Planning

62 acre 1980 Slash Pine stand needs to be harvested but there isn’t any other way to it.

There is an old existing low water crossing that’s become un-crossable due to lack of maintenance and recreational traffic rutting it out.
Crossing needed to access 1980 Planted Slash Pine
The Federal Clean Water Act, Section 404, exempts normal, established, ongoing silvicultural activities from the permitting process for discharges of dredged or fill material in jurisdictional wetlands; provided that 15 federal mandates are complied with.

This crossing:

- Crossing Purpose: To access timber for harvesting
- Alternatives: Other side would have required crossing another stream and building a new road
- Primary objective of State Forest: Timber Production
- Management Plan: Harvest timber and then reforest

Should be eligible for Exemption but only USACE and EPA can make that final determination
Planning - Watershed

Watershed of 778 acres
Planning - Watershed

778 Acre watershed is above the recommended size for a normal culvert crossing.

Bridges, low water crossings, and culverts with runarounds are recommended for watersheds above 300 acres.

Low water crossing was best option for this site.

Table 3-C: Recommended Diameters for Permanent/Temporary Culverts

<table>
<thead>
<tr>
<th>Drainage Area (acres)</th>
<th>Lower Coastal Plain (inches)</th>
<th>Upper Coastal Plain (inches)</th>
<th>Piedmont (inches)</th>
<th>Mountains and Ridge and Valley (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMANENT</td>
<td>BASED ON 25-YEAR, 24-HOUR STORM FLOWS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>24</td>
<td>15</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>50</td>
<td>36 or (2’-30”)</td>
<td>18</td>
<td>48 or (2’-36”)</td>
<td>48</td>
</tr>
<tr>
<td>100</td>
<td>48</td>
<td>24</td>
<td>54 or (2’-42”)</td>
<td>60 or (2’-48”)</td>
</tr>
<tr>
<td>200</td>
<td>60</td>
<td>36</td>
<td>72 or (2’-54”)</td>
<td>72</td>
</tr>
<tr>
<td>300</td>
<td>2’-48”</td>
<td>54</td>
<td>84 or (2’-60”)</td>
<td>78 or (2’-60”)</td>
</tr>
<tr>
<td>TEMPORARY</td>
<td>BASED ON 2-YEAR, 24-HOUR STORM FLOWS)</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>15</td>
<td>15</td>
<td>18</td>
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<td>50</td>
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<td>18</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>200</td>
<td>30</td>
<td>24</td>
<td>42 or (2’-30”)</td>
<td>36</td>
</tr>
<tr>
<td>300</td>
<td>48</td>
<td>30</td>
<td>48</td>
<td>42</td>
</tr>
</tbody>
</table>
When installing a crossing it is helpful to temporarily dewater the stream

- Limits amount of sedimentation into water
- Difficult to see what you’re doing in the black water of Lower Coastal Plain

Ways to Dewater Stream

- Work when stream is dry
- Install a runaround with a check dam
- Install temporary dam and use pump to move water downstream

What we used
Planning - Stream Discharge for Dewatering

Need to determine Stream Discharge to know if pump can handle it

\[
\text{Discharge} = \text{Cross Sectional Area} \times \text{Velocity}
\]

**Area:**
Measure cross section of stream in 1’ segments and add together segments

**Velocity:** Float round object (oranges) down known length and time trip

Stream Discharge:

<table>
<thead>
<tr>
<th>Cross sectional area</th>
<th>Total width</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.17'</td>
<td>6.2 ft²</td>
</tr>
<tr>
<td>1'</td>
<td></td>
</tr>
<tr>
<td>1.17'</td>
<td></td>
</tr>
<tr>
<td>1.2'</td>
<td></td>
</tr>
<tr>
<td>1.04'</td>
<td></td>
</tr>
<tr>
<td>1.1'</td>
<td></td>
</tr>
<tr>
<td>1.0'</td>
<td></td>
</tr>
<tr>
<td>0.17'</td>
<td></td>
</tr>
<tr>
<td>0.065'</td>
<td></td>
</tr>
<tr>
<td>0.27'</td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{Cross sectional area} = 6.2 \text{ ft}^2 = \sum \text{segment areas} \]

\[ \text{Stream Velocity} \quad \text{Distance} = 18' \]
\[ \text{Time} = 132.6 \text{ sec} \]
\[ \frac{D}{t} = \text{Velocity} = 0.14 \text{ ft/sec} \]

\[ \text{Discharge} = \text{Cross sectional area} \times \text{Velocity} \]
\[ \text{Discharge} = 6.2 \text{ ft}^2 \times 0.14 \text{ ft/sec} \]
\[ \text{Discharge} = 378 \text{ gpm} \]

Mark 3 Pump: 98 gpm
Irrigation pump: 1500 gpm
Planning

Take measurements of crossing area to determine what supplies will be needed such as:
Length of crossing in stream area
Total crossing width to be stabilized with rock and Geofabric

Be sure to order all materials well in advance of when the crossing will be installed

Go ahead and mark with flagging where grading will begin and end
Planning - Lists of Materials & Equipment

Materials for Crossing
- Geofabric/Geotextiles
- Geoweb/Geocells
- Stakes
- Connection Tabs for Geocells (or zip-ties)
- #3 or #4 Rock
- Surge Stone

Equipment for Crossing
- Dozer with Straightblade
- Skid Steer with Bucket
- Dump Truck
- Many Shovels & Rakes
- Many Sledgehammers

Materials & Equipment for Dewatering
- 4”x4”s
- 2”x6”s
- Screws
- Plastic Tarp
- Sand Bags (MANY)
- Irrigation Pump
- Hose (at least 300 feet)

Labor
We used 14 individuals and from breaking ground, it took only 1 day to install. Planning and prep work took longer.
The more people, the less time it takes but costs are higher
Minimum of 4 people needed
Planning - Geofabric/Geotextile

Geofabric/Geotextile is a densely woven fabric that is extremely puncture resistant and can be used alone or under the Geoweb. Water can pass through it but soil will not. When used under Geoweb, it will keep the gravel and the Geoweb from sinking deeper in the ground.

Our roll was 300’ long by 12’ wide at $695*

* Only use as estimate, prices will vary, price as of 4/21
Geoweb/Geocells are made of high density polyethylene panels comprised of many cells fused together which can be easily cut to size. These cells help to keep the rock in place preventing it from spreading out. The Geoweb acts like a semi-rigid slab where loads are distributed latterly reducing subgrade contact pressures.

Only use cells at least 8” tall if used by logging equipment. Shorter cells would not be able to support the heavy equipment.

Our panels were 8” tall by 10’ wide and 21’ long at $255* each

* Only use as estimate, prices will vary, price as of 4/21
Planning - Geoweb Accessories

When ordering the Geoweb, be sure to get stakes and tabs/keys which hold down and hold together the panels. The specialized stakes for Geoweb have a head which will hold the cells down. Otherwise you’ll have to get creative as shown later.
#3 or #4 Gravel is 1”-2 ½” in size
Great for filling the Geocells but could potentially wash away
$1005* per load
Each load was 18 tons which covered about 600 cubic feet

Surge Stone is 2”-4” in size
Large stone to be used over the top of Geocells, will not wash away
$1025* per load
Each load was 18 tons which covered less than 600 cubic feet

* Only use as estimate, prices will vary, price as of 4/21
Step 1: Geofabric & Geocells

Creating diagrams can help in estimating needed materials
Step 2: #3 or #4 Gravel

Determine amount of #3 or #4 Gravel needed inside of cells and on approaches.

- Approach 2-3” deep with #3 or 4 Gravel
- Geocells filled 8” deep with #3 or 4 Gravel
- 175 ft Total Road Length Covered with #3 or 4 Gravel
- 60 ft Approach 2-3” deep with #3 or 4 Gravel
Step 3: Surge Stone

Determine amount of Surge Stone needed on top of Geocells and on approaches.

From edge of crossing 2” deep on top with Surge Stone

Crossing 2” deep on top with Surge Stone

2’ wide strip 2” deep of Surge Stone along edge of crossing

95 ft 2” deep layer on top with Surge Stone

20 ft 55 ft 20 ft
Getting Started - Creating Stakes

We did not have any ready made stakes so we had to create our own from Bamboo growing on the State Forest.

We cut them to 18” lengths with a 45° angle on one side.
Getting Started - Creating Stakes

Caution with Bamboo

Bamboo is an invasive species which can reproduce through vegetative propagation (cut pieces can sprout), especially when staking them in a wet place around a stream.

Desiccation is one way to stop bamboo from resprouting.
Dipping the stakes in herbicides works too but shouldn’t be used when staking them in a stream or other wetland area.

We left the cuttings on the asphalt in the sun for a few days. None have resprouted so far.
Getting Started - Dewater the Stream

We created a small temporary dam with 2x6”s that were cut to match the stream channel dimensions and then secured to 4x4”s hammered into the streambed.

Plastic tarp and sandbags were then placed around the dam to reduce leakage, however water slowly found its way around the dam through the porous and fibrous stream banks and stream bed.
An irrigation pump was set up which pumped water out of the crossing to a location farther downstream.

The pump quickly dewatered the area around the crossing, making it easier to work.
The crossing should be graded down 2” lower than the Geoweb you are planning on using.

Example, if you are using 8” Geoweb, you would grade down 10”

There will be 8” of #3 or #4 gravel within the Geoweb and 2” of surge stone over the top = 10” of rock.

Goal: After rock is added, the finished grade is level with the adjacent stream beds

The stream bed has to be graded down to keep from being above grade and impeding any water flow or aquatic organisms.

Federal Mandates #3 & 7
Careful measuring along the entire cut is important to maintain uniformity. Too wide or deep will increase your cost for gravel needed to fill the excess space.

Both Geoweb and Geotextile are flexible and will fit the contour of the stream bed that has been graded down.
Roll out Geotextile in the graded area. We extended it to the planned water diversions on the approaches. Staking down the end helps to hold it in place while rolling.

Installing Geotextile in a flowing stream can be tricky. Someone will need to stand on it to keep it from being carried downstream.
Expanding the Geoweb

Start by staking down one end down

Pull the Geoweb out like an accordion but do not overextend to the point the cells are deforming

The Geoweb should cover the stream channel and any areas that are likely to rut on the approaches
The recommended stakes to use are fiberglass or rebar which have a head with a notch or bend that will hold the Geoweb in place.

However, bamboo stakes and zip-ties work well too.

Stakes should be placed so that the Geoweb is held in place and will not lift once rock is added.

We placed them in every other cell on the edges and every cell on the ends.
We used plastic zip-ties on every stake to hold down the Geoweb.
These zip-ties were not heavy duty but did not break even after rock was added.

When placing the stake, it should be pulling the Geoweb out so it is fully expanded but not deforming.
We found it easiest to cut a small slit in the Geofabric for each stake as the 45° angle on the bamboo was not sharp enough to pierce on its own.
Connecting the Panels Together

Geoweb panels are designed to be connected together when using 2 or more panels. The tabs insert into pre-cut slots and attach the panels together as if they were one. The pre-cut slots in the panels allow for tabs to be quickly inserted and with a half turn, the panels are strongly and firmly clamped together.

These make the process much easier but there are alternatives
Connecting the Panels Together

We used steel zip-ties with a 300 lb rating that worked just as well as the tabs. Every cell on the ends were staked down and connected to the cell of the adjacent panel.
Connecting the Panels Together

Technically only the perimeter needs to be staked down unless more securing is desired.

By using the tabs/keys or zip-ties, the panels can be assembled on dry ground and carried as one piece and set in place.
Preparing for the Gravel

Before filling the cells with gravel, ensure the perimeter of the Geoweb is securely staked in place, otherwise, the gravel will lift the Geoweb spilling the gravel outside of the cells.

If possible, plan to have the rock delivered the day the crossing is installed so the rock can be dumped directly into the cells.

Using #4 gravel, start spreading 8 to 10 feet in front of the Geoweb to build up a ramp so the edge of the Geoweb is not crushed by the equipment spreading rock.
Once the cells are filled with gravel, the trucks, tractors, and/or skid steers can spread gravel over the Geoweb without collapsing the cells.
We found that a skid steer was very efficient in spreading out the gravel and minimized the amount of hand raking needed.
As gravel is spread in the middle of the Geoweb, some raking and shoveling will be needed to fill the cells on the edge.

The more precise the graded width to the Geoweb width, the less gravel you’ll need to fill the edges.

One benefit to using a dump truck to dump the rock in the crossing is less soil getting mixed in compared to moving it from one pile to another like used here.
Larger stone like surge stone is especially important to have in the true stream bed section of the crossing to prevent the smaller #3 or 4 gravel from washing away and to cover and protect the cells from heavy equipment.

Rip rap or in this case, Surge Stone should be placed on the upstream and downstream edge of the crossing in the stream bed to armor the crossing and reduce the risk of it washing out from underneath.
When first placed, the rock may make the grade of the crossing above the stream bed. However, a few passes of heavy equipment will help to compact the rock.

Once the cells were filled with gravel, Surge Stone was then placed over top to provide even more protection.
Approach Stabilization

Water diversions should be installed on both approaches to the crossing to divert runoff from the road into a stabilized area rather than the stream crossing. We installed a broad based dip on each side where the gravel stopped outside of the SMZ. Any disturbed areas within the SMZ should be stabilized by at least seeding with grass.
Gravel within the cells will compact over time from being driven over. Once the stream is flowing, fine sediment will fill all the voids between the gravel and minimal settling will take place.
Completed Geoweb Crossing
# Geoweb Crossing Costs

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost</th>
<th># of Units</th>
<th>Total Item Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geofabric</td>
<td>$695/300’ Roll</td>
<td>1</td>
<td>$695</td>
</tr>
<tr>
<td>Geoweb</td>
<td>$255/Panel</td>
<td>4</td>
<td>$1020</td>
</tr>
<tr>
<td>#4 Rock</td>
<td>$1005/Load</td>
<td>3.5</td>
<td>$3517</td>
</tr>
<tr>
<td>Surge Stone</td>
<td>$1025/Load</td>
<td>1</td>
<td>$1025</td>
</tr>
<tr>
<td>Plastic Zip Ties</td>
<td>$14/Pack</td>
<td>1</td>
<td>$14</td>
</tr>
<tr>
<td>Steel Zip Ties</td>
<td>$33/100</td>
<td>1</td>
<td>$33</td>
</tr>
</tbody>
</table>

**Total**  $6305*  

*Total price does not include labor or equipment*

*This price should only be used as an estimate as prices will vary across the state and over time. These prices are as of April 2021.*
Low-Water Crossing Maintenance

If Geoweb or Geofabric becomes exposed, additional gravel should be added.

Driving on either if exposed will shorten the crossing’s lifespan.

A well maintained Low-Water Crossing will last many decades!
In Service Geoweb Stream Crossings

Immediately after installation when stream was dry

3 months after installation with stream flowing across
In Service Geoweb Stream Crossings
In Service Geoweb Stream Crossings
WQ Staff Contact Information

Full Time Staff

Water Quality Coordinator – Macon, GA
Scott Thackston 912-592-2316

Regional Specialist

- Ritchie Mullen (Gilmer County) 706-889-5797
- Paul McDaniel (Carroll County) 770-530-4901
- Matthew Mrizek (Ware County) 478-283-3881
- Bert Earley (Lee County) 229-854-5229

GFC Region Boundaries


Hanes Geo Components, https://hanesgeo.com
Presto Geo Systems, https://www.prestogeo.com

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