

**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

(m) 403-992-6699 | mcadotte@solmax.com  
4019 Industry Drive, Chattanooga, TN 37416





**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

[chilliard@WoodRodgers.com](mailto:chilliard@WoodRodgers.com)

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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.woodrogers.com](http://www.woodrogers.com) |

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Propex®

# RESILIENT FLOOD MITIGATION

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

**Propex<sup>®</sup> 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®

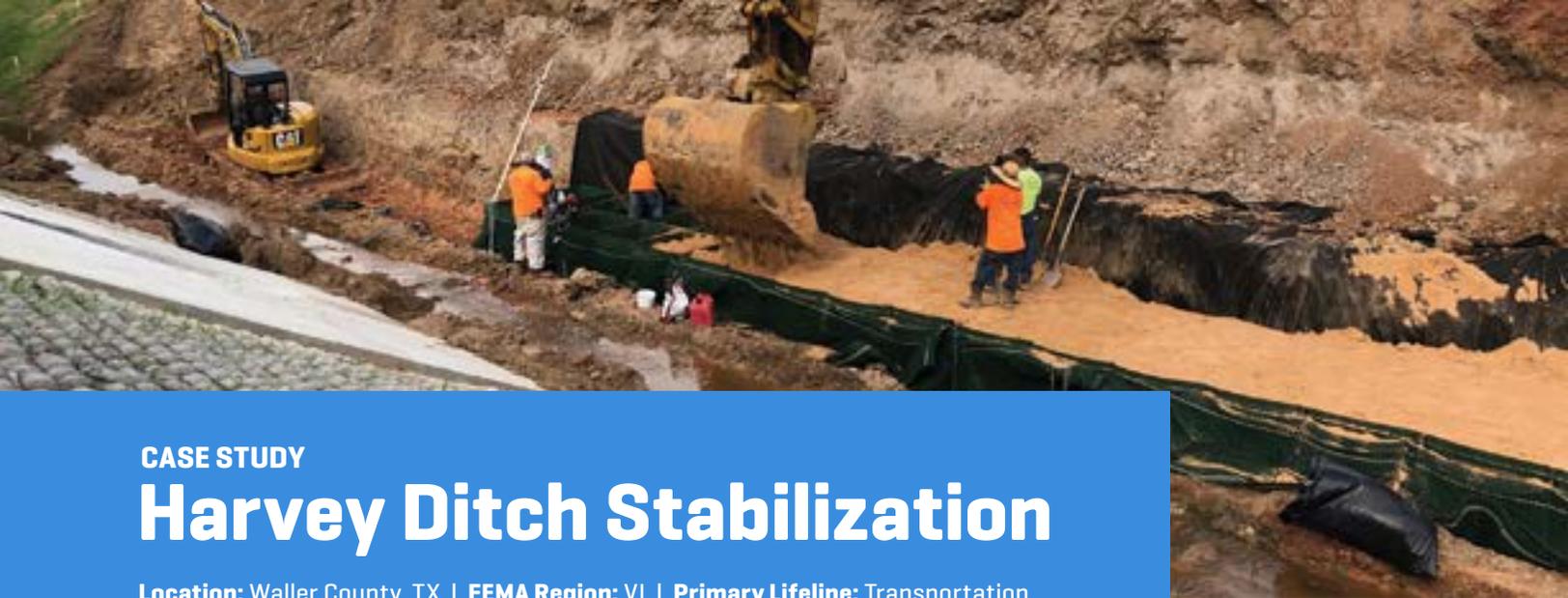
Murrieta Creek has a history of devastating flooding. Notably, the flood of 1993 that claimed the lives of five people and damaged 70 aircrafts and two bridges at Pendleton Marine Corps Base. The flood also inundated pumps at the Eastern Municipal Water District, causing 5 million gallons of raw sewage 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.

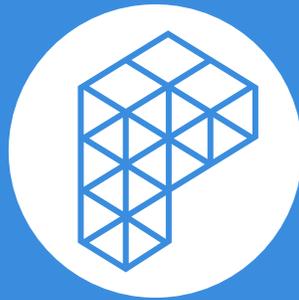
Over the past 30 years, high-flow events eroded higher portions of the channel, causing encroachment of several private properties. To prevent additional property loss and mitigate future flooding, the City and County of Honolulu wanted to find a solution that would provide long-term channel stabilization. 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.

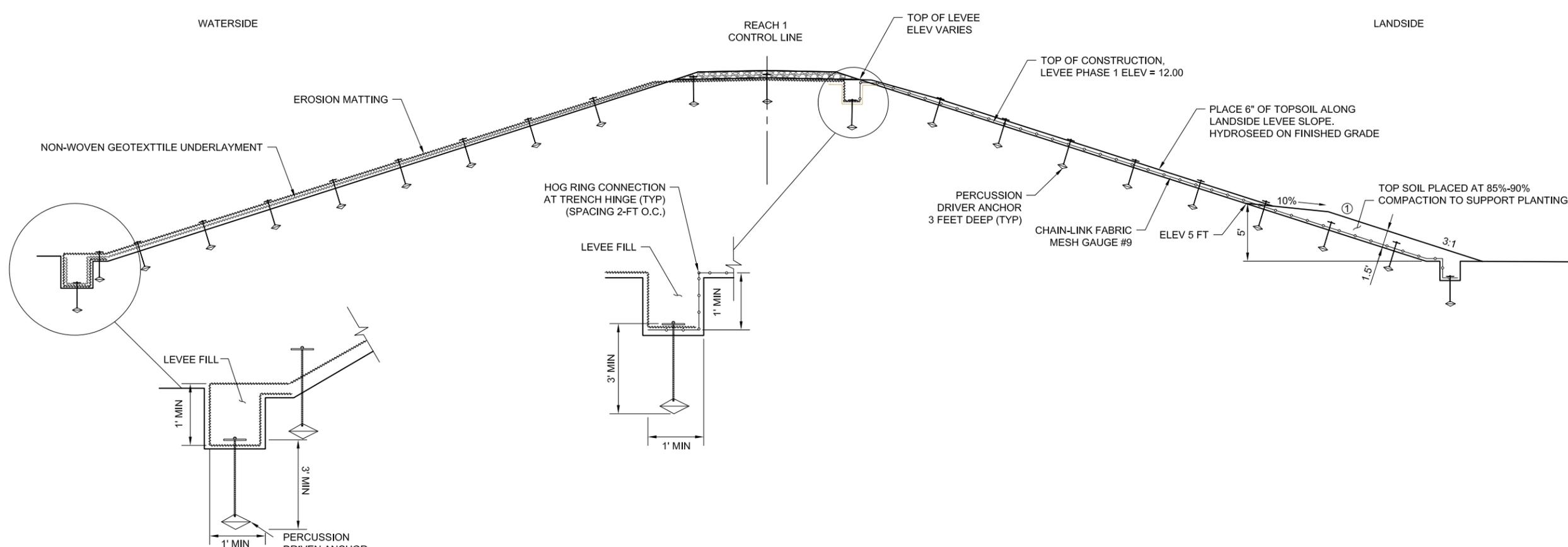
The vegetated wrap-face wall system provided resilient bank reconstruction and stabilization along a residential section of the Kaneohe Stream that will provide flood mitigation for up to 75 years.



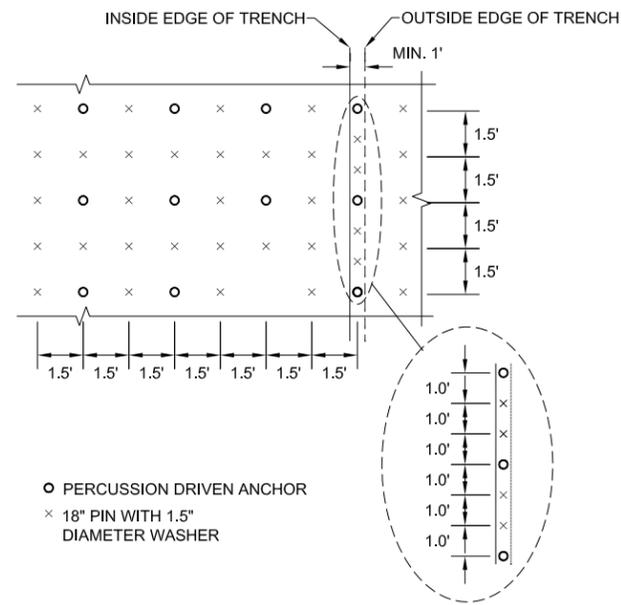


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**A** HPTRM AND CHAIN-LINK MESH INSTALLATION - CROSS-SECTION  
 SCALE: NTS - (SIDE AND DOWNSTREAM ANCHOR TRENCH, ANCHOR AND PIN PATTERN, STANDARD 0.5 ANCHORS/SY)



**B** HPTRM AND CHAIN-LINK MESH INSTALLATION - PLAN  
 SCALE: NTS - NOMINAL ANCHORS AND PIN SPACING, 1.0 ANCHORS/SY, 3.3 PINS/SY, PLAN VIEW, 15' WIDE HIGH PERFORMANCE TURF REINFORCED MATERIAL, OVERLAPPED IN THE DIRECTION OF FLOW

- NOTES:**
- INSTALL HPTRM AFTER LEVEE FILL PLACEMENT IN BOTH PHASES OF CONSTRUCTION.
  - OVERLAPPING OF CHAIN LINK FABRIC MESH IS NOT ALLOWED.
  - CONNECT ROLLS OF CHAIN LINK FABRIC MESH WITH HOG RING EDGE CONNECTIONS SPACED 2 FT OC.
  - CONTRACTOR IS RESPONSIBLE FOR EROSION CONTROL AND PROTECTION DURING CONSTRUCTION AND BETWEEN SEASONS.
- ① PLANTING BERM. LEVEE SLOPE CONCEPTUAL REVEGETATION PLAN, HT HARVEY, 2018. PROVIDED BY USACE 2019.



MARK	REVISION FOR ADDENDUM 1	DESCRIPTION	DATE
Δ			02-01-2020

DESIGNED BY: D.TEAK	ISSUE DATE: 1 OCTOBER 2019
DRAWN BY: A.ARNOLD	SOLICITATION NO: W912P719B0007
CHECKED BY: K.FELLOWS	CONTRACT NO: W912P719CXXXX
SUBMITTED BY: D.TEAK	DRAWING NO: 10047146
SIZE: ANSLD	

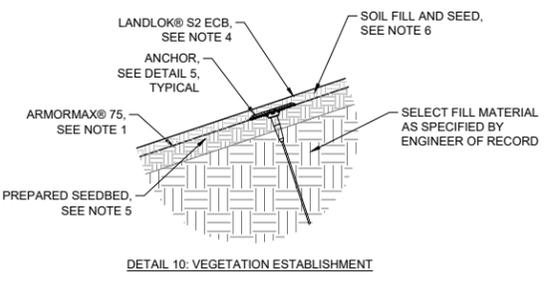
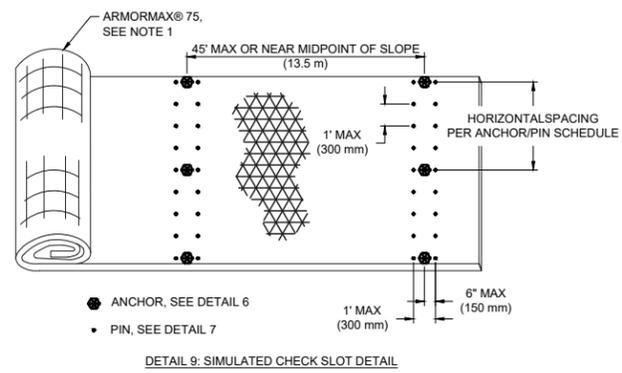
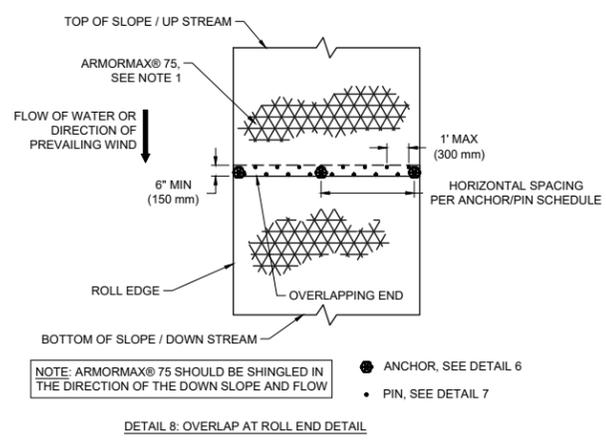
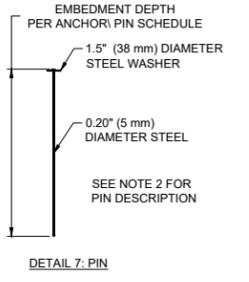
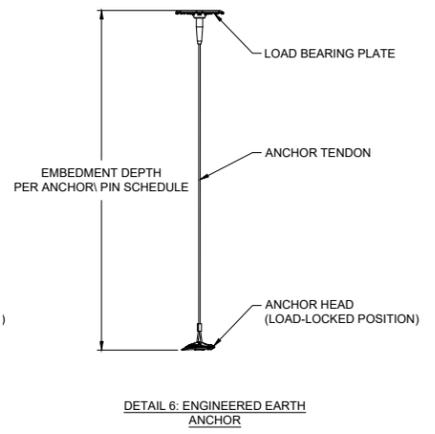
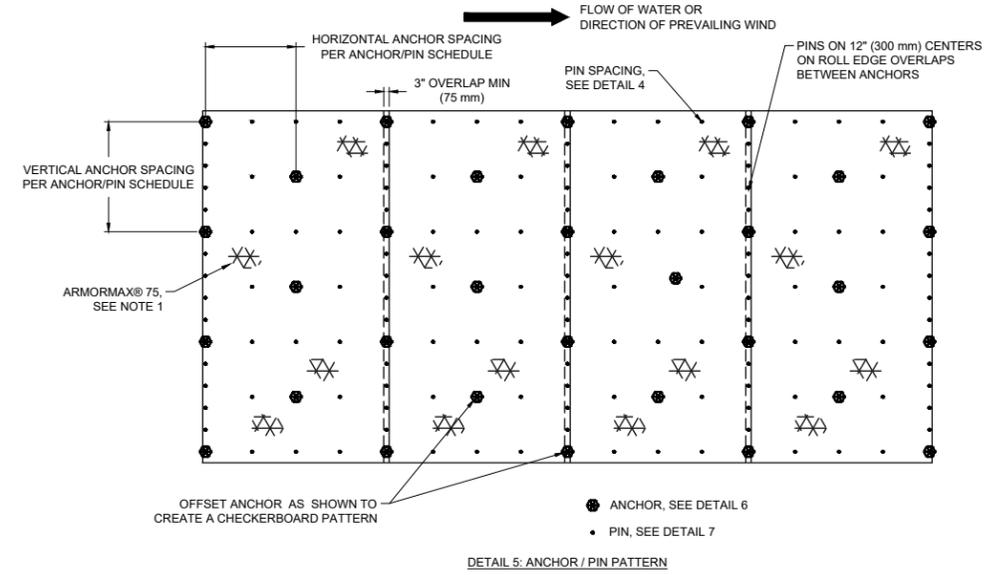
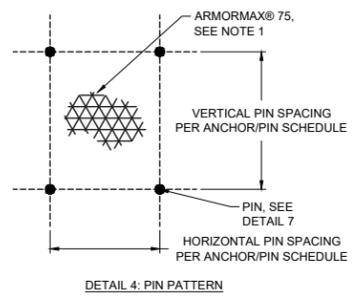
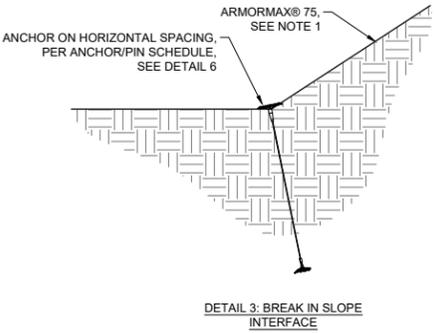
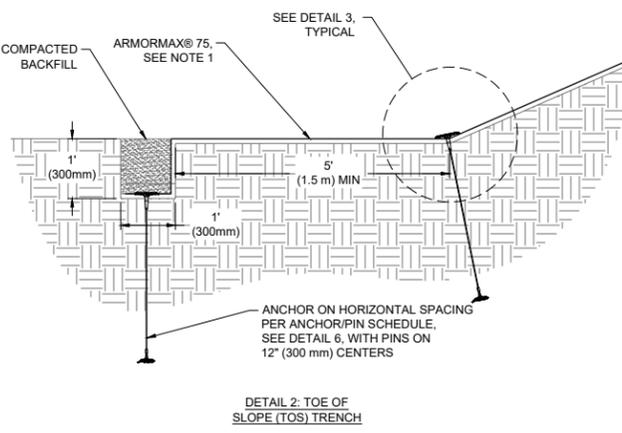
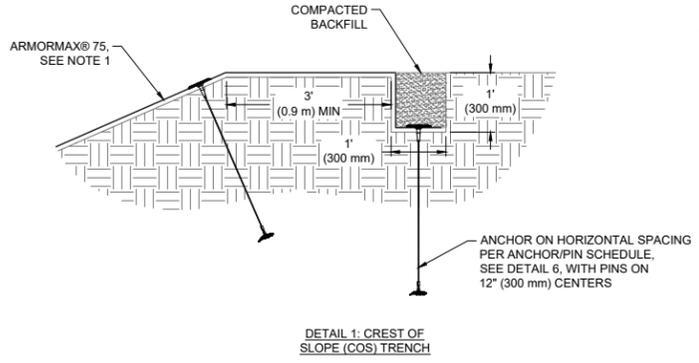
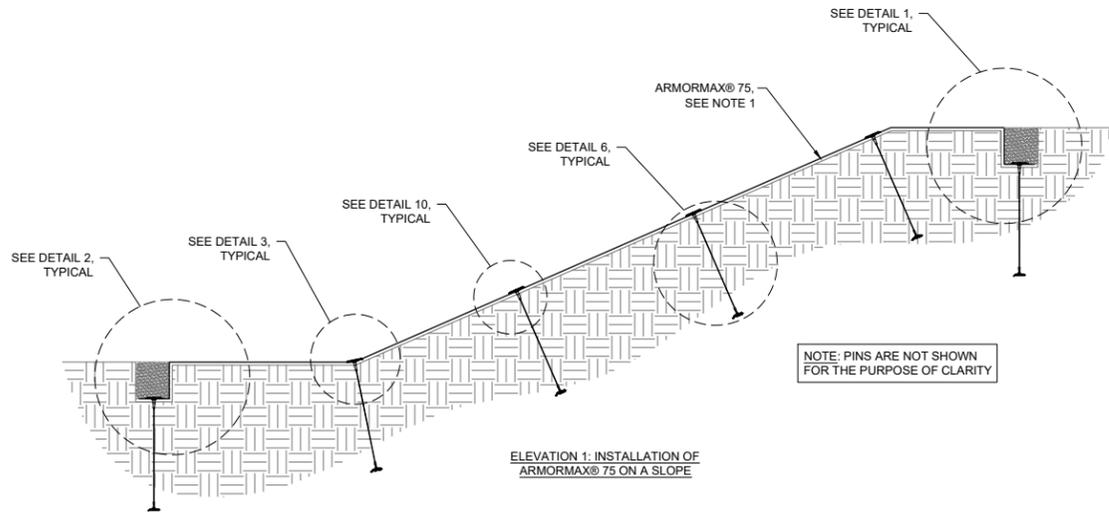
U.S. ARMY CORPS OF ENGINEERS  
 SAN FRANCISCO DISTRICT  
 1455 MARKET STREET, SUITE 1600  
 SAN FRANCISCO, CA 94103

**FR**  
 2365 IRON POINT ROAD, SUITE 300  
 FOLSOM, CA 95630

SANTA CLARA COUNTY, CALIFORNIA  
 SOUTH SAN FRANCISCO BAY SHORELINE  
 REACH 1  
 EROSION MATTING SECTION AND DETAIL

SHEET ID  
**C-503**  
 36 OF 40

**FOR BID**



**ARMORMAX® 75 ON A SLOPE FOR EROSION CONTROL (NON-STRUCTURAL APPLICATION) GENERAL INSTALLATION GUIDELINES**

- GENERAL NOTES**
- ARMORMAX® 75 is an engineered solution used for permanent erosion protection or surficial slope stability in vegetated and unvegetated applications. It is composed of two components: PYRAMAT® 75 High Performance Turf Reinforcement Mat (HPTRM) and Engineered Earth Anchors. The ARMORMAX® 75 is available in green or tan to provide for an aesthetically pleasing solution with proven performance.
    - PYRAMAT® 75 HPTRM is a three-dimensional, lofty, woven polypropylene geotextile that is available in green or tan which is specially designed for erosion control applications on steep slopes and vegetated waterways. The matrix is composed of polypropylene monofilament yarns featuring X3® technology woven into a uniform configuration of resilient pyramid-like projections. The material exhibits very high interlock and reinforcement capacity with both soil and root systems, demonstrates superior UV resistance, and enhances seedling emergence.
    - The Type B1 Anchor model is used for permanent erosion protection applications and has a working load of up to 500 lbs. The Type B1 Anchor consists of an aluminum anchor head, galvanized steel cable, aluminum ferrules, aluminum load-locking mechanism, and an aluminum top plate. The bullet nose design of the anchor head allows the anchor to penetrate HPTRM resulting in minimal installation damage. The Type B1 Anchor is also designed with a recessed cavity so the top of the cable can be cut below the surface being protected.
    - The 12", 18", and 24" Securing Pins are composed of a wire, mushroomed at the top. A washer is then placed on the wire and the wire is crimped or swaged about 3-1/2" below the top so the washer will not slide off. The end of the wire is cut at a 45 degree angle for easy penetration of the soil. These pins with washers conform to industry standards for erosion control pins with washers.
    - LANDLOK® S2 Erosion Control Blankets consist of 100% wheat straw mechanically bound and covered on both sides by netting. The straw is homogeneously blended and evenly distributed throughout the blanket. The netting is photodegradable polypropylene with mesh openings of approximately 3/8 in. by 3/8 in. (11 mm by 11 mm). The blanket is sewn on approximately 2 in. (51 mm) centers with photodegradable polypropylene thread. This product is NTPEP approved for AASHTO standards.
- VEGETATION ESTABLISHMENT**
- Prepare seedbed by loosening 50 to 75 mm (2 to 3 in) of soil above final grade. Apply seed in an amount equivalent to 60% of the total mixture required to be installed on the soil surface, to scarified surface prior to installation of the ARMORMAX® 75. Select and apply soil amendments and fertilizer, to scarified surface prior to installation of ARMORMAX® 75. A site specific soil test should be performed to help determine what soil amendments, such as lime and fertilizer, need to be incorporated into the soil to promote healthy vegetation.
  - The installed ARMORMAX® 75 shall be soil filled and seeded with the remaining 40% of the seed mixture. Do not place excessive soil above material. Once soil fill and additional seed is in place, surficial protection should be accomplished by installing LANDLOK® S2 Erosion Control Blanket (ECB) atop the seed layer. LANDLOK® S2 ECB is to be secured using 6" U-shaped staples with a frequency of 2.0 staples per square meter (1.7 staples per square yard).
  - Irrigate as necessary to establish and maintain vegetation until 75% of vegetation has established and has reached a height of 2 inches. Frequent, light irrigation will need to be applied to seeded areas if natural rain events have not occurred within two weeks of seeding.
- BEFORE INSTALLATION BEGINS**
- Coordinate with a Propex Representative: A pre-construction meeting is suggested with the construction team and a representative from Propex. This meeting should be scheduled by the contractor with at least a two week notice.
  - Gather the Tools Needed: Tools that you will need to install ARMORMAX® 75 include a pair of industrial shears to cut PYRAMAT® 75, tape measure, percussion hammer (sized appropriately for the anchors), ground rod driver compatible with the percussion hammer, drive steel compatible with the anchor, setting tool to set and load-lock the anchor, and wire cutters to cut the cable tendon of the anchor. If Anchors will be load tested during construction, additional testing equipment may be necessary. Consult the "Anchor Load Test Manual" from Propex for further guidance. Available for purchase from Propex are drive steel, setting tools, and wire cutters.
  - Determine how to Establish Vegetation: The method of vegetation establishment should be determined prior to the start of installation. Different vegetation establishment methods require different orders of installation. Refer to Establish Vegetation for further guidance.
  - Please consult the Propex Website for the most up to date installation guidelines.

ANCHOR/PIN SCHEDULE		
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.

1 of 1



ARMORMAX® 75 INSTALLATION DETAILS FOR SLOPES

Date: 12/20/2018 Drawn By: D. LOIZEAUX Scale: NTS \*ALL DIMENSIONS ARE TO BE VERIFIED BY ENGINEER OF RECORD

