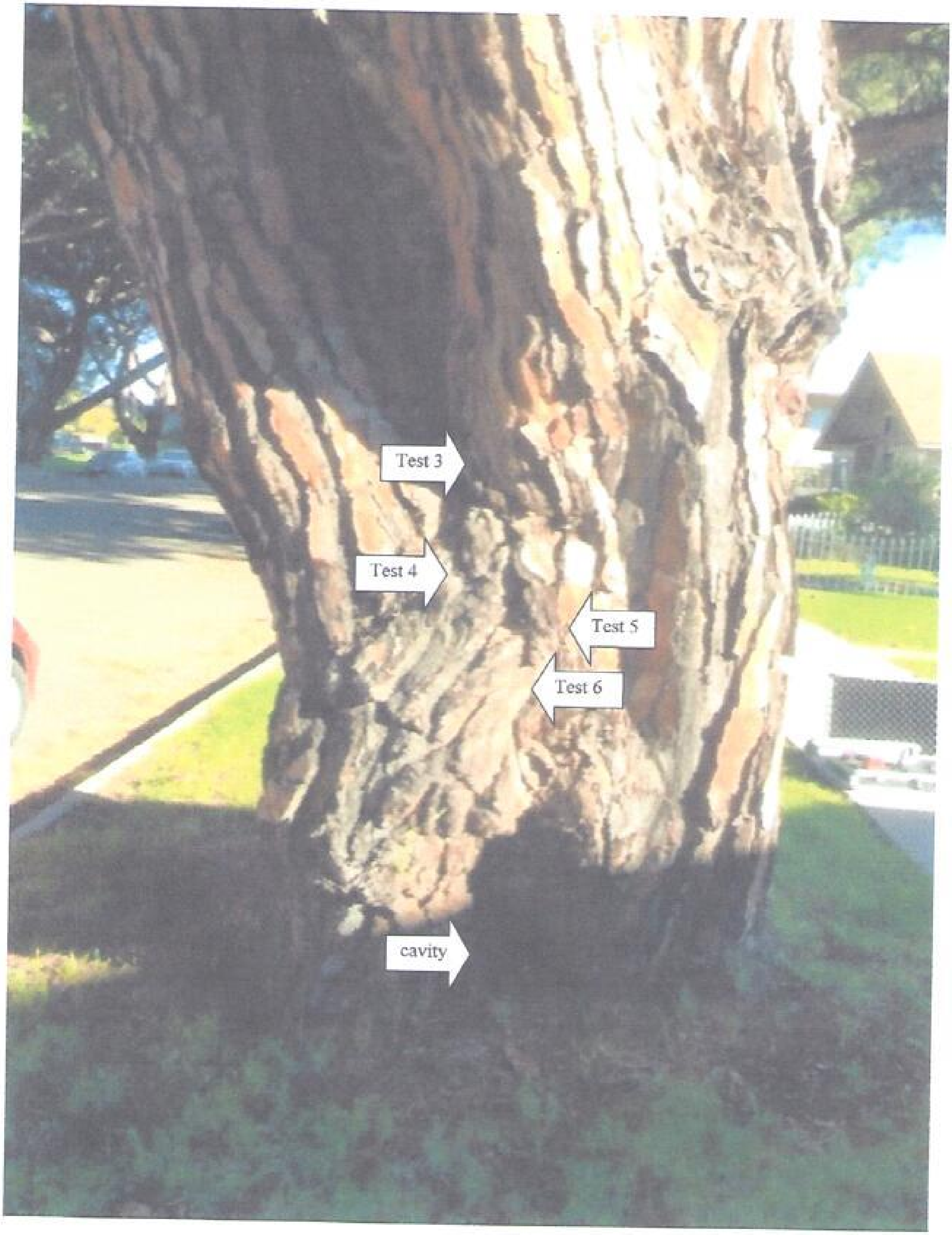
History: In my December 1, 2015 Level Two Assessment of the 50 Italian Stone Pines in the 200-400 blocks of South H Street, this tree was listed as tree 56, as shown on the aerial map below. Tree 56 has a 51" Diameter at Breast Height, a 68-foot crown and is 35 feet tall. The branches in the crown of tree 56 are integrated with tree 55 to the north and tree 57 to the south. The 28" branch leaning at a 45-degree angle over the H Street toward the west is touching the canopy of the tree across the street in front of 415 H Street. I assessed the risk of this tree as moderate due to the heartwood decay, unbalanced crown, overextended branches and weak attachments. Please see my December 1, 2015 report for a discussion of the risk ratings and their limitations

Tree 56 at 414-416 South H Street between Locust to Olive Drive

Tree 56 north side of tree looking south



Test sites 1 and 2 on north side of tree


Test 3
Test 4
Test 5
Test 6
cavity

IML F-500 Resistograph readings

I used a resistance drill to drill 19" into the trunk to detect decay, cracks and/or cavities at the crotch between the 28" branch and the main trunk. The readouts are included as an attachment to this report.

Test 1 was drilled on the north side of the trunk at 4'7" from the ground from a north to south orientation into the base of the crotch. The test indicates an initial 50% weakness in wood strength for the first ten inches and gradually increasing to almost full strength at the 19" mark.

Test 2 was drilled on the north side of the trunk at 4' 5" from the ground from a west to east orientation at the base of the crotch. The test indicates an initial 50% weakness for the first two inches followed by a one inch cavity, then 50% wood weakness for the next 4 inches before the wood then regains full strength.

Test 3 was drilled on the south side of the trunk at 5' from the ground from a south to north orientation at the base of the crotch. The test indicates a 50% wood weakness for the first ten inches before it gradually reaches full strength at 17".

Test 4 was drilled on the south side of the tree at 4' from the ground from a south to north orientation above the cavity at the base of the tree. The test indicates a 50% weakness in wood strength for the first 11 inches before the wood gains almost full strength for the remainder of the test.

Test 5 was drilled on the south side of the trunk at 3' 4" from the ground from an east to west orientation above the cavity at the base of the tree. The test indicates a 50% weakness in wood strength for the first 9 inches before gradually reaching full strength for the remainder of the test.

Test 6 was drilled on the south side of the tree at 3' 4" from the ground from a south to north orientation below the crotch. The test indicates a 50% weakness in wood strength for the first 9 inches before gradually reaching full strength.

Analysis

The most common threshold for sound wood necessary for a tree to maintain adequate load-bearing capacity allows for the loss of two thirds of the diameter of the stem in the center of a round stem with a full crown. That is, if the remaining sound wood thickness surrounding an internal cavity is more than one-sixth of the trunk diameter (one third of the radius), then the tree is considered not likely to fail under normal weather conditions. Source, ISA Tree Risk Assessment Manual 2013, page 191.

For the 28" diameter branch on a 51" trunk, the drilling tests do not indicate any substantial internal cavities. The test does indicate a 50% wood weakness of strength for approximately 9 inches on both the north and south sides of the tree as well as a similar weakness when using an east west or west east orientation. The weakness extends about 18" into a 28" diameter branch, or 65% of the diameter of the 28" branch. One sixth of the diameter of the 28" branch is 4.6 inches, with the remaining actual sound wood of about 10 inches. This result places the tree on the positive side of the threshold for cross-sectional strength.

However, the failure threshold described above has significant limitations;

- The area where the wood is weakest is at the crotch between the 28" branch and the main 51" trunk. It is not the branch that is likely to fail, but the connection between the branch and main trunk.
- There is a substantial load on the 28" branch which has most of the foliage weight at the end of the 45-degree leaning branch.
- 29% of all Italian Stone Pine failures are likely to occur at a weak crotch like this one.

Based on the amount of structurally weak wood in the area of the weak crotch, and the heavy load on the 28" branch, I am revising my risk assessment of this tree from moderate to high.

Recommendation:

Reduce the load on the crotch with a 50% weight reduction of the 28" branch, with the possibility of further reductions in future years. A more conservative action would be to entirely remove the 28" branch, but the size of the cut would likely create future problems for the tree as the wound would not likely seal and leave the tree susceptible to decay and fungus.

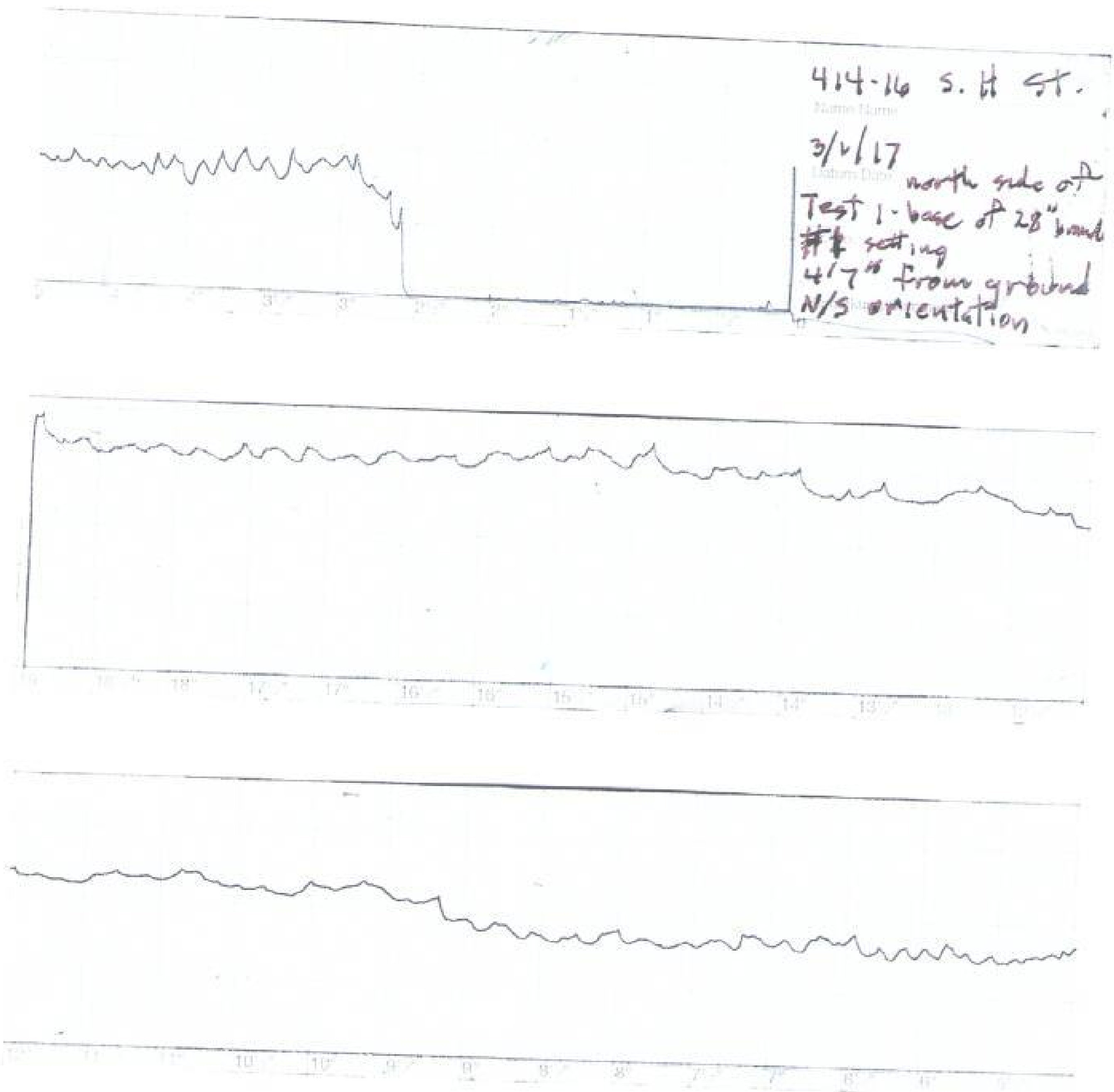
Sincerely,

Ken Knight

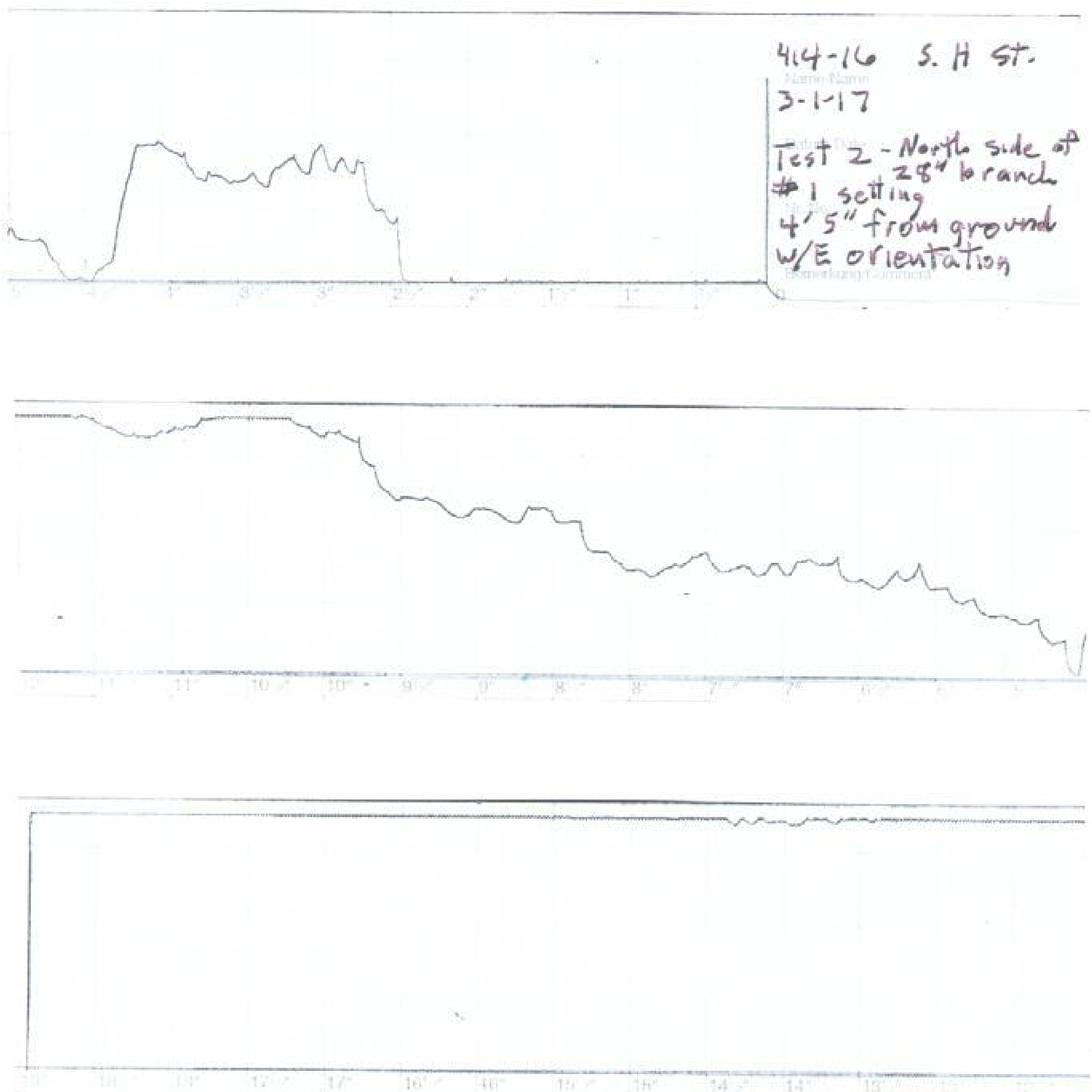
Ken Knight
Registered Consulting Arborist #507
Municipal Specialist Arborist WE6394AM
ISA Tree Risk Assessment Qualified

Attachment – Resistograph readings for tree 56

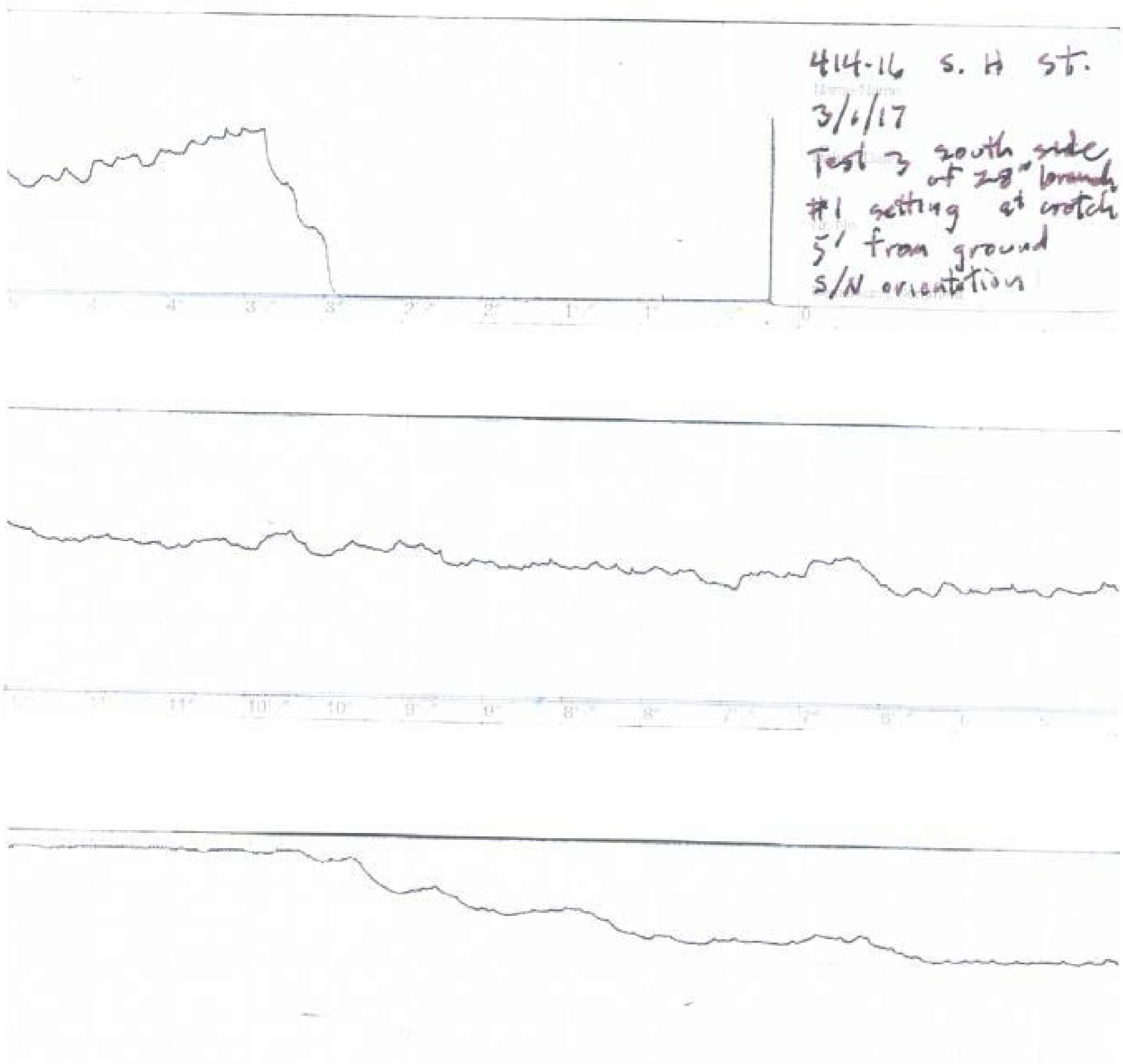
Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test one –



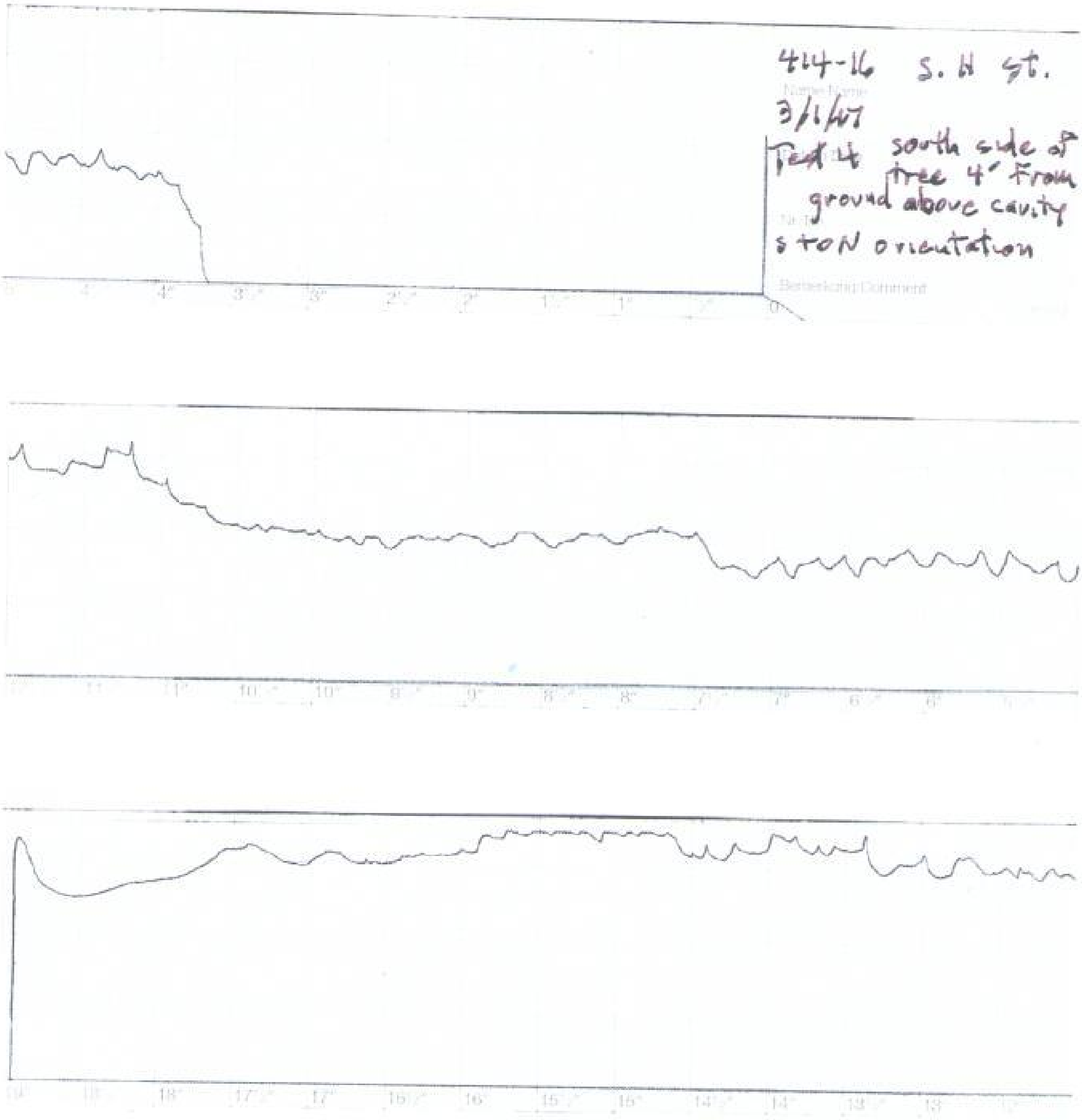
Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test two –



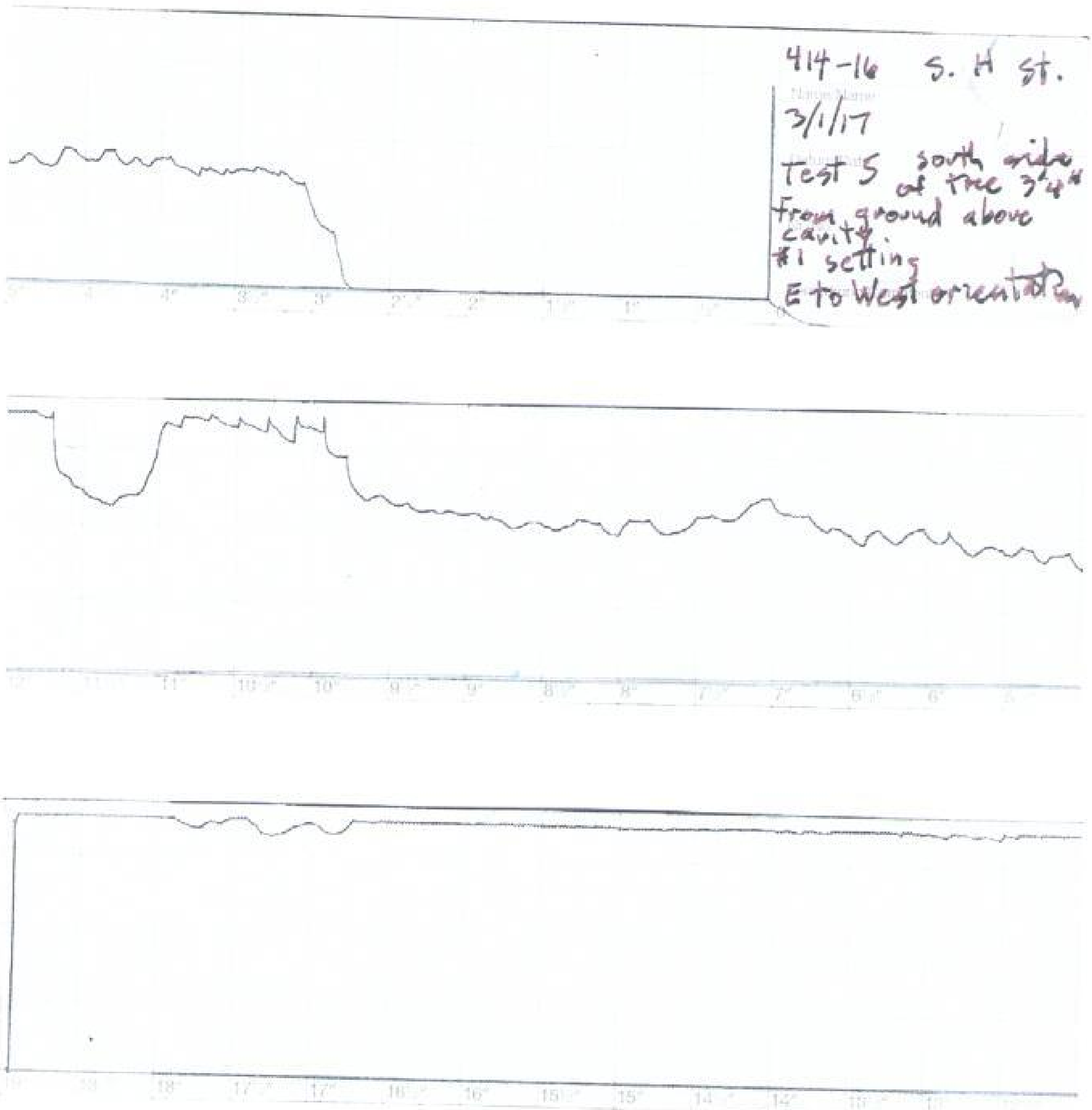
Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test three –



Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test four –



Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test five –



Resistograph drilling results for tree 56. Continuous strip measured in 0.5 inch increments reads right to left. Strip one zero to 5", strip two 5" to 12", strip 3 12" to 19"
Test six –