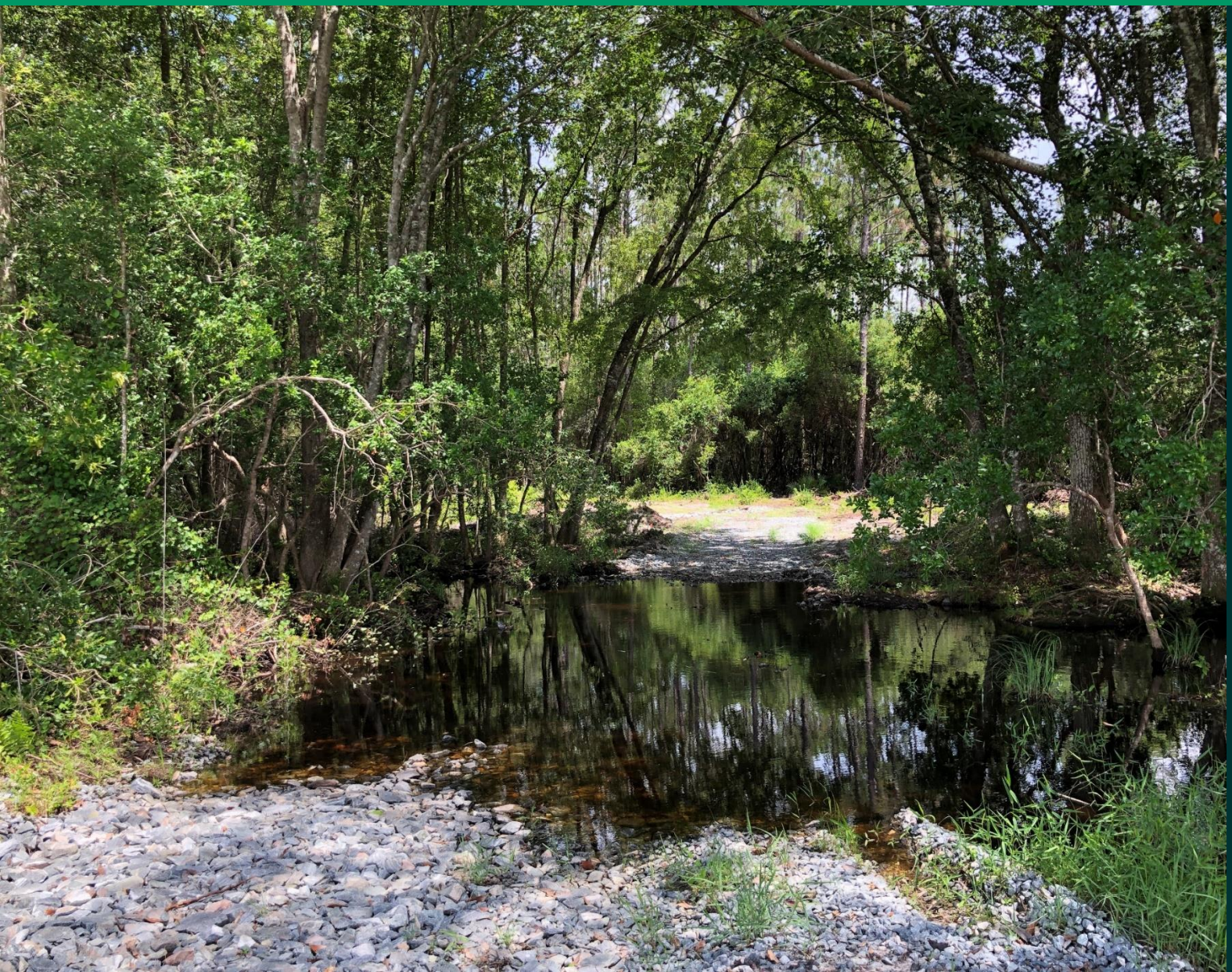
Low Water Crossing Installation in Lower Coastal Plain



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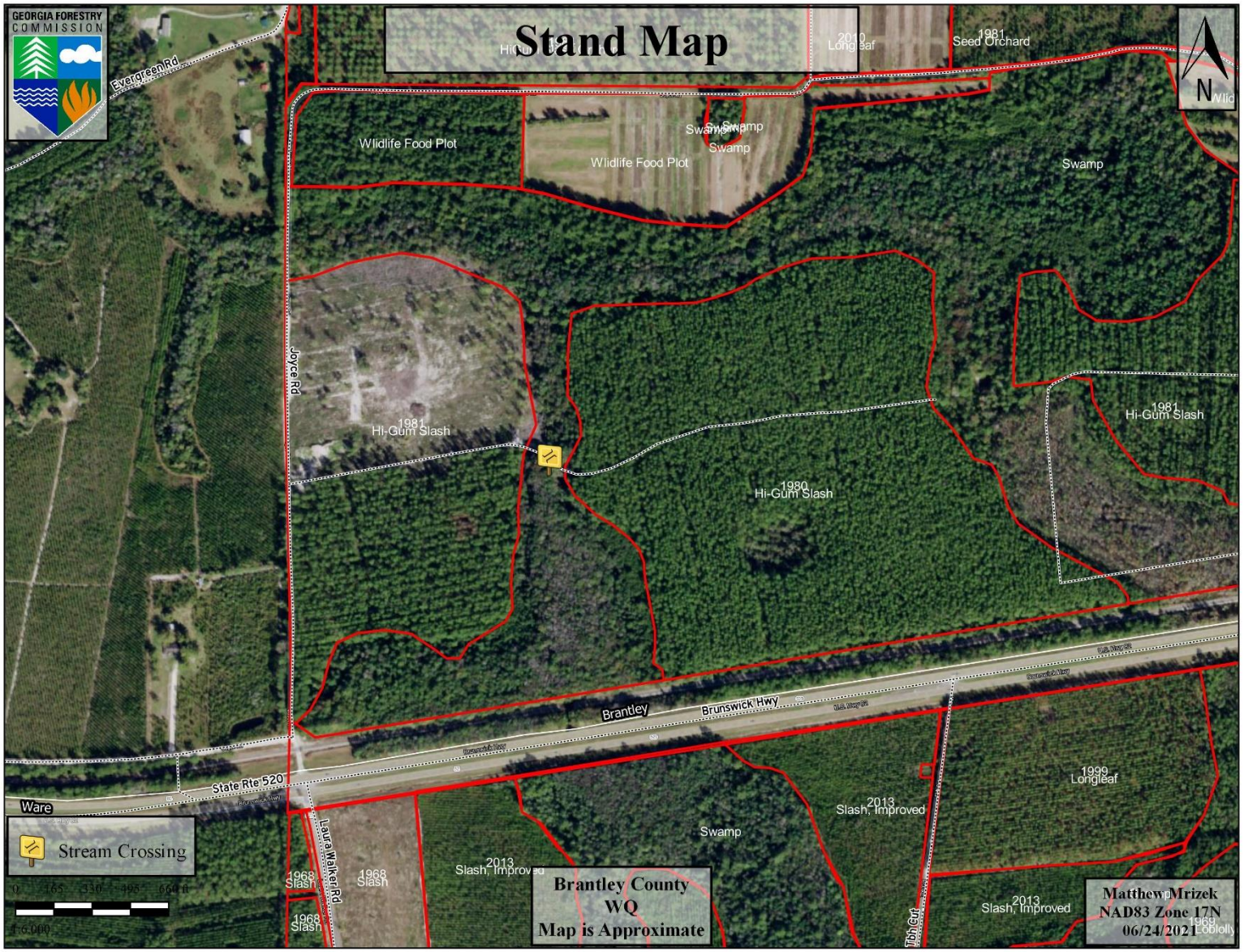
Planning

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

Planning

Crossing needed to access 1980 Planted Slash Pine



Planning - Do you need Permits?

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.

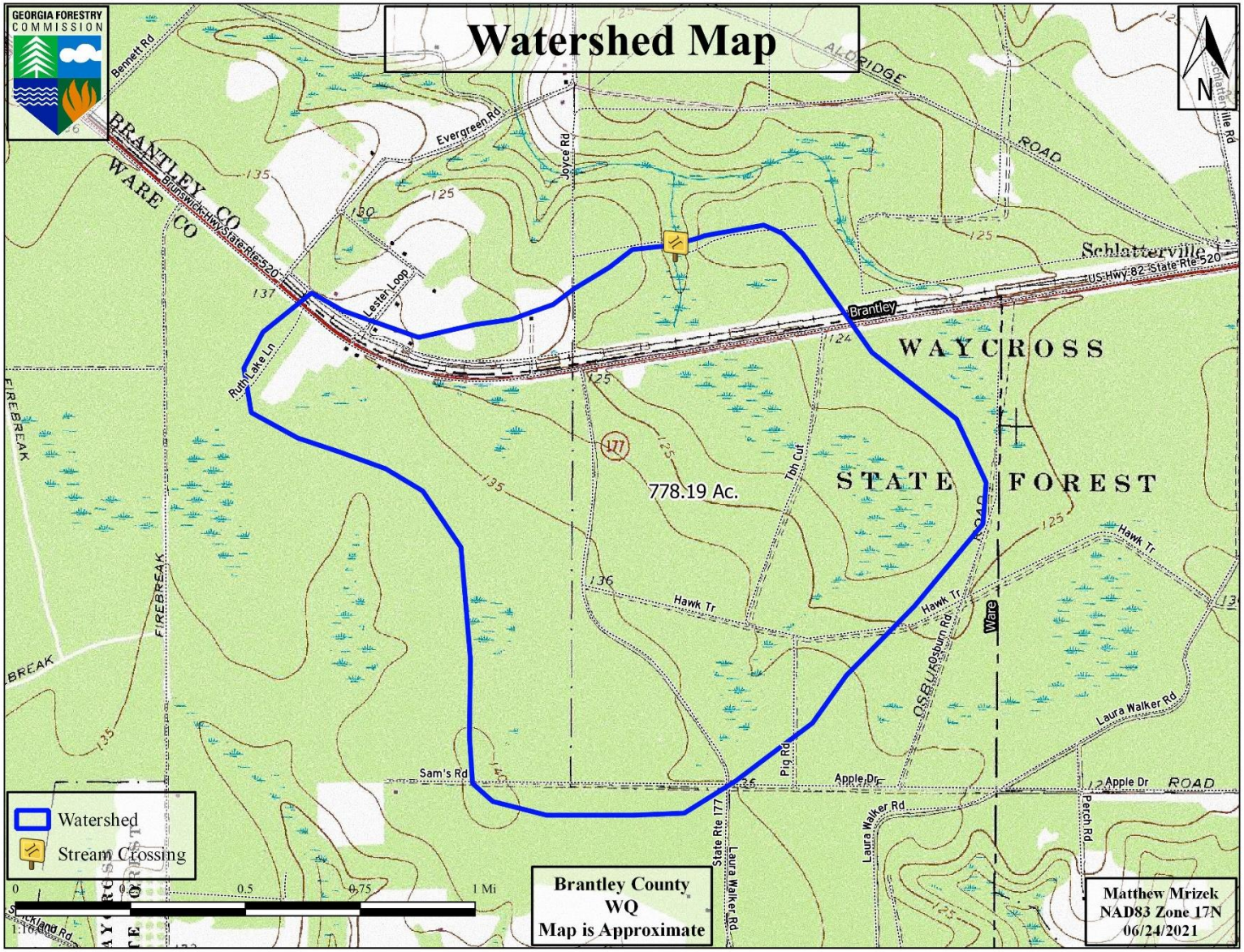
This crossing:

- 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

Drainage Area (acres)	Lower Coastal Plain (inches)	Upper Coastal Plain (inches)	Piedmont (inches)	Mountains and Ridge and Valley (inches)
PERMANENT	BASED ON 25-YEAR, 24-HOUR STORM FLOWS)			
10	24	15	30	24
50	36 or (2-30")	18	48 or (2-36")	48
100	48	24	54 or (2-42")	60 or (2-48")
200	60	36	72 or (2-54")	72
300	2-48"	54	84 or (2-60")	78 or (2'60")
Drainage Area (acres)	Lower Coastal Plain (inches)	Upper Coastal Plain (inches)	Piedmont (inches)	Mountains and Ridge and Valley (inches)
TEMPORARY	BASED ON 2-YEAR, 24-HOUR STORM FLOWS)			
10	15	15	18	15
50	18	15	30	24
100	24	18	36	30
200	30	24	42 or (2-30")	36
300	48	30	48	42

Pg 34 of BMP Manual

Planning - Dewatering Stream

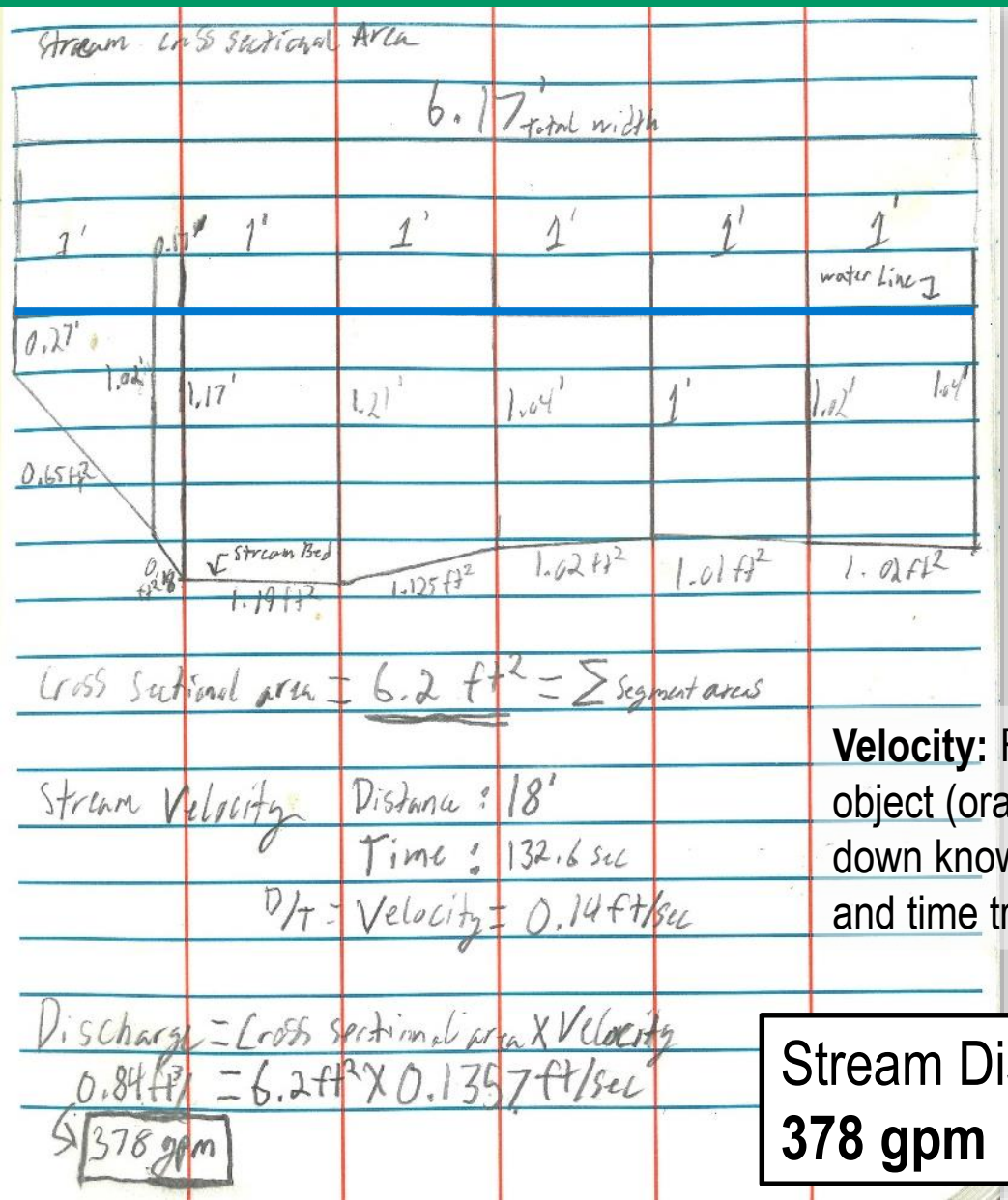
When installing a crossing it is helpful to temporarily dewater the stream

- 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

Discharge = Cross Sectional Area × 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: **378 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

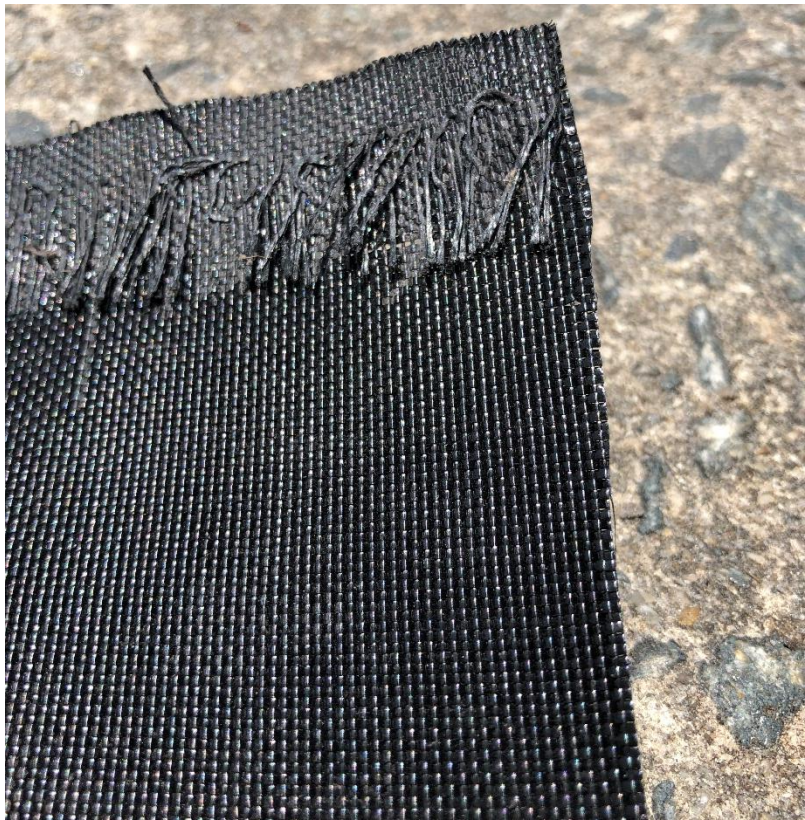
Minimum of 4 people needed

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



Planning - Geoweb/Geocells

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.

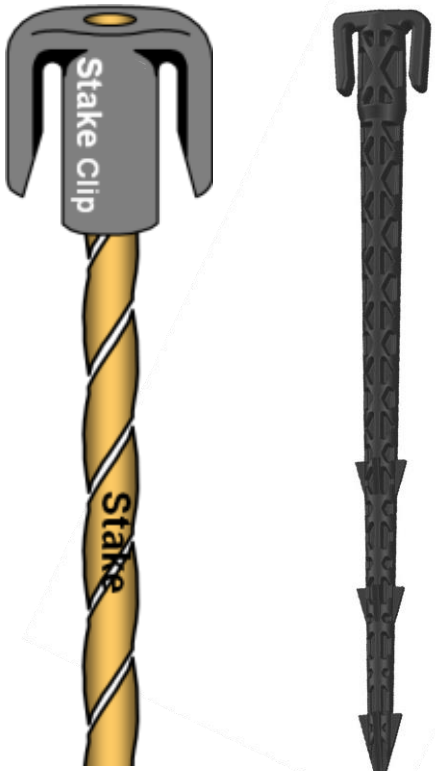
Only use cells at least 8” tall if used by logging equipment. Shorter cells would not be able to support the heavy equipment.

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.



Planning - Rock/Aggregates

#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

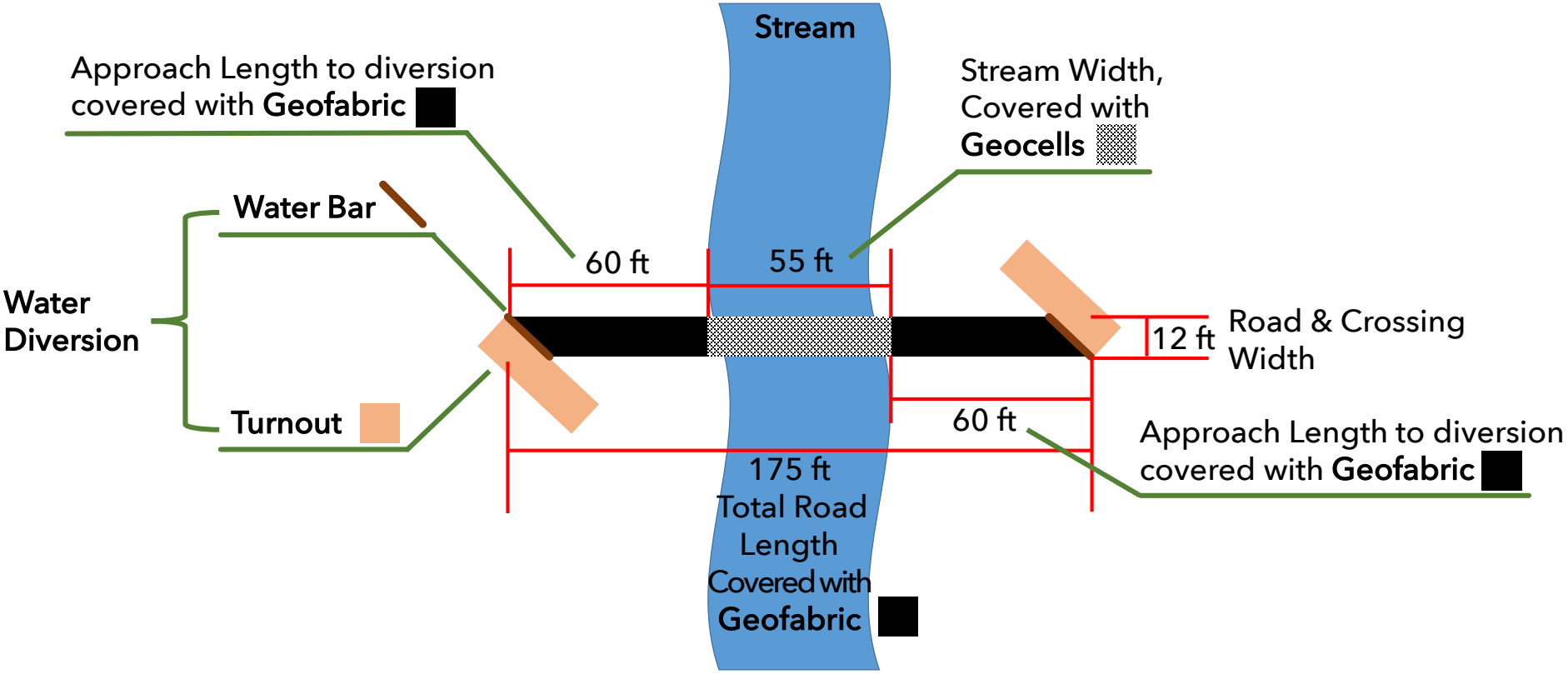
Each load was 18 tons which covered less than 600 cubic feet

* Only use as estimate, prices will vary, price as of 4/21

Planning - Materials Estimation

Step 1: Geofabric & Geocells

Determine crossing width, total length of Geofabric, & length of Geocells

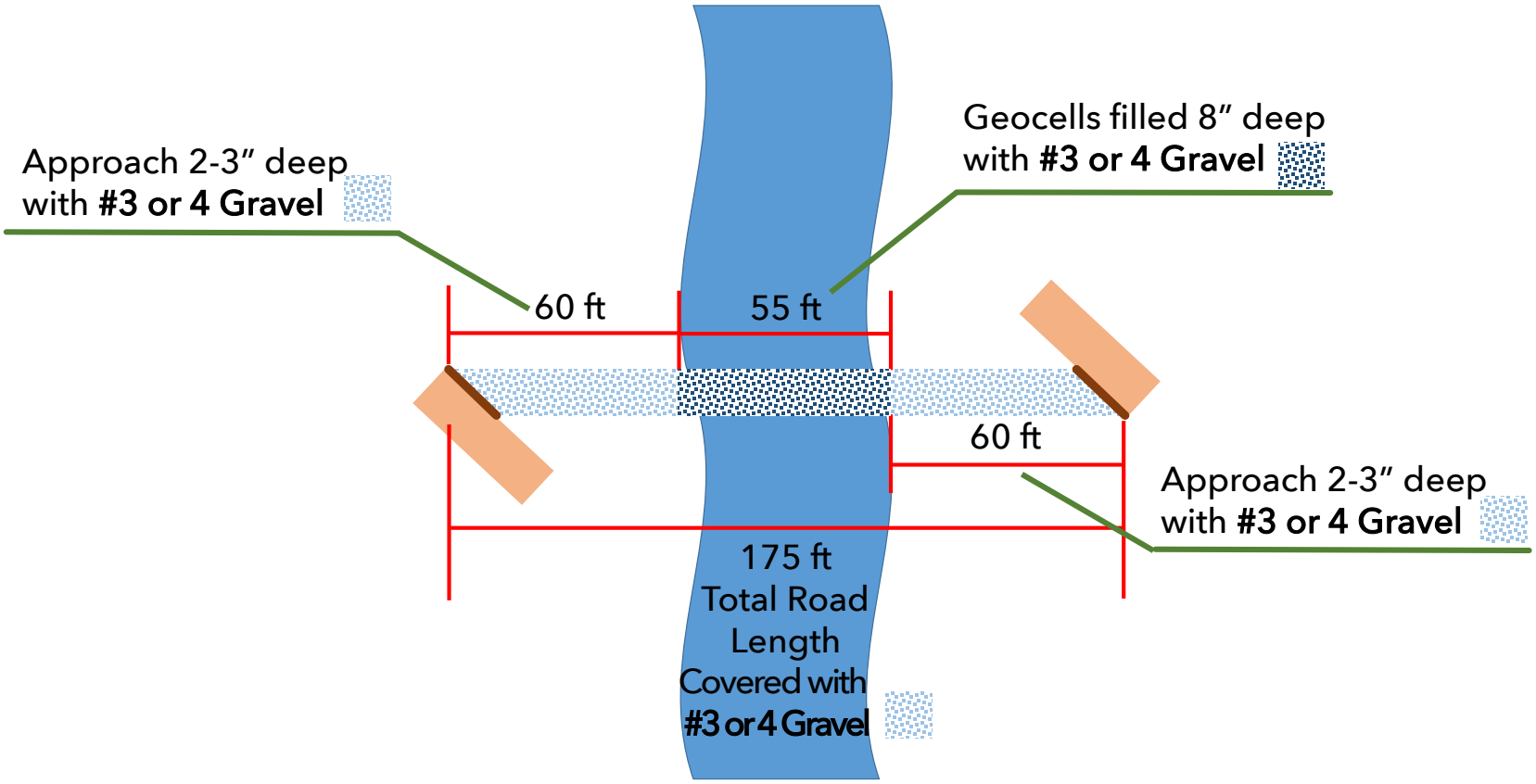


Creating diagrams can help in estimating needed materials

Planning - Materials Estimation

Step 2: #3 or #4 Gravel

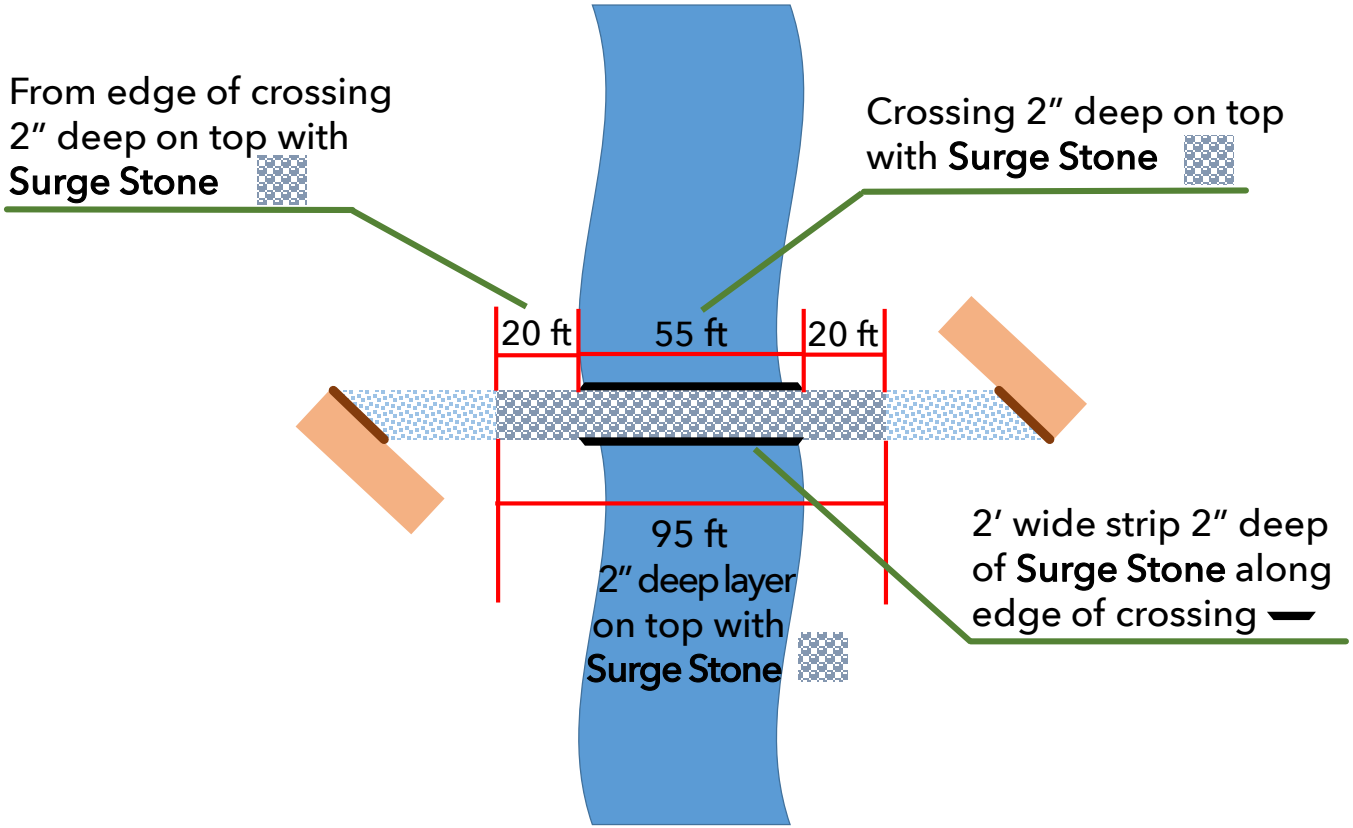
Determine amount of #3 or #4 Gravel needed inside of cells and on approaches



Planning - Materials Estimation

Step 3: Surge Stone

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



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.

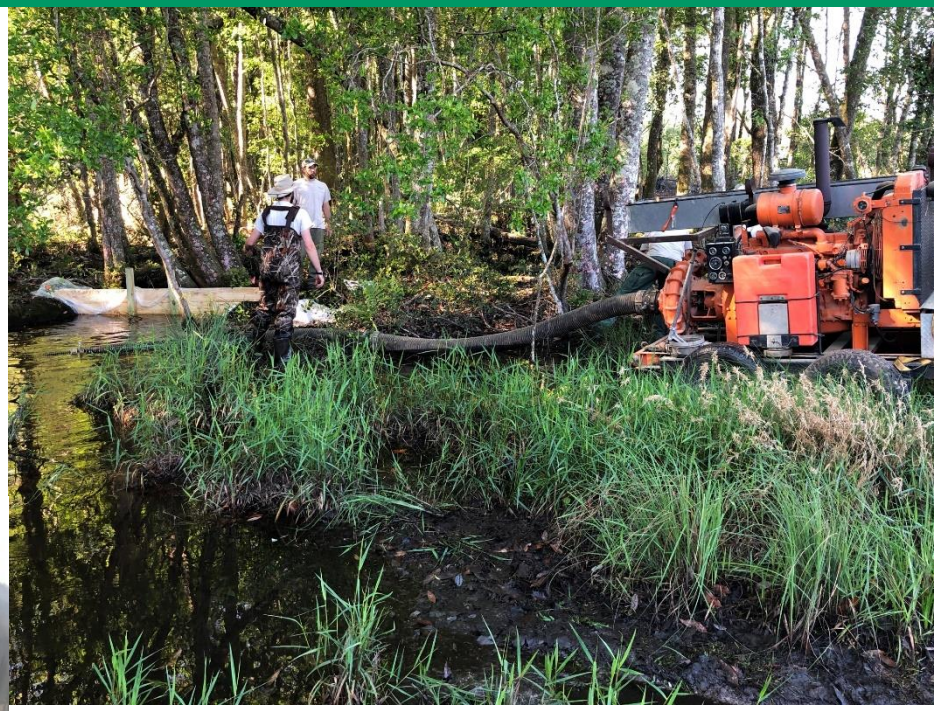
Getting Started - Dewater the Stream

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.

Getting Started - Dewater the Stream

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

Grading the Crossing

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

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

Grading the Crossing

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.

Laying Out the Geofabric/Geotextile

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

Staking The Geoweb Down

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

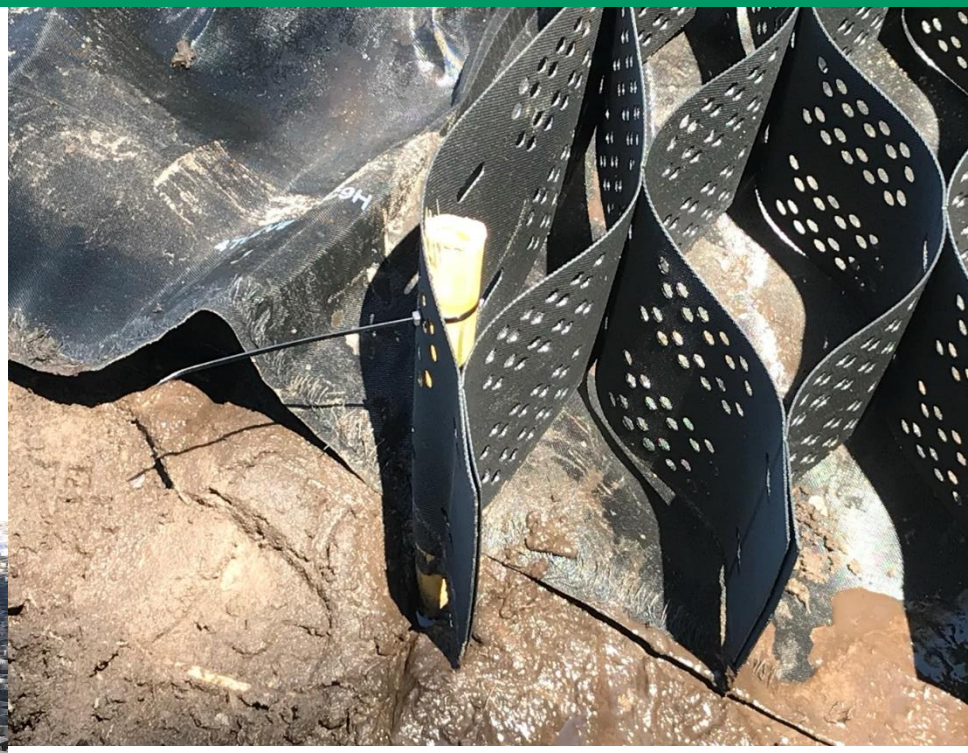
Stakes should be placed so that the Geoweb is held in place and will not lift once rock is added

We placed them in every other cell on the edges and every cell on the ends

Staking The Geoweb Down

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

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

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.

Spreading Gravel Over The Geoweb

Once the cells are filled with gravel, the trucks, tractors, and/or skid steers can spread gravel over the Geoweb without collapsing the cells.

Spreading Gravel Over The Geoweb

We found that a skid steer was very efficient in spreading out the gravel and minimized the amount of hand raking needed.

Spreading Gravel Over The Geoweb

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.

Spreading Gravel Over The Geoweb

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

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

Spreading Gravel Over The Geoweb

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

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.

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

Completed Geoweb Crossing

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.

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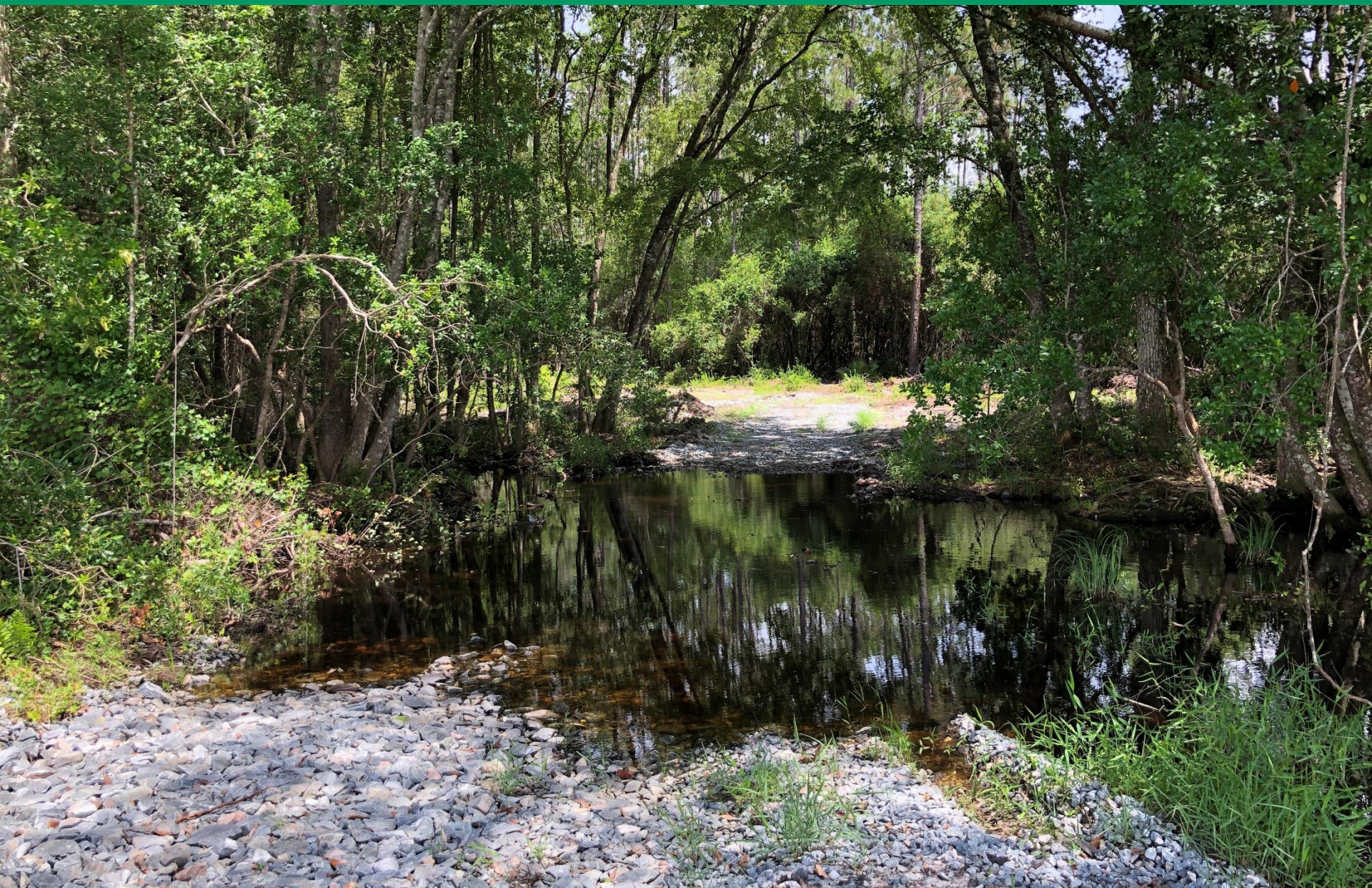
Completed Geoweb Crossing

GEORGIA FORESTRY COMMISSION

Completed Geoweb Crossing



Geoweb Crossing Costs

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

<u>Driving on either if exposed will shorten the crossing's lifespan</u>

US Forest Service

US Forest Service

A <u>well maintained</u> Low-Water Crossing will last many decades!

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In Service Geoweb Stream Crossings

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In Service Geoweb Stream Crossings

In Service Geoweb Stream Crossings

3 months after installation
with stream flowing across

Immediately after installation
when stream was dry

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In Service Geoweb Stream Crossings

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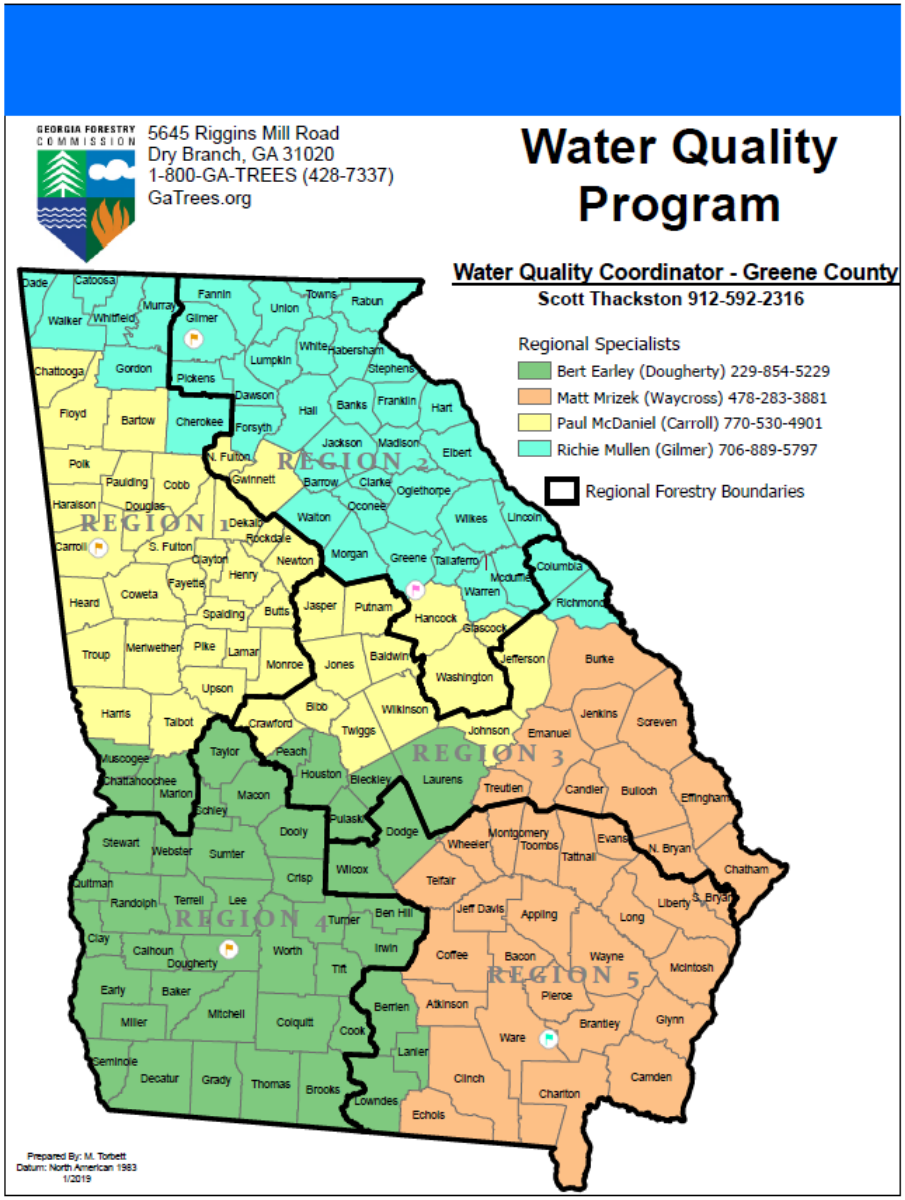
In Service Geoweb Stream Crossings

WQ Staff Contact Information



WATER QUALITY PROGRAM

GEORGIA FORESTRY COMMISSION

Full Time Staff

Water Quality Coordinator – Macon, GA
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Paul McDaniel (Carroll County)	770-530-4901
Matthew Mrizek (Ware County)	478-283-3881
Bert Earley (Lee County)	229-854-5229

GFC Region Boundaries

References

Clarkin, Kim, et al. Low-Water Crossings: Geomorphic, Biological, and Engineering Design Considerations. U.S. Forest Service, https://www.fs.fed.us/eng/pubs/pdf/LowWaterCrossings/LoWholeDoc.pdf, 2006.

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Presto Geo Systems, https://www.prestogeo.com

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