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What is the Best Solution to Fight Slope and Shoreline Erosion?

Fight the destructive forces of nature with an environmentally sound, long-term solution for stable hillsides and shorelines, improved water quality and healthier vegetation.

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SOX EROSION SOLUTIONS

INTRODUCTION

Hillsides and shorelines, if left exposed to wind and rain, can result in severe erosion. The washing away of bank-strengthening vegetation introduces surface pollutants, volatile compounds, and other contaminants into waterways, undermining the beauty of carefully curated landscapes. In addition, unwieldly waterways can quickly be the victim of erosion, growing in size and impacting paths, homes, and businesses—rapidly leading to significant damage and unrecoverable costs.

SOX Erosion Solutions' patented ShoreSOX and DredgeSOX Erosion Control systems are RIP-STOP designed stability and containment systems constructed using a resilient, double layer of knitted high-density technical mesh that immediately protects, reclaims, and restores shoreline and hillside erosion, while supporting healthy vegetation growth.

In this study, we'll compare the benefits of ShoreSOX / DredgeSOX to combat erosion with traditional steel and concrete barricades, as well as what could occur if no action is taken. Looking beyond increased efficacy, we'll also explore how the SOX systems are more sustainable, carbon conscious, filters out pollution, and contributes to a healthier environment.

Key Factors for Considering Erosion Control Solutions

Environmental Benefits:
Does the solution work with the environment to filter out pollutants, reduce carbon, and encourage healthy vegetation by protecting erosion-fighting root systems?

Design Control and Flexibility
Can you better sculpt your surroundings, creating crucial corrections to slopes, elevations, and embankments without causing further problems down the road?

Useful Life and Longevity
Can you see immediate results in preventing future erosive damage and mitigate the costs incurred by erosion, and extreme weather events—reducing the risk to people, property, and the environment for years to come?

SHORESOX / DREDGESOX INSTALLATION

The DredgeSOX Erosion Control technology (DredgeSOX) is a bioengineered geotextile-based system with an anchoring and patented open-containment design that is used to stabilize shorelines, hillsides and other earthen environments that prevent soil erosion.

The DredgeSOX systems consist of a double layer of knitted high-density polyethylene (HDPE) mesh. When installed, the polyethylene mesh is filled with approved or appropriate organic or inorganic fill material. The fill material is often obtained from dredging shallow sediment, blown-in compost mix, or other situationally appropriate sourced fill. The fill or dredged material is washed into the SOX containment system resulting in newly stabilized and often recaptured land assets.

Once installed, the DredgeSOX can be covered with a layer of vegetation. The vegetated choices may include cast seed, turf grass, or native plants and plugs. The SOX system can even accept cast seed and vegetate from the inside out. The DredgeSOX technical mesh allows for penetration of the root systems without damage to the plant roots or to the DredgeSOX technical mesh. As a result, plants are able to root, further stabilizing the protected shore against erosion, and thrive through the uptake of stabilized nutrients.

EROSIONS FIGHTING ANALYSIS

Under a do-nothing approach, no improvement would be made to the creek bank. As a result, no additional protection would be provided to the bank slope, toe or top-of-bank, and serious erosion would occur. As a result, the bank would be susceptible to failure from long-term natural processes as well as infrequent but high-impact events caused by extreme weather.

Both the steel sheet pile bulkhead/concrete decking and DredgeSOX provide sufficient erosion protection. Both have been assumed to have an effective service life of 50 years, and assuming appropriate inspection and as-needed maintenance, both can be expected to minimize the potential for soil erosion and bank failure. The most significant difference, in the case of sheet pile only at the adjacency point of the hardened and non-permeable structure rills and ruts often form due to the inability for surface and subsurface flow to naturally gravitate toward the low point or water course.

This means that while DredgeSOX permeability promotes healthy water flow to pass through it and disperse across its surface, the hardened erosion solutions are under more pressure, may degrade faster over time, and suffer from increased erosion at their edges—leading to future fail points.

*"Assuming a 50-year design life for both constructed alternatives, **DredgeSOX** outperforms steel and concrete."*

And although anecdotal, empirical evidence exists that green spaces can provide a positive social benefit as compared to hard finishes of steel and concrete barriers. In other words, DredgeSOX also just looks better.

RUNOFF FLOW VELOCITY

Water runoff is the top concern when it comes to slope erosion. Water needs to be absorbed into the soil, nourishing healthy vegetation and their roots to slow down water flow, reducing ongoing erosion to a slope. By reducing top-of-bank soil erosion, DredgeSOX offers a more sustainable solution.

The steel pile bulkhead and concrete decking do not allow water to pass through them and may exacerbate erosion by allowing water to quickly move past their surfaces, wearing away soil.

DredgeSOX reduces surface water flow velocity. The presence of the turfgrass provides an increased roughness coefficient and a reduced surface water runoff velocity, as compared to the generally smoother surface of the concrete decking.

Reduced water flow velocity may help protect the

degree and rate of flow-surface flow-related wear and damage. As a result, DredgeSOX is a better alternative for reducing surface flow velocity and reducing the potential for added water erosion. As a do-nothing alternative, there is no additional protection from soil erosion.

REDUCTION IN WATER CONTAMINATION AND NUTRIENT LOSS

In addition to affecting the velocity of surface flow, the top-of-slope ground covering can affect the quality of surface water that flow over these surfaces. Surface runoff can be contaminated with a variety of pollutants. Flows emanating from agricultural, residential, or recreational areas (e.g., parks or golf courses), surface runoff may have been impacted with herbicides, pesticides, fertilizers, or sediments from bare-earthen areas. In urban settings, surface runoff may be impacted with petroleum hydrocarbons, volatile organic compounds (VOCs), heavy metals, and other contaminants.

DredgeSOX aids in the removal of contaminants and nutrients from surface water runoff. By providing a permeable, vegetated ground cover on the protected slope and adjacent top slope areas, DredgeSOX allows sediments to fall out of flowing water due to its reduced rate. Additionally, water percolates into the vegetation root zone and underlying soil, where nutrients, carbon, and contaminants are removed via adsorption to soil particles and plant uptake.

The impermeable nature of the steel and concrete alternatives does not allow water flow to settle in the soil. As a result, surface flows contacting the steel and concrete barriers can continue into streams and rivers, leading to pollutants negatively impacting ground water.

In the do-nothing approach, the natural soils of the slope bank would allow for infiltration of surface flow, which could lead to a reduction of select contaminants in the surface flow. However, the exposed soils of the bank would be subjected to the erosive effects of the surface flow, which could mobilize soil and negatively affect the flow and the quality of the receiving water. Ultimately, water flow into an unmanaged, unstable slope condition could result in slope failure.

In the case of DredgeSOX, the use of turfgrass or similar vegetation on the slope face and at the top of the

slope act as a vegetative filter strip (VFS), a useful best management practice (BMP) commonly implemented for stormwater runoff treatment. A VFS is an area of vegetation designed to remove sediment and other pollutants from surface water runoff through filtration, deposition, infiltration, adsorption, decomposition, and/or volatilization (Smyth et al., 2018). The United States Environmental Protection Agency (EPA) encourages use of engineered VFSs to reduce nonpoint source (NPS) pollution (USEPA, 2002).

Three distinct layers are present within the VFS – the surface vegetation, the root zone, and the subsoil horizon (Grismer and O'Geen, 2006). The vegetation and its ability to slow surface flow velocity increases the residence time over the turf surface, allowing sediments and contaminants to settle out. Additionally, the permeable surface and presence of organic matter allows surface flow to infiltrate into the root zone. Within the root zone, some of the water flow continues to infiltrate into the underlying soil horizon, while some continues as lateral "interflow" within the root zone (Grismer and O'Geen, 2006). For nutrients, the most important VFS capture mechanism is infiltration. Nitrogen is primarily removed via uptake by the vegetation or resident microbial activity, while phosphorus and heavy metals are captured via adsorption to soil particles (Grismer and O'Geen, 2006).

As a result, surface water quality is improved due to the removal of sediments, contaminants, and nutrients from the flow, resulting in a beneficial effect on the quality of the receiving water.

To maintain optimal pollutant removal efficiency, permanent vegetative plants should be harvested properly to encourage dense growth and removal of sediment, nutrients, and other pollutants trapped in the plant tissue (Smyth et al., 2018). Other straightforward maintenance practices include activities at the surface to maintain uniform sheet flow across the vegetation, removal of excessive sediment accumulation, repair of bare spots or distressed vegetation, and limitations of

foot or vehicular traffic across the vegetated surface (Grismer and O'Geen, 2006).

CARBON IMPACT

A third, and important, consideration is the carbon footprint of the project alternatives. In considering the overall carbon footprint, we have considered both the construction carbon footprint as well as the operational carbon footprint.

The construction carbon footprint calculates the net of carbon sources (emissions) and sinks associated with the manufacture, delivery, and installation of the project. The operational carbon footprint considers the net of carbon emissions or sequestration that occur during the presence, operation, and maintenance of the alternative. A do-nothing alternative is assumed to be carbon neutral for this analysis, although it is likely that slope erosion or failure would require future slope rebuilding and/or dredging. This would result in measure carbon emissions and eliminate the carbon neutrality.

With respect to the other alternatives, it's important to note that **steel and concrete manufacturing are two of the most carbon-intensive industries in the world, especially in terms of cumulative carbon emissions generation.** Globally, steel production is responsible for 7 percent to 9 percent of all direct emissions from fossil fuels, with each metric ton of steel produced resulting in an average 1.83 metric tons of CO2 emissions production, according to the World Steel Association (Pooler, 2019).

In calculating the embodied carbon, we assumed a sheet pile unit weight of 324 pounds per linear foot of slope, and a concrete deck unit weight of 625 pounds

per linear feet of slope. Using the World Steel estimate of 1.83 metric tons of CO_2 emissions per metric ton of steel, or 1.83 pounds of CO_2 emissions per pound of steel, we estimate 592.92 pounds of CO_2 emissions per linear foot of bulkhead. Citing the National Precast Concrete Association (NPCA) estimate of 400 pounds of CO_2 emissions per 3,900 pounds of concrete (or 0.103 pound of CO_2 emissions per pound of concrete), we estimate 64.38 pounds of CO_2 emissions per linear foot of concrete deck. Combining the two elements, we estimate that the other alternatives result in 657.30 pounds of CO_2 emissions per linear foot of slope.

While carbon is generated during refining of petroleum-based raw materials and the manufacture of the DredgeSOX product, its carbon footprint is negligible in comparison. In addition, the inclusion of turfgrass on the slope facing and at the top of slope provides a means to sequester carbon. During photosynthesis, plants take in carbon as carbon dioxide and fix the carbon into their structural (leaves, stems, roots, etc.) and non-structural (sugars and other metabolites) components (Putnam, 2016). In perennial grass ecosystems, a large portion of that carbon ends up in the soil organic matter because of their large fibrous root systems (Putnam, 2016). Further, as turfgrass roots die, they decompose into soil organic matter, fixing carbon in the soil, allowing turf areas to act as a carbon sink for greenhouse gases (Leslie, 2021).

- Steel sheet pile bulkhead and concrete decking
  TOTAL: 657.30 pounds of CO_2 emissions per linear foot of slope
- DredgeSOX retained slope with turfgrass vegetated layer
  TOTAL: 13.88 pounds of CO_2 emissions per linear foot of slope

When compared to the embodied carbon of the manufacture of DredgeSOX, its use results in net negative carbon emissions, or positive carbon sequestration over the design life of the installation. The net result is that SOX Erosion Solutions act as a CARBON SINK, actively reducing carbon from the environment over the life of the systems' use.

CONCLUSION

Across the assessed environmental dimensions, DredgeSOX presents a superior alternative to the use of a hard-edge alternatives, such as steel sheet pile bulkhead and concrete deck alternative, while both offer a range of advantages over a do-nothing alternative.

With respect control of velocity of surface runoff flow, the incorporation of DredgeSOX with turfgrass results in a rougher surface, which reduces flow velocity and potential deleterious erosive effects as compared to the paved surface of the considered bulkhead/deck alternative. The inclusion of turfgrass also allows the DredgeSOX alternative to reduce loading of several contaminants before runoff reaches the protected water body, thereby improving water quality as compared to the bulkhead alternative.

Finally, while the steel and concrete used in the bulkhead alternative results in an embodied carbon-intensive installation, the manufacture of DredgeSOX results in a fraction of the carbon emissions that occurs during steel and concrete manufacture, and the use of turfgrass results in a net carbon sink alternative for shoreline and hillside protection. As a result, in addition to providing a long lasting, technically effective, and cost-effective alternative, DredgeSOX offers an environmentally protective and sustainable protection solution.

Read the full report at SOX Erosion—Environmental Benefits Across Several Dimensions.

Do you have erosion problems at your HOA, golf course, municipality, or business? Then give us a call. We can halt detrimental erosion FAST, bringing beauty and control back to your land.

(561)-501-0057
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ShoreSOX And DredgeSOX Erosion Control Systems

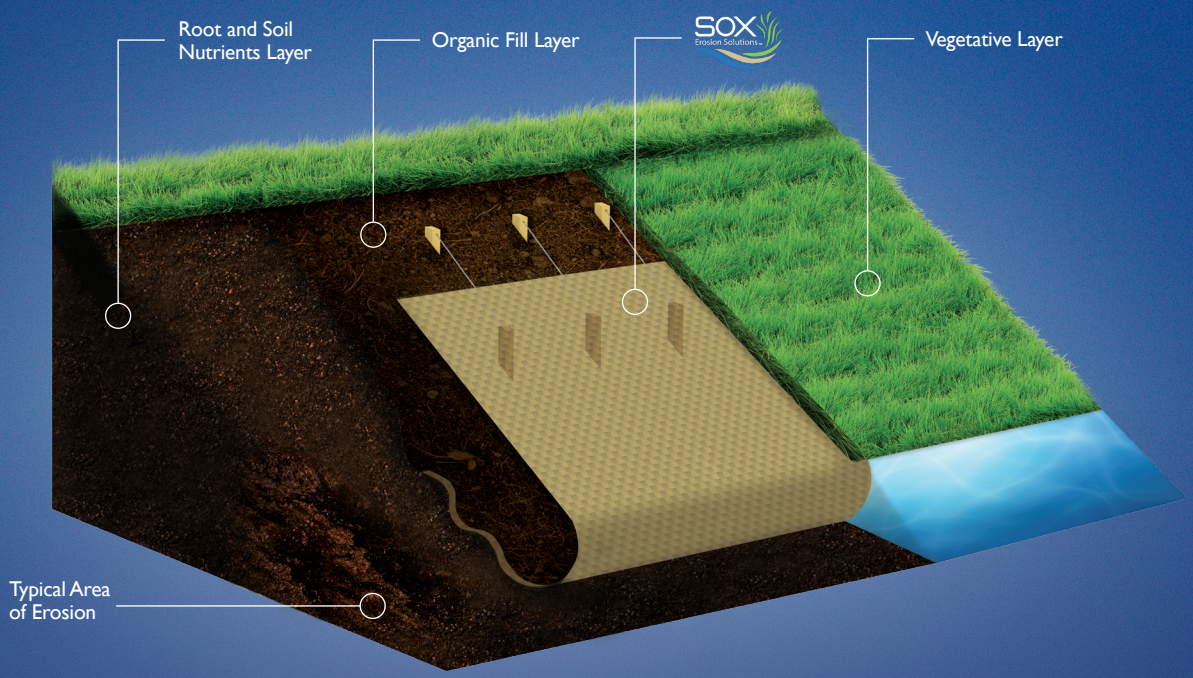
Fight the desctructive forces of nature with an environmentally sound, long-term solution for stable hillsides and shorelines, improved water quality and healthier vegetation.

Benefits

- Penetrative surface
- Reduced waterflow velocity
- Minimized edge erosion
- Supports plant growth
- Captures soil nutrients
- Filters pollutants

Reduction In Water Contamination And Nutrient Loss

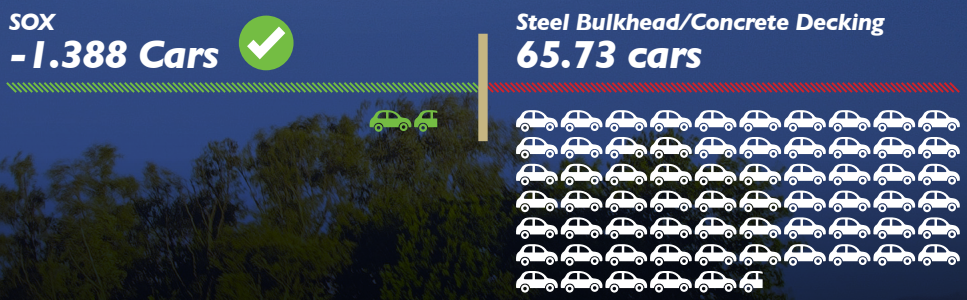
Water penetrates into the vegetation root zone and underlying soil, where nutrients, carbon, and contaminants are removed via adsorption to soil particles and plant uptake-filtering out ground water pollution.



With Carbon, Less is More

Comparing the manufacture, delivery, maintenance, and installation of each solution, SOX requires less waste and captures carbon by transforming eroded shorelines into green spaces.

CARBON EMISSIONS PER 1,000 FEET OVER THE LIFETIME OF THE PRODUCT.*



*Assuming an average car produces 5 tons of carbon every year.

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