

**RECLAMATION DISTRICT 2035  
Cross Canal Permanent Repairs**



**Cost Estimate Summary**

**WOOD RODGERS**

Item	Narrative	Quantity/Unit	Unit Price	Cost
1	Contract Cost for installing 10,0000 Sq. Yard of ARMORMAX Turf Reinforcement	10000 Sq. Yard	\$42/Sq. Yard	\$ 420,000
2	Environmental Compliance	1/LS		\$ 45,000
3	Planning, Design, and Construction Management	1/LS		\$ 30,000
5	Permitting	1/LS		\$ 35,000
		<b>Total</b>		<b>\$ 530,000</b>

Note - The approximate area to be protected by Armormax Turf Reinforcement is about 10,000 square yards, but if needed the project can be scaled down depending on the available funding.

**From:** Mark Cadotte <mcadotte@solmax.com>

**Sent:** Friday, June 2, 2023 9:27 AM

**To:** Jay Punia <jpunia@WoodRodgers.com>

**Subject:** RE: Response to your question RE: Need your help RE: Got it! RE: Response to your question RE: Need basic information about the ARMORMAX® 75 for erosion protection

Hi Jay, please find your requested information attached and below. I've included the following supporting documents:

1. Legacy PROPEX FEMA Brochure
2. Updated Lookout Slough Levee case study
3. Typical ARMORMAX Detail
4. South San Francisco USACE Levee detail

ARMORMAX® will not only protect the bank from future erosion, it will also help promote vegetation where vegetation would otherwise be a challenge. The materials, including tools, delivered to site typically cost ~\$20sy to the owner and installed, will cost ~\$42sy to the owner. 10,000sy would take approximately 12-14 days to install with one crew. I would be on-site for the first day to insure the contractor is following design, any design or site condition changes are addressed, and your client is getting what they paid for. This installed price does not include the earthworks required to prep the slope and dig anchor trenches.

ARMORMAX® is flexible and can be vegetated in a number of ways (plantings, live stakes, sodded, seeded, or hydro-seeded). We can offer a specific detail including the vegetation option, just let us know what direction your client takes. The vegetation options will add \$2sy-\$5sy depending on what option your client chooses.

Just to re-iterate, vegetated ARMORMAX® will offer ~90% carbon footprint reduction and water quality improvement vs rock riprap.

Let me know if I've missed anything or you have any more questions.

**Mark Cadotte**

Western US/Canada-Erosion Control Territory Manager

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**From:** Chuck Hilliard <chilliard@WoodRodgers.com>

**Sent:** Wednesday, May 31, 2023 12:20 PM

**To:** Jay Punia <jpunia@WoodRodgers.com>

**Cc:** Tim Chamberlain <tchamberlain@WoodRodgers.com>

**Subject:** RE: Thank you RE: Seeking your input for environmental compliance , design and construction management costs

Hi Jay,

Just following up on our TEAMS conversation. As we discussed, \$30k-\$35k is likely more in the ballpark for the civil design. That would be assuming 3-4 plan sheets (for each area that requires installation of ARMORMAX), 2 General/Notes sheets (assuming any needed specifications are included on these sheets, and 1 detail sheet (showing anchoring and tie-in details).

We didn't discuss an engineer's estimate, but I assume we would develop one as part of the design to help the client with the bidding process, so that would be included as well.

Please let me know if you have any questions or want to discuss further.

Thank you,

**Charles Hilliard II**, PE | Project Engineer

**Wood Rodgers, Inc.** | [www.woodrodgers.com](http://www.woodrodgers.com) |

916.326.5319 Direct

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**From:** Tim Chamberlain <[tchamberlain@WoodRodgers.com](mailto:tchamberlain@WoodRodgers.com)>

**Sent:** Wednesday, May 31, 2023 11:22 AM

**To:** Jay Punia <[jpunia@WoodRodgers.com](mailto:jpunia@WoodRodgers.com)>; Chuck Hilliard <[chilliard@WoodRodgers.com](mailto:chilliard@WoodRodgers.com)>

**Subject:** RE: Seeking your input for environmental compliance , design and construction management costs

Hi Jay,

Without doing a full environmental scoping of the project area to understand all of the constraints, I can't give you an exact estimate but from a very brief look and from our prior discussions, I would assume the following:

- Would require a cultural and biological study be prepared to support federal permits (404 and 408 with Army Corps)
- Full environmental permits would be required – Army Corps 404 and 408, RWQCB 401, and CDFW 1602
- Consultation with USFWS for Giant Garter Snake would be required for this location
- CEQA Categorical Exemption is already filed and no further CEQA action is needed

Based on those assumptions, some very rough estimates of WR costs to provide environmental and permitting support are below:

- Environmental Compliance - \$45k
- Environmental Permitting - \$35k

Worth noting that this estimate does not include any compensatory mitigation associated with impacts to jurisdictional waters or Giant Garter Snake. Those costs would be estimated during the permitting process.

**Tim Chamberlain** | Senior Environmental Planner

**Wood Rodgers, Inc.** | [www.woodrodgers.com](http://www.woodrodgers.com) |

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# RESILIENT FLOOD MITIGATION

Supporting state/local governments and tribes/territories in building resilient infrastructure and communities through nature-based flood mitigation solutions.



**Propex® is a global leader in developing and manufacturing innovative flood mitigation & erosion protection systems. Our low carbon solutions stabilize the earth and improve the performance of levees, dams, channels and other key infrastructure.**

- **Half the installed cost of rock and concrete**
- **Tested & approved by the U.S. Army Corps of Engineers**
- **Made in the U.S.A.**

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## **Technical Support**

Propex's team of professional engineers offer full service support throughout the design process including site analysis, product selection, design support, construction details, and installation assistance.





# Nature-Based Solutions



## Resilient solutions that meet FEMA's nature-based criterion:

- Promotes vegetation and help restore rivers, floodplains, wetlands, living shorelines and soil stabilization.
- First and only manufacturer of High Performance Turf Reinforcement Mat (HPTRM) to have our **carbon footprint verified** by an independent, third-party organization.
- The carbon footprint of our HPTRM is **up to thirty times smaller** than traditional solutions such as rock riprap and concrete.
- HPTRMs have been **recognized by the Environmental Protection Agency as a Best Management Practice (BMP)** to improve water quality.
- Reinforced vegetative solutions support living shorelines, whereas rock riprap and concrete can decrease streamside vegetation and adversely impact fish populations.





## CASE STUDY

# Oyster Lake Outfall Improvement

**Location:** Santa Rosa, FL | **FEMA Region:** IV | **Primary Lifeline:** Transportation

**Hazards:** Coastal Flooding, Hurricanes | **Solutions:** ARMORMAX®

Oyster Lake is a coastal dune lake that creates a unique interchange between a natural storm water lake and the Gulf of Mexico. When a coastal dune lake reaches a high water level, flow breaks through the dune system forming a channel between the lake and the Gulf. The outfall is critical for regulating water levels and mitigating flooding. Oyster Lake's outfall had become severely degraded and the overall health was strained from major storms and urban growth.

Walton County and other state agencies wanted to reinforce the outfall while preserving the natural vegetation.

More than 2,000 square yards of ARMORMAX, consisting of High Performance Turf Reinforcement Mat (HPTRM) and Engineered Earth Anchors (EEA), was installed along the channel. This system was selected because it provides slope stabilization and erosion control while promoting vegetation. During installation, 2,000 sea oats were planted within the HPTRM, which is designed to promote vegetation.

After installation, Hurricane Michael (category 4) made landfall 60 miles east of Oyster Lake causing winds up to 80 mph, storm surge, and significant rainfall and flooding at the project location. The vegetated slopes of the outfall withstood the extreme conditions, protecting beachfront homes, nearby businesses, underground utilities, a section of Highway 30A, and a bridge that crosses the channel.





## CASE STUDY

# Murrieta Creek Stabilization

**Location:** Temecula, CA | **FEMA Region:** IX | **Primary Lifeline:** Transportation

**Hazards:** Inland Flooding | **Solutions:** ARMORMAX®

Murrieta Creek has a history of devastating flooding. Notably, the flood of 1993 that claimed the lives of five people and damaged 70 aircrafts and two bridges at Pendleton Marine Corps Base. The flood also inundated pumps at the Eastern Municipal Water District, causing 5 million gallons of raw sewage to flow into the creek. Multiple major flood events have occurred since the 1993 flood. Today, more than 600 homes and commercial structures are vulnerable to flooding.

In 2000, the U.S. Army Corps of Engineers initiated the Murrieta Creek Flood Control, Environmental Restoration and Recreation Project to mitigate flooding. In phase two of the project, ARMORMAX was selected to provide erosion and scour protection on the creek banks. The system consists of High Performance Turf Reinforcement Mat (HPTRM) and earth anchors that provide resilient flood control for up to 75 years.

Maintaining water quality was a main concern because Murrieta Creek is recognized as one of the last high-quality, minimally disturbed riverine environments in Southern California. ARMORMAX helps to decrease sedimentation and pollutants and encourages infiltration of water back into the ground water table. The system also promotes rapid root development for long-term vegetation, whereas rock riprap, can decrease streamside vegetation and adversely impact fish populations.

Vegetation was quickly established, and ARMORMAX has effectively protected the channel from erosion and flooding.







## CASE STUDY

# Harvey Ditch Stabilization

**Location:** Waller County, TX | **FEMA Region:** VI | **Primary Lifeline:** Transportation

**Hazards:** Inland Flooding | **Solutions:** SCOURLOK® & ARMORMAX®

Brookshire-Katy Drainage District [BKDD] maintains a drainage channel that runs along Stalknecht Road in Waller County, Texas. Extreme storm water flows caused by Hurricane Harvey caused the roadside drainage ditch to experience erosion and slope instability, reducing the channel's capacity.

The severe erosion and reduction in channel capacity prompted BKDD to pursue permanent erosion protection. An early phase in the design process used rock filled gabion baskets to armor the channel, however, the design engineer wanted a more economical and environmentally-friendly solution. Gabion baskets require the removal and transportation of excavated material from the site, but SCOURLOK allows the reuse of on-site soil to fill the units.

Stakeholders selected SCOURLOK for the remaining phases of the project because it was a more cost-effective solution. SCOURLOK is a stabilization system that features rigid and interlocking cells armored with erosion protection from a highly UV stabilized High Performance Turf Reinforcement Mat (HPTRM). The system is engineered to provide a vegetated, gravity wall system that resists sliding and overturning for up to 75 years.

The design included an eight-foot wall, comprised of two tiers of SCOURLOK that spans 500 feet along the eastern side of the channel. The design also included 300 square yards of ARMORMAX along the top of the channel.





## CASE STUDY

# Kaneohe Stream Bank Restoration

**Location:** Oahu, HI | **FEMA Region:** IX | **Primary Lifeline:** Safety & Security

**Hazards:** Inland Flooding & Coastal Flooding | **Solutions:** PYRAWALL®

As part of Hawaii's National Pollutant Discharge Elimination System (NPDES) and Erosion Prone Area Improvements Program, a streambank stabilization project was completed along Kaneohe Stream in Kaneohe, Oahu.

Over the past 30 years, high-flow events eroded higher portions of the channel, causing encroachment of several private properties. To prevent additional property loss and mitigate future flooding, the City and County of Honolulu wanted to find a solution that would provide long-term channel stabilization. Historically, a concrete solution has been used, but the City and County wanted a more natural system that encouraged growth of native vegetation.

PYRAWALL engineered wrap-faced vegetated solution, was selected to reinforce 330 feet of Kaneohe Stream. The installation ranged from six to eight feet high and was designed based on geotechnical information available at the site. This included steep 1H:4V slope segments with a mid-slope planting bench.

PYRAWALL combines High Performance Turf Reinforcement Mat (HPTRM) with internal braces to reinforce soil mass and resist lateral earth pressures. It is also designed to encourage vegetation and is a vegetated Best Management Practice Solution for NPDES Storm Water Compliance. This wall system is comprised entirely of three engineered geosynthetic components with no metal, concrete or short-lived biodegradable materials.

The vegetated wrap-face wall system provided resilient bank reconstruction and stabilization along a residential section of the Kaneohe Stream that will provide flood mitigation for up to 75 years.



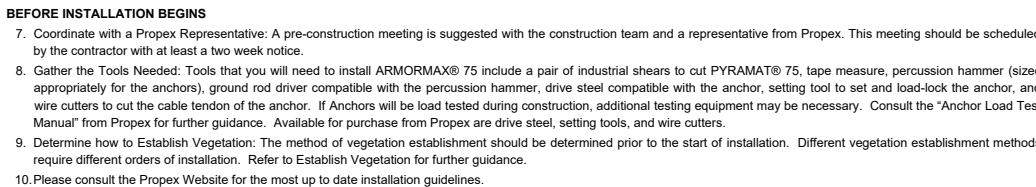
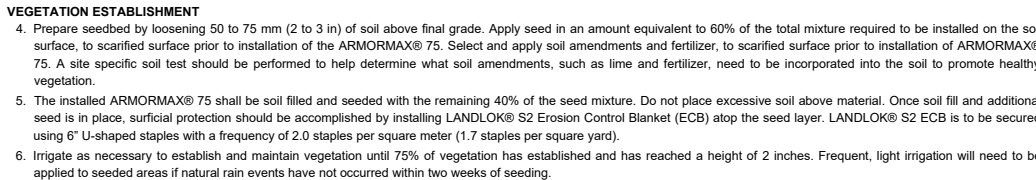
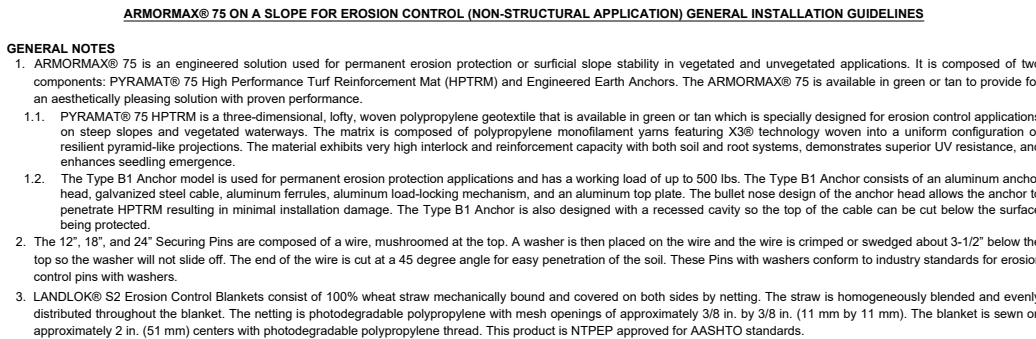
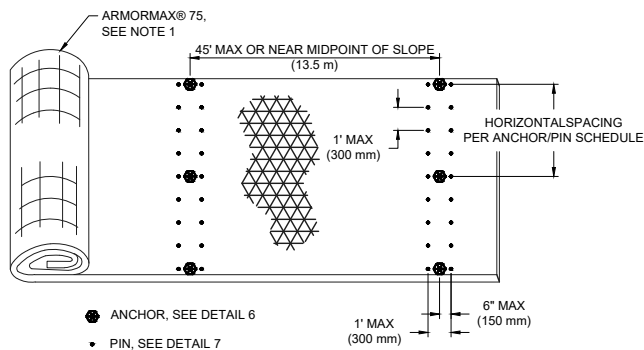
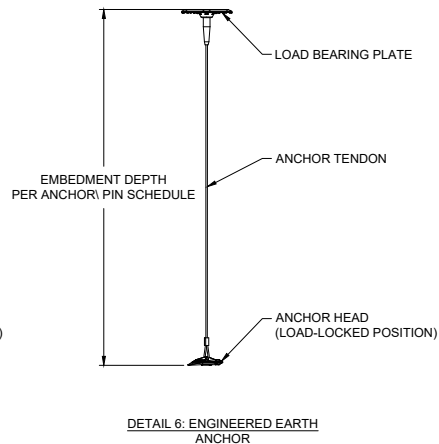
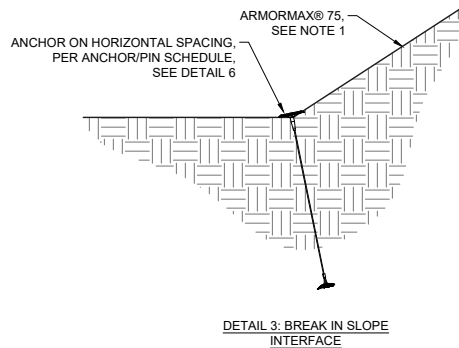


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SECURING DEVICE	ANCHOR	PIN
HORIZONTAL ANCHOR SPACING	PER MANUFACTURERS RECOMMENDATIONS	PER MANUFACTURERS RECOMMENDATIONS
VERTICAL ANCHOR SPACING	PER MANUFACTURERS RECOMMENDATIONS	PER MANUFACTURERS RECOMMENDATIONS
EMBEDMENT DEPTH	PER MANUFACTURERS RECOMMENDATIONS	PER MANUFACTURERS RECOMMENDATIONS

## EROSION CONTROL INSTALLATION DETAILS

Please note that the information presented herein is general information only. It is for conceptual use only and not intended to be used for construction. While every effort has been made to ensure its accuracy, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability, and accuracy. This engineering drawing is protected by the Copyright Act, 17 U.S.C. §101 et seq. and may be used ONLY with the express written permission of Propex in connection with Propex products. Any copying, distributing, and/or creation of a derivative work without permission of Propex is prohibited and is subject of actual damages, statutory damages and attorney's fees under the Copyright Act.

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**ARMORMAX**

## ARMORMAX® 75 INSTALLATION DETAILS FOR SLOPES

\*ALL DIMENSIONS ARE TO BE VERIFIED BY ENGINEER OF RECORD