

# Protecting Critical Infrastructure Along Eroding Streams Using Bioengineering Techniques and Stream Restoration Methodology

William (Will) Rector, P.E.

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AUTHORS:<sup>1</sup> AMEC Environment & Infrastructure, Inc. Columbia, SC 29210, USA

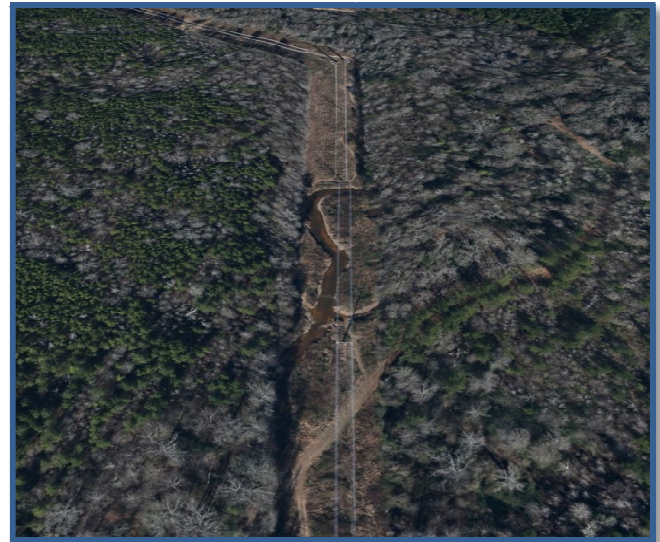
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**ABSTRACT.** Land development along our waterways increases stormwater runoff, erosion within our streams and river systems has caused significant problems as it relates to existing critical utility infrastructure. Sanitary sewer, stormwater, natural gas, potable water, and electrical infrastructure all interact with these stressed stream corridors. Stream erosion within these utility rights-of-way has caused exposure of this critical infrastructure, which can be exposed to threats such as impacts from floating debris and hydraulic pressure during significant storm events. Potential failures or significant damage to the utility infrastructure can cause releases which have the potential to threaten human life and the environment, inhibit product delivery, create expensive repair and clean-up expenses, and result in extensive regulatory oversight and potential fines.

Typically, stream channels within maintained rights-of-way tend to be more severely impacted by erosion than forested/naturalized reaches usually found upstream and downstream of the right-of-way. Exposed pipelines along an eroded stream channel often reveal a lack of woody vegetation within the right-of-way with incised beds, widened channel banks, lateral migration, and sloughing.

The purpose of this presentation is to explore and provide alternatives for the maintenance and installation protocols currently used by government and private entities responsible for the installation of this critical infrastructure and maintaining these rights-of-way that reside parallel and/or perpendicular to these ailing stream systems. This presentation will also look at providing alternative methodology for repairing these eroding stream channels around exposed and/or endangered critical infrastructure using bioengineered techniques and stream restoration methodology. A recent engineering evaluation of a natural gas line exposure in the Carolinas will be used to demonstrate this comprehensive approach.



**Image from Google Earth, Richland County, South Carolina**

## Today's Practices

Utility companies (Public and Private) have a tough job of navigating the state and federal regulations in order to obtain the necessary permits to design, build, and maintain critical utility infrastructure. All reasonable care is taken to preserve and protect our natural systems, as required under the Clean Water Act, and in some cases mitigation is required to offset proposed impacts to waters of the US. However, these regulatory protections do not account for the ever changing landscape and evolution of our rivers, streams, and wetlands once these projects have been implemented and fall short in proactively protecting miles of stream and wetland corridors that are impacted by utility rights-of-way.

Utility corridors require the existing woody vegetation (trees and shrubs) be removed to prevent intrusion and damage of the critical infrastructure itself. Utility companies use selective vegetation control techniques to target woody species. Typically mechanized equipment and handheld sprayers apply herbicide to remove woody vegetation from the right-of-way leaving the herbaceous vegetation to thrive. In doing so, these necessary

installation and maintenance protocols weaken our stream corridors and alter the surrounding ecosystems, inciting in some cases severe erosion, loss of land, and degradation of our natural resources.

History has taught us that the world is in continuous evolution and that adaptation is critical for the success of our future endeavors. The expansion and maintenance of utility rights-of-way is unavoidable, so what can be done to enhance and protect the currently impacted natural systems and how can we modify our current practices to minimize the disturbances in the future?

### **A Way Forward**

The science and methodologies used in current stream restoration and bank stabilization projects has become widely accepted and the benefits of applying these natural channel design concepts, to strengthen our degraded systems is gaining traction within the science-based community. We can use these methodologies to augment existing problem areas and to incorporate during the planning and design phases to minimize future degradation of our natural systems. The construction of in-stream structures and replanting of native vegetation provides the ability to augment unstable conditions and allow the system to naturally restore itself.

The establishment of riparian corridors and natural buffers where utility rights-of-way cross or parallel stream and wetland systems will help provide the natural stability necessary to minimize future erosion problems. The creation of a planting palette and the planting of native vegetation that would not impact existing and proposed critical infrastructure while providing enough woody vegetation to protect natural corridors could be implemented. Selected native vegetation for inclusion into the planting palette would have qualities that support a healthy and fibrous root structure and limited vertical growth to avoid impact with both underground and overhead utilities. The benefit of establishing a natural buffer around our stream and wetland systems within utility right-of-way crossings would provide the appropriate sustainable protection to minimize the continued degradation of our precious natural resources.

Modification of current maintenance protocols to avoid the mass removal of woody vegetation within the proposed riparian buffer zones would include utilizing herbicide application methods that would only target the problem species and allow non-harmful woody vegetation. Woody vegetation within the riparian corridors and along stream banks within the right-of-way would provide deep root systems that naturally retain soil and protect these natural systems from erosion and degradation.



**Herbicide application within utility right-of-way using backpack sprayer.**

### **Example Project**

The Jake Creek Natural Gas Pipeline Protection project is located in McDowell County, North Carolina. During the utility contractor's routine inspections, it was discovered that a portion of gas line had become exposed for approximately 50 linear feet within the banks of Jake Creek, located within a FEMA floodzone "AE". The challenges faced by the project were that that gas main paralleled the existing stream channel and the stream had migrated, exposing the gas line, due to a lack of natural woody vegetation to protect the in-bank soils from the erosive forces within the stream channel during storm events. The project site was also located within a farm field, where the farmer had starting utilizing the existing gas main right-of-way Row crop planting up to the creek bank increased the instability of the native soils.

Due to the project restraints and proximity to the gas line and existing farming operations, a combination of natural channel design and bank stabilization techniques were employed. The gas line stabilization project included the construction of a two foot high rock toe wall the length of the existing exposure and the installation two boulder j-hooks structures and one boulder cross-vane to relocate Jake Creek back to its historic location, based off historical aerial photographs of the area and local knowledge gathered from the property owner. The installation of the in-stream structures was used to mitigate erosive shear forces during bankfull and greater storm events. The area behind the rock toe was backfilled with suitable material and planted with native vegetation that should provide long-term stability to the project area. The project site was planted with native vegetation consisting of a riparian seed mix and live stakes consisting of silky dogwood, black willow, button bush, and common elderberry. The placement of the vegetation was such that an adequate buffer was kept between the existing gas main to ensure that root intrusion would not cause long-term issues for the utility owner.



**Figure 1. Exposed gas line prior to project implementation.**



**Figure 2. Project completion (August 2014)**

In order to complete the project and comply with State and Federal regulations the following services were performed: Wetland Delineation and USACE Verification, 404/401 Permitting, Protected Species and Historic Properties Assessment, and FEMA “No-Rise” Certification.

The total cost of the project was approximately \$100,000 and included environmental permitting, engineering design, construction, and construction oversight services.

### **Conclusion**

The current design, installation, and maintenance protocols utilized by both private and public utility companies are effective in providing critical infrastructure to the ever growing economy. The presence of woody vegetation within these rights-of-way has the ability to hinder their capability to deliver their services and cause significant problems for the consumer when these services are impaired. Re-examining the way

we approach utility rights-of way and their interaction with our natural resources has the ability to minimize the adverse affects currently being placed on our surrounding landscape. Improvements can be accomplished by:

- Establishing riparian buffers along stream and wetlands within existing and proposed utility rights-of –way;
- Replanting of riparian buffers utilizing a planting palette that both stabilizes natural systems and reduces the potential for adverse impacts to utility infrastructure;
- Modernizing herbicide applications within existing and proposed utility rights-of-way to selectively treat problem vegetation and leave non-harmful woody vegetation to flourish within the riparian buffer;
- Incorporate natural channel design and bioengineering techniques into utility infrastructure design and planning where crossings are unavoidable; and
- Use natural channel design and bioengineering techniques to restore currently impaired natural systems.

The Jake Creek Natural Gas Pipeline Protection Project provides a demonstration of the tools that are available to not only protect existing infrastructure from the natural systems they inevitably cross, but also provide protection to the natural systems themselves by restoring bank stability and reducing in-stream erosion at these critical intersections.

### **LITERATURE CITED**

Rosgen, David L. *Applied River Morphology*. 1996. Pagosa Springs, Colorado: Wildland Hydrology Books.

Edison Electric Institute’s Vegetation Management Task Force. *Environmental Stewardship Strategy for Electric Utility Rights-Of-Way*. August 1996.

Welsch, David J. *Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources*. USDA Forest Service. Radnor, Pennsylvania.