Mitigation Planning For Utility Hazards

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Abstract

After an environmental incident in San Bruno, California involving a spontaneous rupture of underground utilities caused by underground roots, the government is developing a system to monitor the health of underground pipeline. Tree roots can enter the service pipe at joints and travel a long way, causing blockages along the way. Roots can also create structural defects when they crack and break pipes as they grow. Our analysis shows that by using ArcMap 10.1 engineers, environmental managers, and GIS analyst can accurately estimate where underground utilities will intersect with potentially harmful subsurface interferences. Creating an analysis of a neighborhood within Arcata, California we were able to estimate potential dangers to underground utility services, preventing further harm.

Introduction

The State of California has a growing demand for energy and is requiring more underground utility pipeline services than ever before. As a result, the growing demand for underground pipeline utility services, resource supplying companies (i.e. Arcata Municipal Water District) are beginning to pay attention to the potential harmful interaction between underground utilities and root systems of trees and woody vegetation.

Methods

We began by creating a workspace on a local drive to ensure quicker data transfers and a cleaner work environment. An originals, working, and final product folder was created to help organize the data while working on the project. The City of Arcata data set was then imported into ArcMaps 10.1. The data was Quality Assured and Quality Controlled (QAQC) for any errors or discrepancies. Once QAQC'ed, the City of Arcata data set was reprojected into a corrected spatial reference: North American Datum (NAD) 1983 Universal Transversal Mercator (UTM) zone 10. The data was QAQC'ed again before moving forward to assure that the spatial references match our other available datasets and there were no conflicting issues.

We then loaded the ESRI base map to allow us to identify and digitize the trees in our selected parcels. Unfortunately we were unable to find real data associated with the City of Arcata's underground utility services. Instead we estimated where the utility service pipeline would be in respect to residential and commercial needs. Shapefiles were then created to digitize utility lines and digitize trees to allow the use of the buffering and intersecting tool available through ArcMap 10.1.

Once the shapefiles were created, the buffer tool was then used to create a 15 and 25 foot buffer zone around the constructed underground utility line. Next, the intersect tool allowed us to identify where the tree roots were going to intersecting with the utility lines at 15 and 25 feet. Once the issues were identified, an additional data layer was created with just the identified issues.

The last step before publishing our completed data is to make the information portrayed readable for the general public. In doing so, we added a comprehensive legend and north arrow to orient readers. We also created a layout map to depict where in Humboldt County, California, the City of Arcata is.

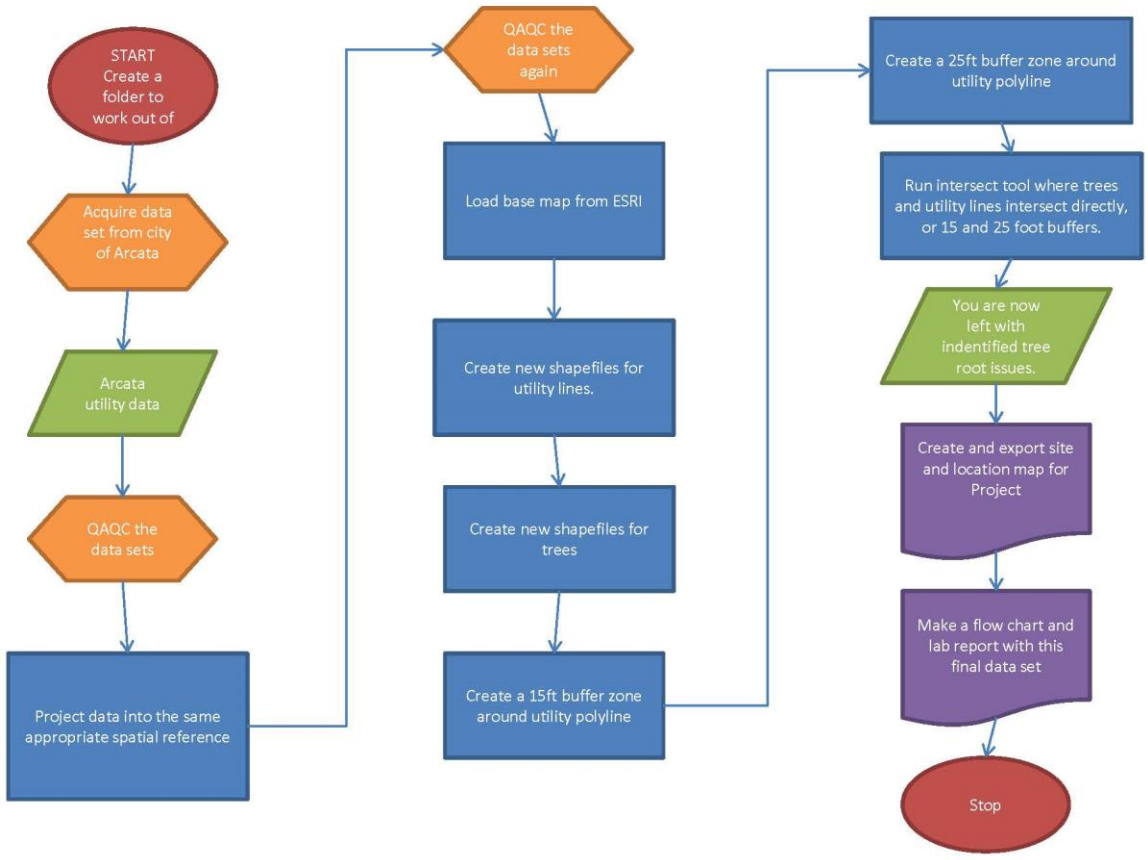

Figure A: Flowchart for the methods of procedure.

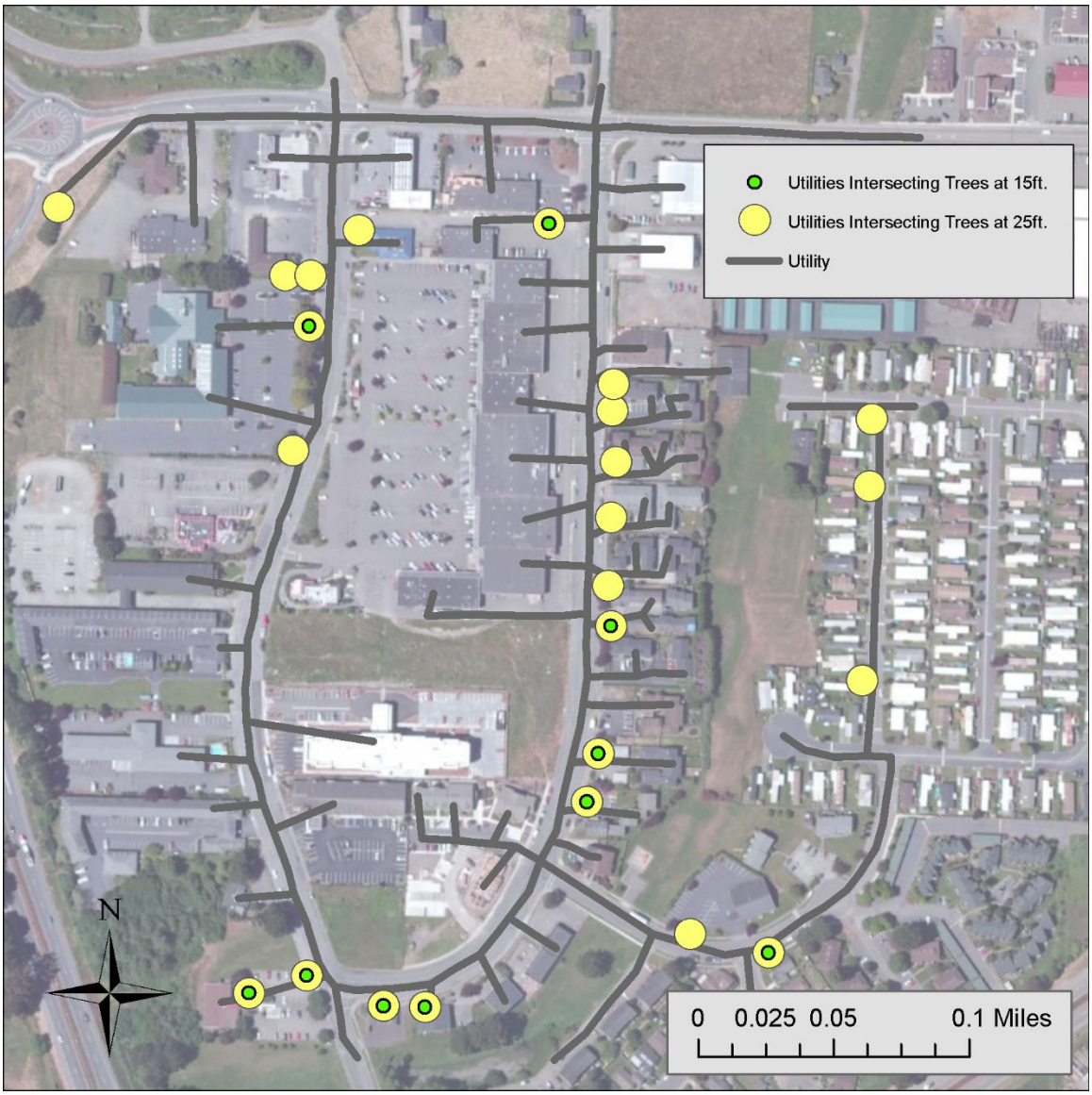

Figure B: Overview of research neighborhood

Figure C: Layout map projecting the location of Arcata within the County of Humboldt.

Results

Our results show a total of 235 trees within our research neighborhood. Of those 235 trees, 10 trees are within 15 feet of the utility lines and are considered immediate dangers to the underground pipeline services. Using a 25 foot safety buffer around the utility service 16 trees (excluding tree overlap) were within dangerous proximity to the utility lines. To mitigate

possible root intrusion with the underground pipeline service, removal off potentially dangerous trees is imminent. Allotting for visual impacts of tree removal allow for removal, new vegetation will be planted to mitigate the impact. However, special care in choosing vegetation is critical. As long as the roots remain within short distance to the original planting site then there should be no future issues with root interference.

Unfortunately, we were unable to find real data associated with the City of Arcata's underground utility services. Instead, we estimated where the utility service pipeline would be in respect to residential and commercial needs. Our outcome was as close to real life circumstances as possible given the lack of available datasets.

Conclusion

The growth of tree roots will happen as long as you have water and healthy soil. Development will also occur in similar areas as long as people continue to build. Whether it is an existing issue or planning for future issues the interaction between tree roots and utility lines is inevitable. What is not inevitable is having it cause an issue. Our analysis shows that you can identify existing or place future utility lines and then identify the trees within the project footprint. Once the two are identified you can easily create any size buffer allowing for the varying tree types and tree root growth rates to be adjusted for. Using ArcMaps allows for the prevention and safety when nature meets modern.

References

ESRI (Environmental Systems Resource Institute). 2014. ArcMap 10.1. ESRI, Redlands, California.