Threats Posed by Trees on ROW

For CPUC
By Transmission Asset Integrity Management

April 23, 2014

Meeting Objective

- **Discuss threats posed by presence of trees on PG&E's Right of Way (ROW)**

- **Overview of studies performed to date**
  - "Tree Root Interference Threat Analysis," April 2013
  - "Tree Root Interference Assessment," January 2014
  - "Tree Removal Assessment," in progress, May 2014

- **Next Steps**

Threat Analysis

Threats from Trees on ROW

➢ Threat Analysis (April 2013)

- ❖ **Conclusion**: Trees on ROW increase risk of pipeline
  - Increased susceptibility to external corrosion, weather related outside forces, excavation damage
  - Masks location of ROW, reducing effectiveness of public awareness and damage prevention
  - Decreases ability to respond quickly to emergencies
  - Decreases ability to monitor and mitigate external corrosion
  - Limited ability to predict interaction of tree roots with pipeline prior to excavation
- ❖ **Recommendations**: Tree removal program, development of mitigation strategies, and further study
  - Review and update PG&E Utility Standard TD-4490S
  - Further study needed: 1) ability to monitor, 2) ability to protect and 3) ability to predict root interference.

Relative Risk Assessment
Presence of Trees on ROW

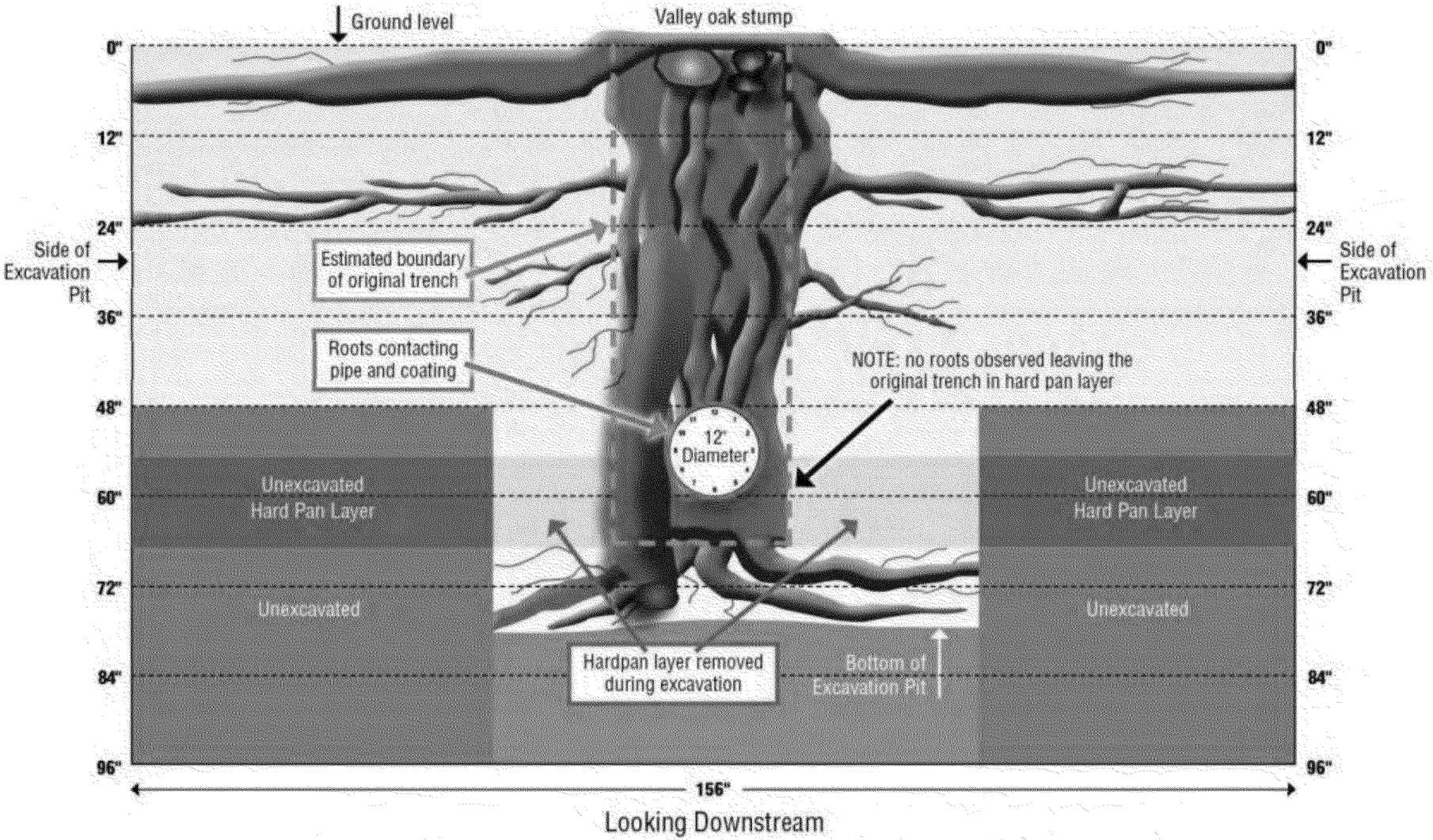
	RISK PROFILE: ROW with Trees compared to Historically Cleared ROW	RISK PROFILE: ROW with Trees Removed compared to Trees Remaining on ROW
Threats		
External Corrosion	Higher	No Change/Lower
Environmentally Assisted Cracking	Higher	No Change/Lower
Weather – Lightning	Higher	Lower
Weather – Wind/Flooding	Higher	Lower
Outside Force – Seismic	Higher	Lower
Manufacturing and Construction Related	Higher	Lower
Monitoring/Mitigation Methods		
Damage Prevention – Monitor ROW	Higher	Lower
Damage Prevention - Publicly Recognized ROW	Higher	Lower
Cathodic Protection (CP) Surveys	No Change	No Change
Ability for timely response		
Emergency Response	Higher	Lower
Integrity Assessment Response	Higher	Lower

Interference Assessment

Interference Assessment - Objective

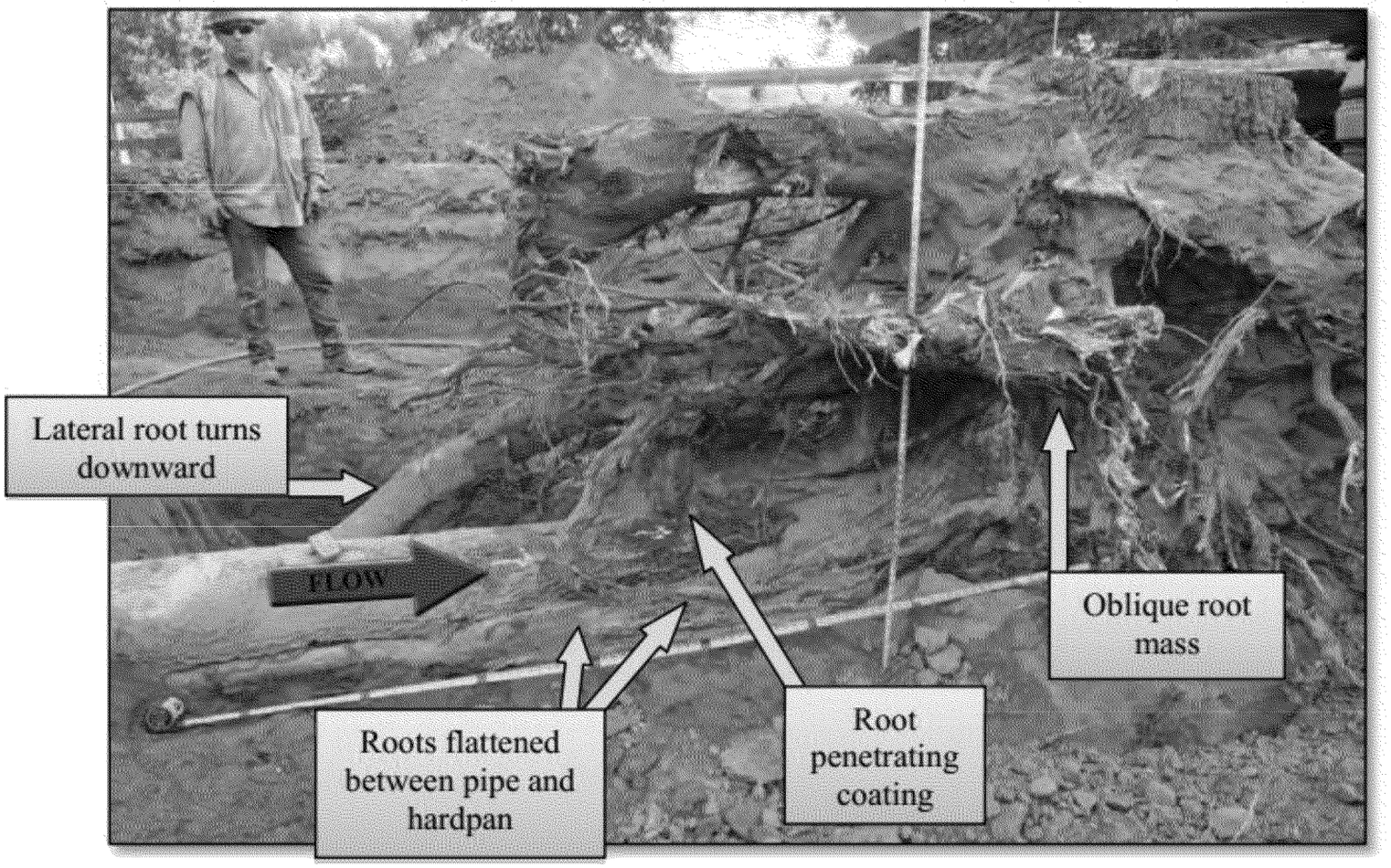
- **Better understand tree root interference with pipeline integrity**
  - Interaction of live tree roots with buried pipelines
  - Effectiveness of detection/mitigation tools with tree roots
    - Is Cathodic protection (CP) shielded by presence of tree roots?
    - Are other above ground surveys (CIS, ECDA) affected?
  - Impact of dead tree roots
  - Sufficiency of PG&E's ROW Standard
    - Pipe Zone and Border Zone distances appropriate?
- **Collect data from tree root excavations**
  - 53 tree root excavations conducted in 2013

Hall Road Case Study

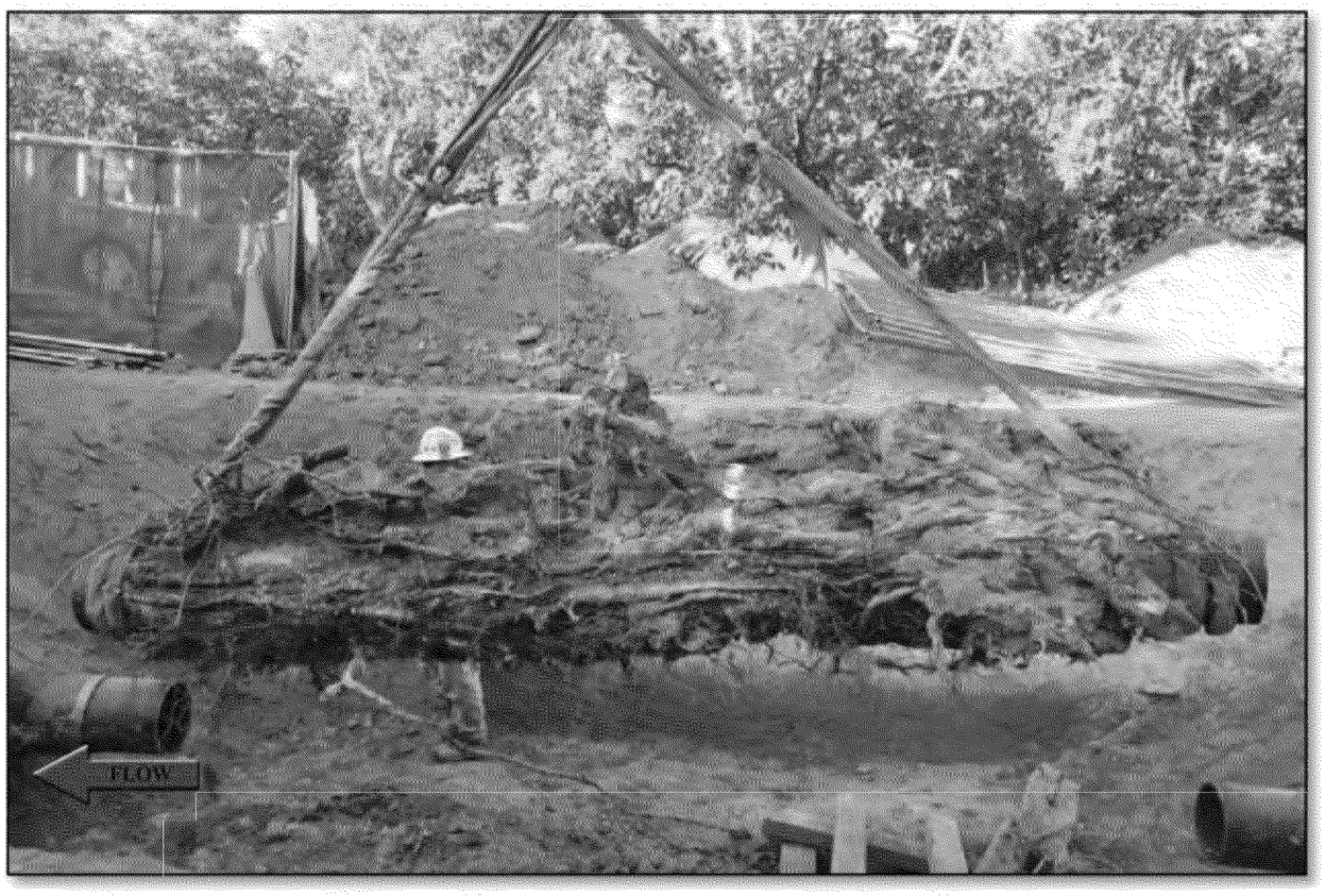


Excavation was accomplished by destructive methods using a trackhoe excavator. The integrity of the root system could not be maintained as the excavation proceeded, therefore, this graphic is strictly the root inspector and graphic artist's best estimate of the actual root architecture that existed underground.

Hall Road Case Study



Hall Road Case Study

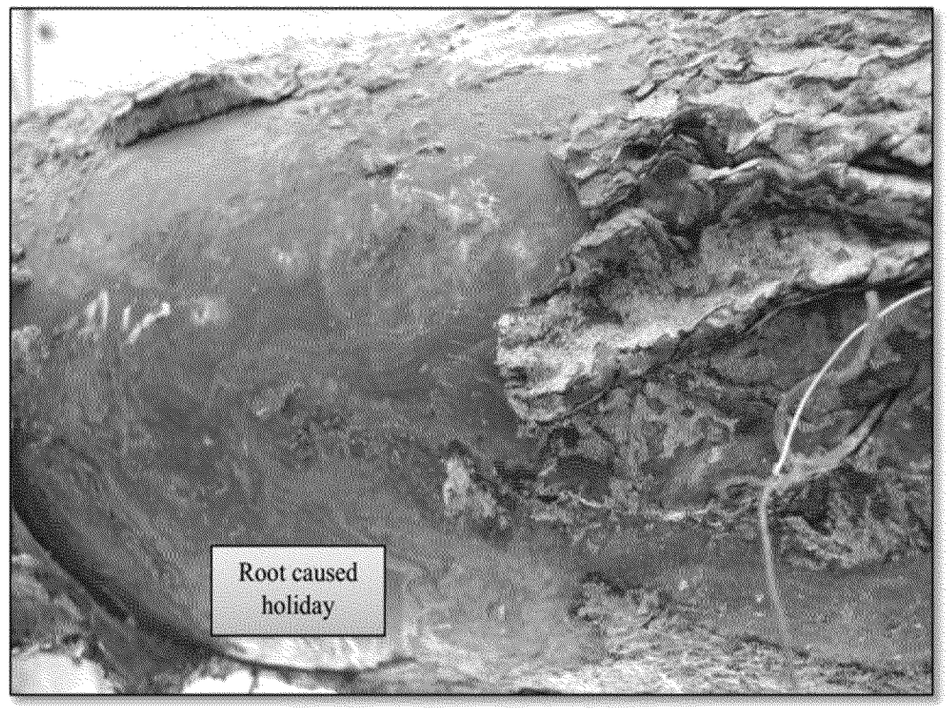


A 15-foot section of pipe with roots intact was extracted from the construction site.

Interference Assessment - Hall Road Case Study Results

➢ Coating damage present due to root interference

- 25% of the surface area of the coating was damaged by root impact
- "Coating impressions" from a single root caused an identifiable groove or impression in the coating
- Approximately one half of the pipe section was affected by root contact



One of many large root-caused holidays.

Interference Assessment – Corrosion Threat Findings

- **Coating damage was observed in 75% of excavated sites**
- **Corrosion observed in 38% of the excavated sites**
- **Extent of damage varies by coating type and other local conditions; unclear whether any difference by tree type.**

Tree Root Study - Conclusions

➢ Conclusions from Threat Analysis and Interference Assessment

- ❖ **Trees and Tree Roots increase pipeline risk profile**
- ❖ **Increased susceptibility to external corrosion**
- ❖ **Increased risk for structural damage caused by outside events**
  - High winds / seismic events could cause tree to be pulled over or damaged resulting in damage to pipe.
  - Lightning strike to tree could result in damage to pipe
- ❖ **Other threats posed by presence of trees on ROW remain**
  - Reduced effectiveness of public awareness and damage prevention
  - Adverse impact on emergency response

Tree Root Study -
Additional Observations Corrosion Threat

- **No evidence of tree roots adversely affecting cathodic protection (CP)**
  - CP appears to reach pipe at tree roots
  - Above ground surveys (CIS, DCVG, and the use of ECDA) appear to identify coating holidays at tree roots
  - It is uncertain whether dead roots impact corrosion risk (though very limited data collected)
  - No impact on other integrity assessments (hydrostatic testing and ILI) to detect for presence of external corrosion.

Vegetation Management Standard

Right of Way Standard TD-4490S

- **Standard designed to reduce pipeline integrity risk resulting from presence of trees on ROW**

  - Standard Manages Vegetation In Zones

    1. Pipe Zone

       Not permitted: Trees and woody shrubs
       Permitted: Lawns, flowers, low-profile grasses and low-growing herbaceous plants

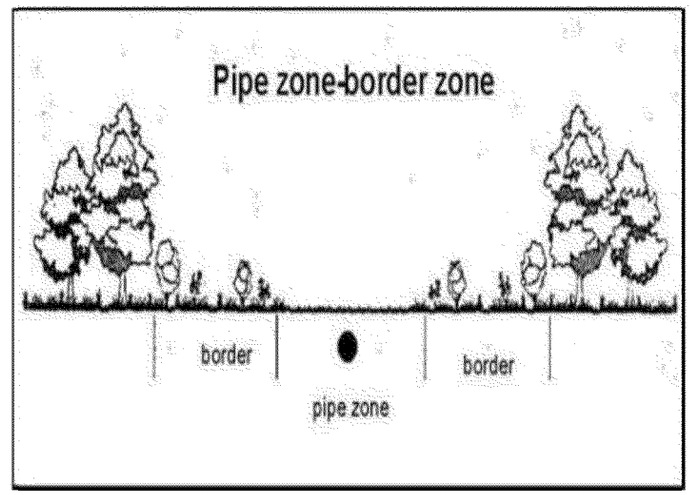
    2. Border Zone

       Not permitted: Woody shrubs, woody vegetation,
       or species that exceed, or likely to exceed the following:

       - **Diameter > 8 in @ 4.5 ft DBH***
       - **From centerline of the pipe line trunk/main branch >/= 10 ft**

  - Provides Exception Process with case by case integrity management evaluation

*DBH – diameter at breast height (above ground)



Pipe zone: an area around the pipeline extending from the edge of the pipe to the border zone. In a ROW with widths equal to or less than 10 feet: the width of the pipe zone must be equal to the width of the ROW. In ROW with widths greater than 10 feet, the width of the pipe zone must be equal to the width in the ROW that is up to 5 feet on either side of the edge of the pipeline. Any area within the ROW that is outside of the pipe zone will be considered “border zone.”

PG&E Standard Review

- **ROW Standard for managing vegetation is appropriate to manage pipeline integrity and reduce risk**
  - The study supports the guidelines in the standard regarding clearing the pipe zone and border zone of vegetation
  - Potential enhancements include: distance between the buried pipe and the tree and tree diameter restrictions
- **Identified the need for better understanding of tree unloading during removal**

Tree Removal Consideration

Tree Removal Assessment

- **Evaluate whether removal of tree on top of pipe (or in close proximity) could adversely impact pipeline integrity**
  - Determine whether vertical displacement occurs with tree removal
    - Unloading of pipe / potential to add strain to girth welds
  - Consider what constitutes a tree "on top of" or "in close proximity" to the pipe
- **Activities of study included**
  - Collect data from removal of 46 trees
  - Identify and quantify any deflection of the local ground and pipeline when a tree's load is removed
  - Engineering strain analysis performed to estimate strain limits
  - Provide guidance for safe removal
- **Minimal vertical displacement measured**

Next Steps

- **Continue public education of threats posed by tree roots**
- **Enhance PG&E's integrity management program to recognize and assess threats posed by trees**
  - Studies support PG&E's Vegetation management procedure
  - Develop site-specific assessment process, where required
    - Use continuing excavations to expand knowledge
    - Recognize community impact
    - Assess unmitigated risk
- **Incorporate threats posed by presence of trees and tree roots into risk assessment process**

Questions