



Living shoreline technologies to improve coastal resiliency

Project Details

COMPANY

Shell Pipeline Company LP

COUNTRY

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Coastal Pipeline Erosion Control Using Living Shorelines and Oyster Reefs

CONTEXT

Attenuation of soil and marshland erosion around oil and gas pipelines located on or near shorelines is a chronic concern for Shell Pipeline Company LP (Shell) and other commercial operators in the Gulf of Mexico. Erosion is caused by waves from marine traffic, tidal currents, and acute weather events like hurricanes. Maintaining these pipelines currently requires an intensive and expensive monitoring and maintenance system.

To lower these costs and the overall risks to the pipeline, Shell Global Solutions International and The Nature Conservancy have explored shoreline erosion control methods using green infrastructure to further attenuate erosion from waves. This project in the Louisiana Coastal Zone, Louisiana, USA is comprised of approximately 1 mile of shoreline in total and is a pilot project designed with the intention to be replicated at other similar sites, once installed and evaluated for performance.

Stakeholders included The Nature Conservancy (strategic environmental partner), CH2M (engineering services contractor), Louisiana Department of Natural Resources (LDNR), US Army Corps of Engineers (USACE), and Shell Pipeline Company.

OBJECTIVE AND PROJECT OVERVIEW

The traditional gray approach to protecting oil and gas pipelines uses hardened structures that armor and stabilize the shoreline; rock reinforcement, wood and metal structures, sand or cement bags to slow erosion, particularly in high energy environments. The primary drawbacks of these approaches are the costs and risks related to maintenance activities taking place around these hardened manmade structures, and the ongoing risk of pipeline damages related to frequent boat traffic, as well as the loss of intertidal habitat.

As described above, this pilot project was undertaken to develop a green infrastructure solution to lower costs and the overall risks to the pipeline. Green infrastructure solutions are expected to require lower initial capital costs and lower maintenance costs due to being inherently self-sustaining. Therefore, a primary objective of the design of this pilot project was to better understand the relative costs of using green infrastructure and test the hypotheses that it is more cost effective than manmade infrastructure.

The final designs are hybrid solutions using a combination of green and gray infrastructure. So called 'living shorelines' technologies augment and strengthen the currently installed 'gray' infrastructure. The living shorelines will include HESCO/Gabion erosion control baskets filled with sediment and vegetation. Sediment will be added to scour holes and other locations. Historical riverbeds will be restored using coir logs filled with rocks and coconut fibers. Coir logs filled with oyster shells will be deployed to promote growth of new oyster reefs.

THE BUSINESS CASE

Empirical evidence supports that green infrastructure can be an effective measure against shoreline erosion and wave energy. The innovation lies in applying the concept of green infrastructure to more effectively protect pipelines from coastal erosion while offering multiple financial, environmental, and social benefits.

Historically, green infrastructure installations, such as oyster reef breakwaters have cost approximately \$1 million per mile versus \$1.5 million to 3 million per mile to install traditional gray rock barriers. And, as described above, green infrastructure solutions also have lower long-term maintenance costs over traditional gray infrastructure.

In addition to reducing capital and long-term maintenance costs, additional benefits to selecting an oyster reef breakwater over traditional gray infrastructure solutions include:

- Oyster reefs have the dynamic capacity to repair themselves and adapt to evolving chronic and acute stressors. For example, in response to rising water levels because of climate change, an oyster reef will grow to match the new water levels.
- Oyster reef breakwaters offer ancillary benefits in the form of ecosystem services – they can preserve and/or create habitat for benthic, estuarine, shallow water, and intertidal organisms, and improve local water quality.
- The oyster reef creates a natural buffer to protect the shoreline and pipeline from erosion.
- The reef will increase stability for pipelines.
- The installation and resulting increased biodiversity and fish populations offer potential for local job creation.
- Oyster reefs create land behind the natural defenses (open water to marsh; marsh to land).
- These reefs have the potential for self-repairing (fixes cracks developed from potential storms).

DECISION MAKING PROCESS

Design workshops and meetings have included Shell Global Solutions International, Shell Pipeline Company LP, and experts from The Nature Conservancy.

Selection criteria for the proposed solutions included installation and maintenance cost savings, efficiency in sediment accumulation for stabilization, innovative edge, and the delivery of ecosystem services. Additionally, to ensure the pipeline integrity is maintained, an internal risk analysis was performed on the proposed solutions.

Initial approval of this pilot project was given at the executive vice president level. During the project's design and engineering phase, the budget holder (Shell Pipeline Company JV) was the main decision maker.

Additionally, to obtain the permit to deploy the project's scope, approval was required from LDNR and USACE.

Although no specific decision-support tools were required for the design phase; developing these tools is part of the project's long-term scope following installation and evaluation of performance. The performance of these pilot projects will be evaluated, and the results will define which technologies will be used going forward.

Additionally, these pilot projects will help to create a valuable green vs. gray infrastructure cost analysis which includes a variety of variables (i.e. capital cost, execution costs, safety, etc.).

As this is a pilot project, the goal is to test the hypothesis that green infrastructure is indeed less expensive and better performing than gray infrastructure. Under that premise, no green vs. gray assessment was made. Rather, this will be evaluated after the construction and monitoring phase. Various green and gray hybrid infrastructure technologies were designed and will be tested in the pilot project.

Key performance criteria will include the ability of the selected alternative to provide reliable and cost-efficient/effective erosion control and depth of cover assurance, and the ability of the project to assure proper depth of cover of pipeline assets.

PROJECT DETAILS

The project is a pilot study aimed at testing various green infrastructure technologies at four locations along the pipeline. These technologies include:

- HESCO/Gabion erosion control baskets filled with sediment and vegetation
- Add sediment to pilot site locations to promote vegetation growth
- Install coir logs filled with rocks and coconut fibers
- Install coir logs filled with rocks or oyster shells to promote growth of oyster reefs

LESSONS LEARNED

Some key lessons learned through the planning and design have been:

- Long-term liability issues are a significant consideration for public access
- Green infrastructure solutions will need to comply with company and industry standards and requirements
- Engagement and buy-in of internal and external stakeholders are key
- It is important to select contractors knowledgeable about the green infrastructure solutions under consideration, or consider training
- A successful pilot test should address most institutional, regulatory, and financial concerns relevant to the project

FUTURE IMPLEMENTATION AND NEXT STEPS

This project was designed with the intention to be replicated at similar sites. The planning and design phase are complete. Once the pilot studies are underway the the results assessed, the technologies will be evaluated for use at other locations.

REFERENCES

- Dow, Swiss Reinsurance Company, Shell Global, Unilever, and The Nature Conservancy. 2013. "Green Infrastructure Case Studies." Available at: <http://www.nature.org/about-us/working-with-companies/case-studies-for-green-infrastructure.pdf>. June.

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