

# GREEN CAY GUT HEADCUT STABILIZATION PROJECT Final Report

114-H Green Cay  
St. Croix East End, USVI



**Prepared for:**

NOAA Coral Reef Conservation Program and USDA-NRCS  
Green Cay Farm, LLP,  
VI Department of Planning and Natural Resources, and  
the National Fish and Wildlife Foundation

**Prepared by:**

Horsley Witten Group, Inc and  
St. Croix Environmental Association



August 2017

## Purpose

This report documents completion of the Green Cay Gut Headcut Stabilization construction project as part of HW's final project closeout requirements under the NOAA CRCP Order No. DG-133C-12-BA-0056/C-0013.

The following objectives were successfully met by this project:

1. Cessation of active headcut migration and a reduction of sediment loads to Chenay Bay, which is impaired for turbidity;
2. Implementation of a priority watershed restoration project identified in the NOAA-funded 2011 Watershed Management Plan for the St. Croix East End Marine Park;
3. Development of a list of native plants suitable for gut restoration projects in the USVI and support of the island's only native plant nursery;
4. Creation of an interagency partnership to fund implementation and provide support during project permitting and construction;
5. Completion of proper permitting at the Territorial and Federal Level;
6. Capacity building for the St. Croix Environment Association to manage permitting, construction bidding, construction oversight, and grant administration for a watershed restoration project;
7. Demonstration of a headcut restoration technique using a combination of rock step pool and vegetation that has not been previously used in the VI; and
8. Preparation of engineering design plans for downstream Phase II work.

## Project Background

In 2011 the St. Croix East End Watershed Management Plan (WMP) was created to identify and develop a plan for reducing land-based sources of pollution to the East End Marine Park. Watershed evaluations suggested that the Southgate watershed contributed nearly 20 percent of the total sediment load to the East End Marine Park. As such, the Southgate watershed was identified as a priority area, with the most significant source of sediment originating from erosion of an active headcut on the East Gut, locally and herein referred to as Green Cay Gut.

Green Cay Gut (also known locally as the East Gut) flows east to west and discharges into Chenay Bay, which is part of the East End Marine Park and is included in the island's 303(d) list of impaired waters for turbidity and other water quality parameters. The upper reaches of the gut are located on Green Cay Farm, LLC property and were highly incised with active bank erosion, down cutting, and bed scour. There was a severely-eroded, three-lobed headcut approximately 20-40 feet wide and up to 25 feet deep (**Figure 1**). An additional, smaller headcut was located to the south of the main headcut. The landowners estimated the rate of headcut migration at approximately 10-15 feet per year, which was been confirmed by HW through analysis of aerial imagery. Below this headcut (approximately 1,200 ft) the channel is extremely incised, as evidenced by past attempts to stabilize banks with cars and other debris. There is no clearly defined channel between the headcut and the up-gradient farm pond, except for a low point where overflow crosses the unpaved road.

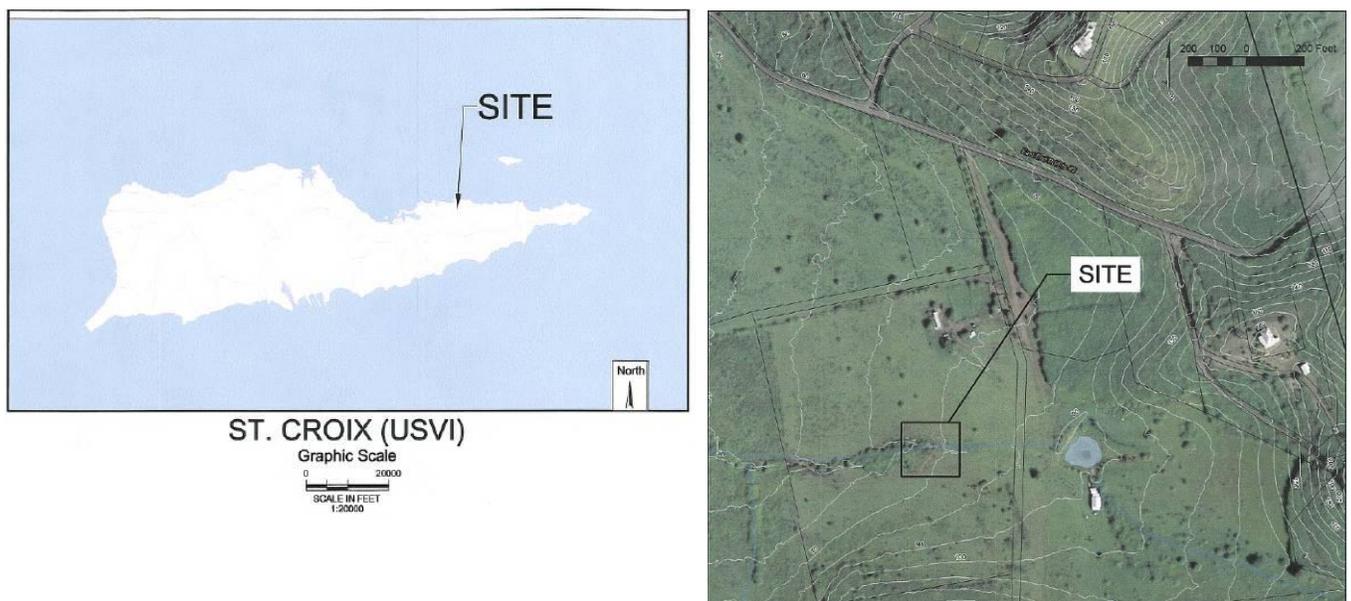
Later in 2011, the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) provided \$12,700 in funding for the St. Croix Environmental Association (SEA) and Horsley Witten Group (HW) to conduct a site survey and develop engineering design plans to repair the active headcut of Green Cay Gut to prevent it from migrating further up-gradient. Repairing the headcut was estimated to reduce Southgate watershed sediment loading by nearly 17%. HW completed site topographic survey, preliminary engineering design plans, and cost estimates that were reviewed by NRCS staff in Puerto Rico. Territorial staff from Building Permits, DEP, and Fish and Wildlife went to the site during various phases of the project.

By 2015-2016, a total of **\$260,300** in implementation funds had been cobbled together by NOAA Restoration Center and NRCS partners as follows:

- \$131,400 in NOAA Coral Reef Conservation Program funds allocated to HW through a contract with the National Fish and Wildlife Foundation (NFWF);
- \$49,500 in NOAA Restoration Center funds to HW through the NOAA Coral Reef Conservation Program (CRCP) call contract;
- \$54,400 from NRCS directly to the property owners, Green Cay LLC through the EQIP Program;
- \$20,000 from DPNR Coastal Zone Management to the St. Croix Environmental Association for this effort;
- \$5,000 in house match from DPNR-CZM and the State Historic Preservation Office for the Archeological Phase I survey

US EPA was unable to provide additional support for this project, however, opportunity exists for additional support for educational or additional downstream restoration efforts in the future.

**Figure 1. Site Location**



## Permits

The project was approved under the National Environmental Policy Act (NEPA ID No. NA10NOS4630131, dated August 21, 2015). A phased NEPA review determined that the project permitting process would have no adverse environmental impacts. Following acquisition of permits (see below), NOAA confirmed that the site is outside the range of any endangered species and project construction would result in no adverse effect upon essential fish habitat. No sensitive resource areas were impacted by the proposed project.

DPNR performed the Archeological Phase 1 Survey in house with oversight from SEA. Results (report dated February 8, 2016) found no evidence of historic artifacts on site.

HW and SEA prepared and submitted required permit applications on behalf of the property owners. An approved Earth Change Permit (STX-010-16) was issued to the property owners (dated February 11, 2016).

A Nationwide Permit Number 27 (Aquatic Habitat Restoration, Establishment and Enhancement Activities) (SAJ-2015-03108) was issued by the US Army Corps of Engineers (verification letter dated April 6, 2016). It is noteworthy that the headcut at the top of an intermittent channel was considered jurisdictional by the Army Corps.

Copies of all permits can be provided upon request.

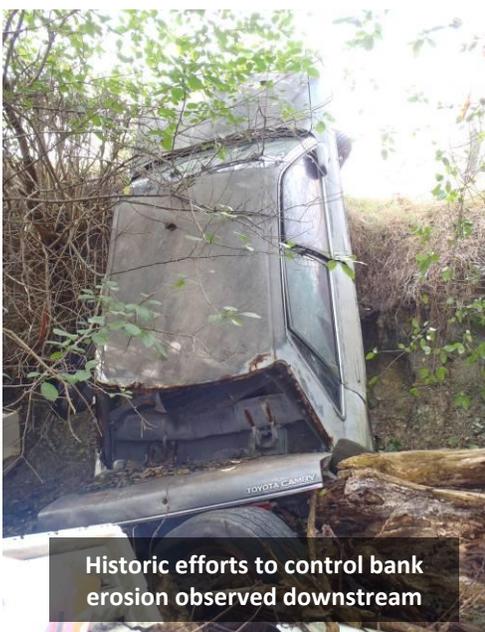
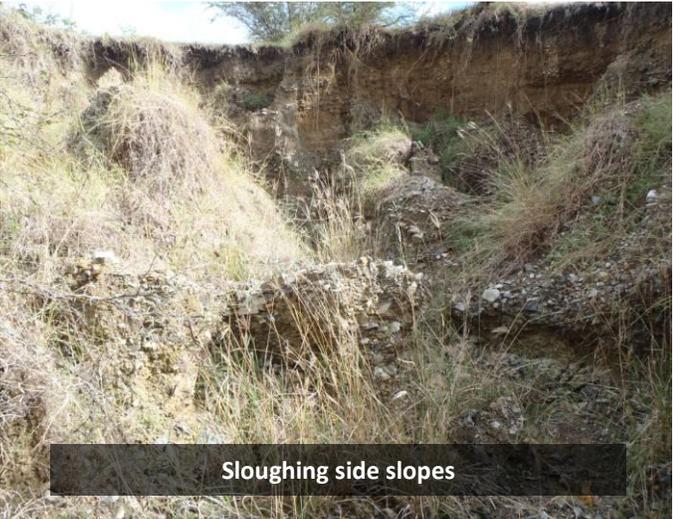
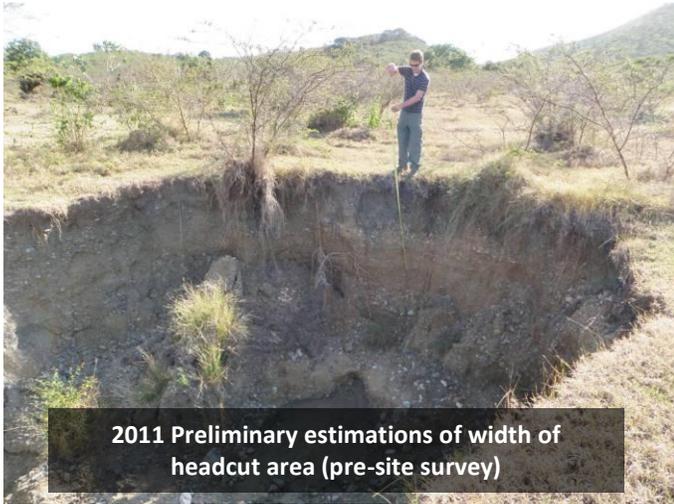
## Project Design

The emergency repair approach was to excavate back from the edge of the headcut and establish a non-erodible channel with boulder step-pools mimicking steep, intermittent channels in the USVI. "Hard" stabilization consisted of large boulders used to establish a series of step pools to reduce velocities of storm flows. "Soft" engineering practices (e.g., erosion control blankets, and native shrubs, trees, and grasses) were used to stabilize side slopes and recreate a vegetated buffer. Fencing was installed to restrict livestock access.

The repair area under this project was limited to the immediate headcut and adjacent uplands (total disturbed area approximately 10,500 SF or 0.24 acre; approximately 180 ft long by 30-75 ft wide and did not include any stream restoration activities downstream). This repair project did not alter existing hydrologic conditions at the site or create changes in runoff patterns in the contributing drainage area. The conveyance channel was designed to convey storm flows produced during the 1.5-year recurrence interval event, as recommended by NRCS. This event approximates what is commonly referred to as the "channel forming discharge" event or the "bankfull" event. Boulder step-pool structures were sized based on stability requirements for the 100-year storm event flows of approximately 700 cubic feet per second.

**Appendix A** includes the set of construction plans for reference.

**Figure 2. Green Cay Headcut Before Stabilization Project**



## Construction

The project team put the project out to bid in July, 2016 and held a pre-bid meeting on site February 27, 2016 to answer contractor's questions. Marco St. Croix, Inc. was selected as the contractor and construction began in early September, 2016. Due to rain delays, construction was not substantially completed until January, 2017. During the construction period, SEA provided routine construction oversight. HW and NRCS performed site inspections at key times during the construction process, such as during the installation of first step pool. Regular construction reports were submitted by HW to the contractor, owners, and members of the project team throughout the duration of the project. Due to unanticipated buried debris and some improvised grading, HW slightly revised the layout and number of step pools. This was issued as a revised site plan in October, 2016.

A final punchlist was provided by HW after a site walk was completed in January, 2016. A certification of completion was provided to the property owner on March 14, 2017 by HW certifying that the project was in substantial compliance with the approved "GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI, CONSTRUCTION PLANS" dated June 2016 and REVISED SITE PLAN dated 10/10/16. An AS-BUILT MARKUP dated 1/4/17 provided adequate representation of the extent of stonework and fencing.

## Planting

Geographic Consulting Inc (GCI) was separately contracted to finalize a landscape plan for the site based on local expertise and plant availability. Planting started shortly after approved installation of step pools, and final installation of erosion control blankets and fencing. Native trees, shrubs and vines were planted along with fast-growing grasses on the banks of the Green Cay Head Cut Repair Project during the week of December 26-30, 2016. A wide variety of native plant material was established to: control soil erosion, stabilize banks and enhance the buffer forest habitat on site. All plants for this project were grown on St. Croix in GCI's native plant nursery. A total of 377 plants were established on the banks including 114 trees and shrubs in 1 gallon pots, 214 4" grass plugs, 36 trees and shrubs in 3-gallon pots and 13 native vines. Additional details of the species, quantities and sizes of all plants appear in **Attachment B**. GCI watered and replaced dead plants during a 6-month plant warranty period.

See **Attachment B** for GCI's final report and more information on why particular species are suitable for these types of restoration projects.

Figure 3. Construction of the stabilization project





Green Cay Headcut Stabilization

## Cost Summary

Total project implementation cost includes design, permitting, and construction (**Table 2**). Construction costs include both material and contractor labor, but also administration and oversight efforts. There are likely some additional costs not captured here, such as grant administration and coordinate efforts of all the project partners, particularly for effort associated with securing funding. Long-term maintenance is also not included.

**Table 2. Approximate Total Project Cost\***

Description	Cost
Site topographic survey and preliminary design (2011)	\$12,700
75% engineering design plans	\$13,500
Permitting (meetings, applications, response to questions, notifications)	\$25,000
Construction plans and material specifications	\$13,800
Construction Admin (bidding, contractor selection, contracting, grant admin)	\$13,650
Construction Oversight (on site inspections, submittals, RFI, revisions, as-built, closeout, Phase II design)	\$42,350
Construction **	\$137,000
<i>mobilization</i>	<i>\$13,700</i>
<i>site clearing and grubbing</i>	<i>\$15,000</i>
<i>excavation and haul away</i>	<i>\$38,000</i>
<i>fine grading and compaction</i>	<i>\$20,200</i>
<i>3/4" stone</i>	<i>\$4,000</i>
<i>12" stone</i>	<i>\$5,500</i>
<i>boulders</i>	<i>\$28,850</i>
<i>fencing/gate</i>	<i>\$6,750</i>
<i>erosion control</i>	<i>\$5,000</i>
Landscaping	\$12,000
Watering & Plant Replacement	\$3,000
<b>Total Implementation Cost</b>	<b>\$260,300</b>
<b>Total Project Cost (including 2011 preliminary design effort)</b>	<b>\$273,000</b>

\* Does not include NRCS, NOAA, or Green Cay Farm time associated with meetings, plan review, permitting, or site inspections

\*\* General estimates based on Marco invoices

## Maintenance

The property owners have entered into a long-term maintenance agreement with NRCS as part of the EQIP grant program. Table 3 includes a list of key maintenance inspection, repair options, and a proposed frequency of inspection.

We recommend completing an inventory of buffer plantings 1 to 2-yr after planting to evaluate establishment success and to identify invasive species removal needs.

**Table 3. Inspection and Maintenance Frequency**

Inspection	Maintenance/ repair options	Frequency of inspections		
		Each month for first year	After rain events > 1"	Annually
Look for evidence of erosion at top of channel, along sides of stone step pools, and at bottom of channel.	<ul style="list-style-type: none"> <li>Evaluate cause of erosion (e.g., runaround of weirs, side slope erosion, etc)</li> <li>Check with engineer to determine if more stone is needed, size, and placement.</li> <li>Repair as directed</li> </ul>	X	X	X
Check for gulling and erosion on side slopes or upland contributing area	Smooth area and re-seed or install erosion control matting	X	X	X
Check step pool undercutting, settling and sediment accumulation	<ul style="list-style-type: none"> <li>The channel should be self-cleaning, however if excessive sediment is filling up stone, address it at the source- stop upstream erosion</li> <li>Do not need to remove sediment accumulated in pools</li> <li>Add more stone to weirs if settling is occurring and weir/pool inverts are not maintained</li> <li>If evidence of undercutting, consult with engineer. May need to dig out, add new filter fabric ¾" and 12" stone</li> <li>If trees are in the center the channel that have potential to get very large and reduce cross-sectional capacity of channel, then remove them</li> </ul>	X		X
Make sure fence and gate are secure and horses cannot get in	Repair enclosure as needed	X		X
Check establishment of buffer plantings vs weeds and invasives	<ul style="list-style-type: none"> <li>Replant bare spots and replace dead trees</li> <li>Remove tan tan and other invasives</li> <li>Only cut vegetation in stone step pools if there is an anticipated loss of cross-sectional capacity</li> </ul>	X		X

## Lessons from the field

- It was particularly difficult to secure funding from multiple partners AND assure coordinated timing of disbursement of funding. Each partner required specific outcomes from the project, which required flexibility in the division of outcomes across the partners.
- Permitting of a restoration project in a dry, intermittent channel was challenging and more time consuming (and costly) than anticipated. There are some opportunities to streamline the process and to address inconsistencies. The US Army Corp of Engineers considered this active headcut to be a jurisdictional wetland, which is not consistent with determinations made for other guts on the island. Army Corps officials were unable to come over from Puerto Rico to look at the site, nor did this particular type of activity easily fit into one of the existing Nationwide permit categories. Equally, the Earth Change permit issued through DPNR-DEP does not have a category for gut restoration/stabilization activities; therefore a full Level 3 application was submitted. There was some back and forth regarding the need to complete a flood permit and water quality certification, neither of which is applicable to a non-development project. That being said, all permitting agencies were extremely cooperative in moving the process forward. Establishing a permitting process specifically for restoration activities may help DPNR and future applicants.
- NRCS approval of engineering designs and implementation was done through the Puerto Rico office, since there is not an NRCS engineer in the USVI office. This added an additional layer of coordination and grant management for the USVI –based staff. Having technical expertise on island would be extremely helpful for future NRCS-supported restoration projects.
- Make sure limits of disturbance (LOD) are clearly marked in the field prior to clearing and grading activities. A section of the LOD was placed in an incorrect location, which led to additional grading and required stabilization.
- Be sure to specify volcanic-derived stone vs. limestone for drainage projects. Even though it was clearly called out in the construction specifications, it came up during the pre-bid meeting as an obvious “cost-saving” option.
- Hydroseeding was not overly successful given the poor soils on site. We recommend required soil amendments in these situations for better grass growth. Bare areas remain where soils were excessively clayey (covered with erosion control blanket).
- The 12” stone was in short supply, making it difficult to shape the step pools correctly.
- The contractor had difficulty installing the erosion control matting and in many places it did not have proper contact with the ground surface due to weeds, large chunks of clay/rock, etc.
- Unsecure fencing led to a number of plants getting eaten by horses, so be sure to secure fencing prior to planting investments.
- Wet and dry season don’t seem to particularly accurate labels. Be sure to include on-site watering and a minimum 6-month plant warranty period in landscaping contracts.

# **Attachment A**

GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI, CONSTRUCTION PLANS" dated June 2016 with REVISED SITE PLAN dated 10/10/16

# GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI CONSTRUCTION PLANS

JULY 11, 2016



ST. CROIX (USVI)

Graphic Scale  
0 20000  
SCALE IN FEET  
1:20000



VICINITY MAP

Graphic Scale  
1-inch = 200-feet

Sheet List Table

Sheet Number	Sheet Title
1	COVER SHEET
2	CONSTRUCTION NOTES
3	EXISTING CONDITIONS
4	GRADING PLAN
5	DETAILS

GENERAL NOTES:

- ALL ELEVATIONS SHOWN ON VICINITY MAP ARE APPROXIMATE AND BASED ON ORTHOMETRIC IMAGERY AND AN AERIAL SURVEY PROVIDED BY THE VIRGIN ISLANDS DEPARTMENT OF NATURAL RESOURCES (VI DPNR) (2007).
- ROAD LAYOUT AND PROPERTY BOUNDARIES SHOULD BE CONSIDERED APPROXIMATE.

Plan Set:		<b>GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI CONSTRUCTION PLANS</b>																										
Prepared For:		Green Cay Farm LLP 5024 Estate Green Cay Christiansted, VI 00820 ----																										
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294 Washington Street, suite 801 Boston, MA 02108 (857) 263-8193 voice																												
Date Issued: JULY 11, 2016	Registration: PROFESSIONAL ENGINEER KRISTOPHER M. HOULE 689-TE	Revisions	Project Number: 15130																									
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**SUMMARY OF PROPOSED ACTIVITY**

- 1. THE PURPOSE OF THE PROJECT IS TO STABILIZE THE EXISTING EAST END GUT HEADCUT AND TO MINIMIZE THE AMOUNT OF SUSPENDED SEDIMENT THAT IS TRANSPORTED TO THE EAST END MARINE PARK. THE HEADCUT IS CURRENTLY MIGRATING UPLAND AS MUCH AS 10-15 PER YEAR.
2. THE PROPOSED PROJECT IS LOCATED ON THE EAST END OF ST. CROIX UNDER JURISDICTION OF THE GREEN CAY FARM LLP. THE CONSTRUCTION ACTIVITIES WILL OCCUR WITHIN THE CONFINES OF THE HEADCUT.
3. LAND CLEARING AND SITE DISTURBANCE SHALL OCCUR ONLY WITHIN THE PROPOSED LIMIT OF WORK AREA. ALL TREES WITH A SIX-INCH CALIPER SIZE OR GREATER SHALL REMAIN WHEN POSSIBLE. CONSTRUCTION ENTRANCE(S) SHALL BE SITED TO AVOID EXISTING TREES GREATER THAN FOUR INCHES WHEN POSSIBLE.
4. STRIPPED TOPSOIL SHALL BE STOCKPILED AND REUSED ON-SITE IN ACCORDANCE WITH ENGINEER REQUIREMENTS.
5. A COMBINATION OF SILTATION FENCE AND STONE CHECK DAMS SHALL BE INSTALLED TO MINIMIZE OFF-SITE SEDIMENTATION. STORMWATER WILL BE ALLOWED TO PASS THROUGH THE PROJECT SITE DURING CONSTRUCTION. TEMPORARY SEDIMENTATION BASINS MAY BE CONSTRUCTED WITHIN THE PROJECT AREA TO CONTROL SILE RUNOFF AND SEDIMENT, IF NEEDED.

**GENERAL CONSTRUCTION NOTES**

- 1. ALL SITE PREPARATION NECESSARY TO COMPLETE THIS PROJECT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
2. THE CONTRACTOR SHALL MAKE ALL NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN ALL NECESSARY CONSTRUCTION PERMITS, PAY ALL FEES AND POST ALL BONDS, IF NECESSARY, ASSOCIATED WITH THE SAME, AND COORDINATE WITH THE OWNER(S) AND THE ENGINEER.
3. ALL EXISTING CONDITIONS SHOWN SHALL BE CONSIDERED APPROXIMATE AND ARE BASED ON THE BEST INFORMATION AVAILABLE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THAT THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS DO NOT CONFLICT WITH ANY KNOWN EXISTING OR OTHER PROPOSED IMPROVEMENTS. IF ANY CONFLICTS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE OWNER AND THE ENGINEER PRIOR TO INSTALLING ANY PORTION OF THE SITE WORK WHICH WOULD BE AFFECTED.
4. TO OUR KNOWLEDGE, NO EXISTING UTILITIES AND STRUCTURES ARE IN THE VICINITY OF WORK. NOTIFY ENGINEER AND APPROPRIATE UTILITY COMPANY IF ANY UTILITIES ARE FOUND DURING EXCAVATION. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED, INCOMPLETELY OR INACCURATELY SHOWN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ACCURATE RECORDS OF THE LOCATION AND ELEVATION OF ALL WORK INSTALLED AND EXISTING UTILITIES FOUND DURING CONSTRUCTION FOR THE PREPARATION OF THE AS-BUILT PLAN.
5. THE CONTRACTOR SHALL UTILIZE ALL PRECAUTIONS AND MEASURES TO ENSURE THE SAFETY OF THE PUBLIC, ALL PERSONNEL AND PROPERTY DURING CONSTRUCTION IN ACCORDANCE WITH OSHA STANDARDS, INCLUDING BARRICADES, SAFETY LIGHTING AND CONES AS DETERMINED NECESSARY BY THE ENGINEER.
6. ALL IMPORTED MATERIAL SHALL BE CLEAN. NO MATERIAL WILL BE ACCEPTED FROM AN EXISTING OR FORMER CONTAMINATED SITE.
7. SITE LAYOUT SURVEY REQUIRED FOR CONSTRUCTION WILL BE PROVIDED BY THE CONTRACTOR AND SHALL BE CONDUCTED BY A USVI REGISTERED PROFESSIONAL LAND SURVEYOR. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH THE SURVEYOR FOR ALL SITE SURVEY WORK.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING AND MAINTAINING ALL CONTROL POINTS AND BENCHMARKS DURING CONSTRUCTION INCLUDING BENCHMARK LOCATIONS AND ELEVATIONS AT CRITICAL AREAS. THE LOCATION OF ALL CONTROL POINTS AND BENCHMARKS SHALL BE COORDINATED WITH THE ENGINEER.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL GRADE STAKES SET BY THE SURVEYOR. GRADE STAKES SHALL REMAIN UNTIL A FINAL INSPECTION OF THE ITEM HAS BEEN COMPLETED BY THE ENGINEER. ANY RE-STAKING OF PREVIOUSLY SURVEYED SITE FEATURES SHALL BE THE RESPONSIBILITY (INCLUDING COST) OF THE CONTRACTOR.
10. UNLESS OTHERWISE SPECIFIED ON THE PLANS AND DETAILS/SPECIFICATIONS, ALL SITE CONSTRUCTION MATERIALS AND METHODOLOGIES ARE TO CONFORM TO THE MOST RECENT STANDARD SPECIFICATIONS OF THE CARIBBEAN AREA DIVISION OF THE NATURAL RESOURCES CONSERVATION SERVICE (NRCS).
11. CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE LAWS AND REGULATIONS REGARDING NOISE, VIBRATION, DUST, SEDIMENTATION CONTAINMENT, AND TRENCH WORK.
12. ANY EXCAVATED MATERIAL TO BE HAULED OFF-SITE IN COORDINATION WITH THE OWNER. CONTRACTOR WILL BE RESPONSIBLE FOR SECURING ANY REQUIRED PERMITS FROM VIRGIN ISLANDS WASTE MANAGEMENT AUTHORITY FOR ANY MATERIAL TAKEN TO THE LANDFILL.
13. A PORTABLE RESTROOM FACILITY SHALL BE PROVIDED ON-SITE BY THE CONTRACTOR DURING THE ENTIRETY OF THE CONSTRUCTION PHASE.
14. THE CONTRACTOR SHALL RESTORE ALL SURFACES EQUAL TO THEIR ORIGINAL CONDITION AFTER CONSTRUCTION IS COMPLETE. AREAS NOT DISTURBED BY CONSTRUCTION SHALL BE LEFT NATURAL. THE CONTRACTOR SHALL TAKE CARE TO PREVENT DAMAGE TO SHRUBS, TREES, OTHER LANDSCAPING AND/OR NATURAL FEATURES. WHEREAS THE PLANS DO NOT SHOW ALL LANDSCAPE FEATURES, EXISTING CONDITIONS MUST BE VERIFIED BY THE CONTRACTOR IN ADVANCE OF THE WORK.
15. ALL REMAINING AREAS DISTURBED BY THE WORK SHALL BE SEEDED WITH GRASS SEED AS SHOWN ON THE PLAN AND/OR DIRECTED BY THE ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR WATERING SEEDED AREAS UNTIL COVER IS ESTABLISHED AND APPROVED BY THE ENGINEER AND/OR OWNER.
16. IF ARCHEOLOGICAL RESOURCES ARE FOUND DURING EXCAVATION, ALL ACTIVITIES WILL STOP UNTIL VISPO CONSULTATION CAN BE COMPLETED.
17. THE CONTRACTOR SHALL REGULARLY INSPECT THE PERIMETER OF THE PROPERTY TO CLEAN UP AND REMOVE LOOSE CONSTRUCTION DEBRIS BEFORE IT LEAVES THE SITE. ALL DEMOLITION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE SITE TO AN APPROVED DUMP SITE. ALL TRUCKS LEAVING THE SITE SHALL BE COVERED.
18. IF ANY DEVIATION OR ALTERATION OF THE WORK PROPOSED ON THESE DRAWINGS IS REQUIRED, THE CONTRACTOR IS TO IMMEDIATELY CONTACT AND COORDINATE WITH THE ENGINEER AND OWNER.
19. AT THE END OF CONSTRUCTION, THE CONTRACTOR SHALL REMOVE ALL CONSTRUCTION DEBRIS AND SURPLUS MATERIALS FROM THE SITE. A THOROUGH INSPECTION OF THE WORK PERIMETER IS TO BE MADE AND ALL DISCARDED MATERIALS, BLOWN OR WATER CARRIED DEBRIS, SHALL BE COLLECTED, AND REMOVED FROM THE SITE.
20. CONTRACTOR IS RESPONSIBLE FOR PROVIDING REDLINE MARKUP OF FINAL AS-BUILT PLANS.

**BASIC CONSTRUCTION SEQUENCE**

THE FOLLOWING CONSTRUCTION SEQUENCE IS TO BE USED AS A GENERAL GUIDELINE. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER, ENGINEERS, AND REGULATING AGENCIES, AND SUBMIT A PROPOSED CONSTRUCTION SEQUENCE FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.

- 1. SURVEY AND STAKE THE PROPOSED LIMIT OF DISTURBANCE, CONSTRUCTION ACCESS AND LIMIT OF SEDIMENTATION BARRIERS.
2. PLACE SEDIMENTATION BARRIERS (STRAWBALES, SILT FENCE, ETC.) AS SHOWN ON THE PLANS AND STAKED OUT IN THE FIELD. IN NO CASE IS THE LIMIT OF WORK TO EXTEND BEYOND THE SEDIMENTATION BARRIERS/LIMIT OF DISTURBANCE AS SHOWN ON THE PROJECT PLANS.
3. BEGIN CLEARING AND GRUBBING IMMEDIATELY, AS REQUIRED. TOPSOIL IS TO BE STRIPPED FROM AREA AND STOCKPILED IN APPROVED LOCATIONS PROTECTED BY SILT FENCE.
4. INSTALL STONE CHANNEL ABOVE THE ADJACENT, SMALLER HEADCUT.
5. SURVEY AND STAKE CENTERLINE OF THE PROPOSED DRAINAGE CHANNEL AND POOLS.
6. EXCAVATE AND ROUGH GRADE THE PROPOSED DRAINAGE CHANNEL AND SIDE SLOPES.
7. INSTALL CHECKDAM OR TEMPORARY SEDIMENT BASIN AT BOTTOM OF HEAD CUT, TO CONTROL SITE RUN-OFF.
8. FINE GRADE AND COMPACT CHANNEL WITH ENGINEER-APPROVED FILL MATERIAL.
9. INSTALL GEOTEXTILE AND STONE LAYER (3'4").
10. INSTALL ALL PROPOSED BOULDERS AND STONE PER THE CONSTRUCTION DETAILS.
11. COMPLETE FINE GRADING OF SIDE SLOPES. STABILIZE ALL SLOPES WITH SEED MIX, USE COIR FABRIC ON SIDE SLOPES 3:1 OR STEEPER.
12. INSTALL STONE REVETMENTS, AS SHOWN.
13. PERMANENTLY SEED ALL REMAINING DISTURBED AREAS WITH SEED MIX.
14. INSTALL EXCLUSIONARY FENCE W/ GATE.
15. HAUL OFF AND PROPERLY DISPOSE OF ANY REMAINING EXCAVATED MATERIAL. COORDINATE REUSE AND DISPOSAL WITH SITE OWNER.
16. COMPLETE ALL REMAINING LANDSCAPE PLANTING (BY OTHERS).
17. REMOVAL OF ALL TEMPORARY SOIL EROSION AND SEDIMENTATION CONTROL MEASURES FOLLOWING STABILIZATION OF ALL DISTURBED AREAS AS APPROVED BY THE ENGINEER AND DPNR. (BY OTHERS)

**GENERAL GRADING AND DRAINAGE NOTES**

- 1. ALL CUT AND FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED.
2. EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT.
3. PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT.
4. CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE INTO PROPOSED CHANNEL.
5. PROPOSED ELEVATIONS ARE SHOWN TO FINISH GRADE UNLESS NOTED OTHERWISE.
6. BACKFILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT TO EXCEED TWELVE INCHES IN THICKNESS AND COMPACTED TO A DENSITY OF 95% OF MAXIMUM DRY DENSITY WITH A MOISTURE CONTENT WITHIN +/- 2% OF OPTIMUM. ALL COMPACTION IS TO BE DETERMINED BY ASTM D1557. TESTING OF BACKFILL MATERIAL SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

**EROSION & SEDIMENT CONTROL NOTES**

- 1. PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR MUST OBTAIN A TRACKING NUMBER FROM THE DEPARTMENT OF ENVIRONMENTAL PROTECTION FOR PURPOSES OF SCHEDULING ON SITE INSPECTIONS. NOTIFICATIONS MUST BE FILED WITH THE VIRGIN ISLANDS DEPARTMENT OF NATURAL RESOURCES (DPNR) SEE EARTH CHANGE PERMIT. THE CONTRACTOR SHOULD REFER TO THE PERMITS REGARDING ALL EROSION CONTROL MATTERS AND SHALL MAINTAIN A COPY ONSITE AT ALL TIMES. THE CONTRACTOR SHALL MAINTAIN ALL OF THE SITE EROSION CONTROL DOCUMENTATION, WEEKLY EROSION INSPECTION REPORTS COMPLETED BY THE DESIGNATED SITE PERSONNEL, AND ANY OTHER PERTINENT SITE DOCUMENTATION FOR A MINIMUM OF 3 YEARS FROM THE DATE OF PROJECT COMPLETION.
2. THE SITE CONSTRUCTION FOREMAN SHALL BE DESIGNATED AS THE ON-SITE PERSONNEL, RESPONSIBLE FOR THE DAILY INSPECTION AND MAINTENANCE OF ALL SEDIMENT AND EROSION CONTROLS AND SHALL IMPLEMENT ALL NECESSARY MEASURES TO CONTROL EROSION AND PREVENT SEDIMENT FROM LEAVING THE SITE.
3. THE CONTRACTOR SHALL INSTALL ALL EROSION AND SEDIMENT CONTROL (ESC) MEASURES AS SHOWN ON THE DESIGN PLANS IN CONSULTATION WITH THE REGULATORY AGENT, AND AS DETERMINED NECESSARY IN THE FIELD BY THE ENGINEER BEFORE ANY CONSTRUCTION ACTIVITIES ARE TO BEGIN. THESE MEASURES SHALL BE CHECKED, MAINTAINED/REPLACED AS NECESSARY DURING THE ENTIRE CONSTRUCTION PERIOD OF THE PROJECT. SUCH MEASURES SHALL REPRESENT THE LIMIT OF WORK. WHERE APPLICABLE, WORKERS SHALL BE INFORMED THAT NO CONSTRUCTION ACTIVITY IS TO OCCUR BEYOND THE LIMIT OF WORK AT ANY TIME THROUGH THE CONSTRUCTION PERIOD.
4. THE CONTRACTOR SHALL PROTECT THE RESOURCE AREA(S) FROM SEDIMENTATION DURING PROJECT CONSTRUCTION UNTIL ACCEPTANCE BY THE OWNER & IN CONFORMANCE WITH THE EARTH CHANGE PERMIT.
5. A CONSTRUCTION ENTRANCE/EXIT SHALL BE STABILIZED, IF NECESSARY, TO REMOVE TRACKING OF DIRT FROM TIRES.
6. THE LIMIT OF ALL CLEARING, GRADING AND DISTURBANCES SHALL BE KEPT TO A MINIMUM WITHIN THE PROPOSED AREA OF CONSTRUCTION. THE CONTRACTOR SHALL PHASE THE SITE WORK IN A MANNER TO MINIMIZE AREAS OF EXPOSED SOIL. IF TREES ARE TO BE CUT ON THE ENTIRE SITE, ONLY THOSE AREAS WHICH ARE ACTIVELY UNDER CONSTRUCTION SHALL BE GRUBBED. THE REQUIRED SEDIMENTATION CONTROL FACILITIES MUST BE PROPERLY ESTABLISHED, CLEARLY VISIBLE AND IN OPERATION PRIOR TO INITIATING ANY LAND CLEARING ACTIVITY AND/OR OTHER CONSTRUCTION RELATED WORK.
7. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MONITOR LOCAL WEATHER REPORTS DURING CONSTRUCTION AND PRIOR TO SCHEDULING EARTHMOVING OR OTHER CONSTRUCTION ACTIVITIES WHICH WILL LEAVE LARGE DISTURBED AREAS UNSTABILIZED. IF INCLEMENT WEATHER IS PREDICTED, THE CONTRACTOR SHALL USE THEIR BEST PROFESSIONAL JUDGEMENT WHEN SCHEDULING CONSTRUCTION ACTIVITIES AND SHALL BE RESPONSIBLE FOR ENSURING THE NECESSARY EROSION CONTROL DEVICES ARE INSTALLED AND FUNCTIONING PROPERLY TO MINIMIZE EROSION FROM ANY IMPENDING WEATHER EVENTS.
8. ESC MEASURES SHALL BE INSPECTED AND MAINTAINED ON A WEEKLY BASIS AND AFTER EACH RAINFALL EVENT OF 0.25 INCH OR GREATER DURING CONSTRUCTION TO ENSURE THAT THE EROSION AND SEDIMENTATION CONTROL MEASURES ARE INTACT AND FUNCTIONING PROPERLY. IDENTIFIED DEFICIENCIES SHALL BE CORRECTED IMMEDIATELY NO LATER THAN 24 HOURS AFTER IDENTIFICATION.
9. SOIL STOCKPILES LEFT OVERNIGHT SHALL BE SURROUNDED ON THEIR PERIMETERS WITH SILT FENCE.
10. DISTURBED AREAS AND SLOPES SHALL NOT BE LEFT UNATTENDED OR EXPOSED FOR EXCESSIVE PERIODS OF TIME. THE CONTRACTOR SHOULD PROVIDE APPROPRIATE STABILIZATION PRACTICES ON ALL DISTURBED AREAS AS SOON AS POSSIBLE BUT NOT MORE THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT AREA HAS TEMPORARILY OR PERMANENTLY CEASED. TEMPORARY AREAS HAVING A SLOPE GREATER THAN 4:1 SHALL BE REINFORCED WITH EROSION BLANKETS OR APPROVED EQUAL UNTIL THE SITE IS PROPERLY STABILIZED.
11. SMALL SEDIMENTATION BASINS MAY BE CONSTRUCTED ON AN AS-NEEDED BASIS DURING CONSTRUCTION TO AID IN THE CAPTURE OF SITE RUNOFF AND SEDIMENT. IT WILL BE THE RESPONSIBILITY OF THE SITE CONTRACTOR, IN CONSULTATION WITH THE ENGINEER, TO SIZE AND CREATE THESE BASINS IN APPROPRIATE LOCATIONS, IF NEEDED.
12. THE CONTRACTOR SHALL CONTAIN ALL SEDIMENT ONSITE. ALL EXITS FROM THE SITE WILL BE SWEEP AS NECESSARY INCLUDING ANY SEDIMENT TRACKING. PAVED AREAS SHALL BE SWEEP AS NEEDED TO REMOVE SEDIMENT AND POTENTIAL POLLUTANTS WHICH MAY ACCUMULATE DURING SITE WORK.
13. ACCUMULATED SEDIMENT SHALL BE REMOVED FROM ALL TEMPORARY PRACTICES AND DISPOSED OF IN A PRE-APPROVED LOCATION BY THE CONTRACTOR AS DIRECTED BY THE ENGINEER.
14. THE CONTRACTOR SHALL PROVIDE ON SITE OR MAKE READILY AVAILABLE THE NECESSARY EQUIPMENT AND SITE PERSONNEL DURING CONSTRUCTION HOURS FOR THE DURATION OF THE PROJECT TO ENSURE ALL ESC DEVICES ARE PROPERLY MAINTAINED AND REPAIRED IN A TIMELY AND RESPONSIBLE MANNER. IF SITE WORK IS SUSPENDED AT ANY TIME THE CONTRACTOR SHALL BE REQUIRED TO PROVIDE PERSONNEL AND EQUIPMENT EITHER ON SITE OR MAKE READILY AVAILABLE TO ENSURE ALL ESC DEVICES ARE PROPERLY MAINTAINED AND REPAIRED IN A TIMELY AND RESPONSIBLE MANNER.
15. PROPER MEASURES SHALL BE IMPLEMENTED BY THE CONTRACTOR IF DEWATERING IS NECESSARY DURING CONSTRUCTION. THESE MEASURES SHALL INCLUDE DEWATERING BAGS, TEMPORARY STRAWBALES, SILT FENCES, SILT SOCKS AND/OR OTHER APPROVED DEVICES. THE DEWATERING SETUP SHALL BE APPROVED BY THE ENGINEER.
16. DUST SHALL BE CONTROLLED BY WATERING OR OTHER APPROVED METHODS AS NECESSARY, OR AS DIRECTED BY THE ENGINEER AT NO EXTRA COST TO THE OWNER.
17. TEMPORARY EROSION CONTROL MEASURES MUST BE REMOVED BY CONTRACTOR ONCE SITE IS FULLY STABILIZED.

**GENERAL PLANTING NOTES: (BY OTHERS)**

- 1. SEASONS FOR PLANTING : FALL / EARLY WINTER (WET SEASON) ; SEPTEMBER 15 THROUGH DECEMBER 31.
2. PLANTING TO BE DONE UNDER SEPARATE LANDSCAPE CONTRACT.
3. FURNISH AND INSTALL ALL PLANTS AS SHOWN ON THE DRAWINGS AND IN THE SIZE AND QUANTITIES SPECIFIED ON THE PLANTING SCHEDULE.
4. CONTRACTOR TO PROVIDE A ONE (1) YEAR GUARANTEE FOR ALL MATERIALS. CONTRACTOR GUARANTEES THAT PLANTS WILL REMAIN HEALTHY FOR ONE (1) GROWING SEASON. CONTRACTOR TO MAINTAIN ALL PLANTING AND SEEDED AREAS UNTIL FINAL PROJECT ACCEPTANCE. GUARANTEE PERIOD TO COMMENCE AT FINAL ACCEPTANCE. ANY REPLACEMENT PLANTS SHALL BE OF THE SAME SIZE AND SPECIES AS SPECIFIED WITH NEW GUARANTEE COMMENCING ON THE DATE OF REPLACEMENT.
5. ALL PLANT MATERIAL SHALL CONFORM, IN ALL RESPECTS, TO THE GUIDELINES OF "THE AMERICAN STANDARD FOR NURSERY STOCK," LATEST EDITION, PUBLISHED BY THE AMERICAN NURSERY & LANDSCAPE ASSOCIATION, INC. AND SHALL HAVE BEEN GROWN UNDER CLIMATIC CONDITIONS SIMILAR TO THOSE IN THE LOCALITY OF THE PROJECT FOR AT LEAST TWO (2) YEARS. ALL PLANTS SHALL BE NURSERY GROWN AND HEALTHY, FREE OF DISEASE, INSECTS, PESTS, EGGS OR LARVAE, AND SHALL HAVE A WELL DEVELOPED ROOT SYSTEM.
6. ALL PLANTS SHALL BE PLANTED WITHIN ONE (1) WEEK OF PURCHASE. IF PLANTS ARE TO BE STORED AT THE SITE PRIOR TO PLANTING, THEY SHALL BE PROPERLY MAINTAINED AND WATERED BY THE CONTRACTOR.
7. ALL PLANT LAYOUT AND ACTUAL PLANTING LOCATIONS ARE TO BE FIELD VERIFIED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING.
8. PLANT SUBSTITUTION SELECTION MUST BE APPROVED BY THE NATURAL RESOURCE CONSERVATION SERVICE (NRCS) OR ENGINEER PRIOR TO INSTALLATION.
9. FOR POTTED PLANTS, REMOVE THE PLANT FROM THE POT AND LOOSEN OR SCORE THE ROOTS BEFORE PLANTING SO THAT THEY MAY GROW OUTWARDS INTO THE SOIL.
10. FOR FIELD GROWN PLANTS, CUT AND REMOVE ANY PLASTIC, CUT AND REMOVE WIRE FROM THE TOP HALF OF ROOTBALL. UNTIE, CUT AND REMOVE BURLAP WRAP FROM AT LEAST THE TOP HALF OF THE ROOTBALL AND TURN DOWN ANY EXTRA BURLAP INTO THE HOLE MAKING SURE TO BURY THE MATERIAL COMPLETELY.
11. ALL PLANT PLUGS SHALL BE PLANTED UPRIGHT AND NOT AT AN ANGLE. PLANTING HOLES SHALL BE DUG LARGE ENOUGH AND DEEP ENOUGH TO ACCOMMODATE THE ENTIRE ROOT MASS. THE PLUGS SHALL BE PLANTED WITH NO TWISTED OR BALLED ROOTS AND SHALL BE PLANTED WITH NO ROOTS EXPOSED ABOVE THE GRADE LINE. THE SOIL SHALL BE HAND PACKED AROUND THE ENTIRE PLUG ROOT MASS.
12. THE PLANTING HOLE IS TO BE DUG THE SAME DEPTH AS THE ROOT BALL AND TWO TO THREE TIMES WIDER. SCORE ALL SIDES OF THE HOLE, PLACE THE PLANT IN THE HOLE SO THE TOP OF ROOT BALL IS EVEN WITH SOIL SURFACE. FILL THE HOLE HALFWAY AND THEN ADD WATER ALLOWING IT TO SEEP INTO BACK FILLED MATERIAL. BE SURE TO REMOVE ALL AIR POCKETS FROM BACK FILLED SOIL. DO NOT SPREAD SOIL ON TOP OF THE ROOTBALL. IF SOIL IS EXTREMELY POOR REPLACE BACK FILL WITH GOOD QUALITY TOP SOIL. AMEND THE SOIL, AS NECESSARY.
13. CREATE A 2" TO 4" BERM AROUND THE EDGE OF PLANTING HOLE WITH REMAINING SOIL TO RETAIN WATER.
14. MULCH ALL PLANTING BEDS AS SHOWN ON DRAWINGS. UNLESS NOTED OTHERWISE, ALL PLANTS TO RECEIVE 2-3 INCHES OF MULCH. DO NOT PILE OR MOUND MULCH AROUND THE PLANT STEMS OR TRUNK.
15. TRIM BROKEN AND DEAD BRANCHES FROM TREES AND SHRUBS AFTER PLANTING. NEVER CUT A LEADER.
16. ALL AREAS THAT ARE DISTURBED AND/OR GRADED DURING CONSTRUCTION ARE TO BE BROUGHT TO FINISHED GRADE AND SEEDED WITH A QUICK GERMINATING GRASS SEED, AS SPECIFIED ON PLANS.
17. AN APPROPRIATE WATERING SCHEDULE SHALL BE ESTABLISHED BY THE CONTRACTOR FOR ALL PLANT MATERIAL BASED UPON PLANT SPECIES REQUIREMENTS AND SHOULD BE FOLLOWED UNTIL PLANTS ARE FULLY ESTABLISHED.
18. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPER PLANT CARE, MAINTENANCE AND WATERING ON SITE UNTIL SUCH TIME AS THE LANDSCAPING IS ACCEPTED BY THE PROPERTY OWNER OR AS DETERMINED BY ANY WRITTEN AGREEMENTS BETWEEN THE CONTRACTOR AND PROPERTY OWNER.

**KEY INSPECTION POINTS**

THE FOLLOWING ARE KEY INSPECTION POINTS DURING THE CONSTRUCTION PROCESS REQUIRING ENGINEER, OWNER, AND/OR AGENCY APPROVAL.

- 1. PRE CONSTRUCTION MEETING WITH DPNR, NRCS, SITE OWNER AND ENGINEER.
2. EROSION AND SEDIMENT CONTROL PRACTICE INSTALLATION AND DEMARCATION OF LIMITS OF DISTURBANCE.
3. COMPLETION OF CLEARING AND SNAGGING/GRUBBING, PER NRCS.
4. COMPLETION OF ROUGH GRADING AND STAKEOUT OF CHANNEL.
5. COMPACTION OF FILL AND FINE CHANNEL GRADING.
6. CONFIRM KEY ELEVATIONS OF CONSTRUCTED BOULDER STEP POOLS.
7. CONFIRM SIDE SLOPE GRADING PRIOR TO STABILIZATION.
8. COMPLETED STABILIZATION OF SIDE SLOPES AND DISTURBED AREAS WITH SEED MIX AND COIR FABRIC.
9. FENCE INSTALLATION, PER NRCS.
10. FINAL CONSTRUCTION CLOSEOUT.
11. LANDSCAPE PLANTING ( BY OTHERS).
12. LANDSCAPE CLOSEOUT (BY OTHERS).

Revisions table with columns: No., Date, By, Description. Includes a grid for tracking design review stages.

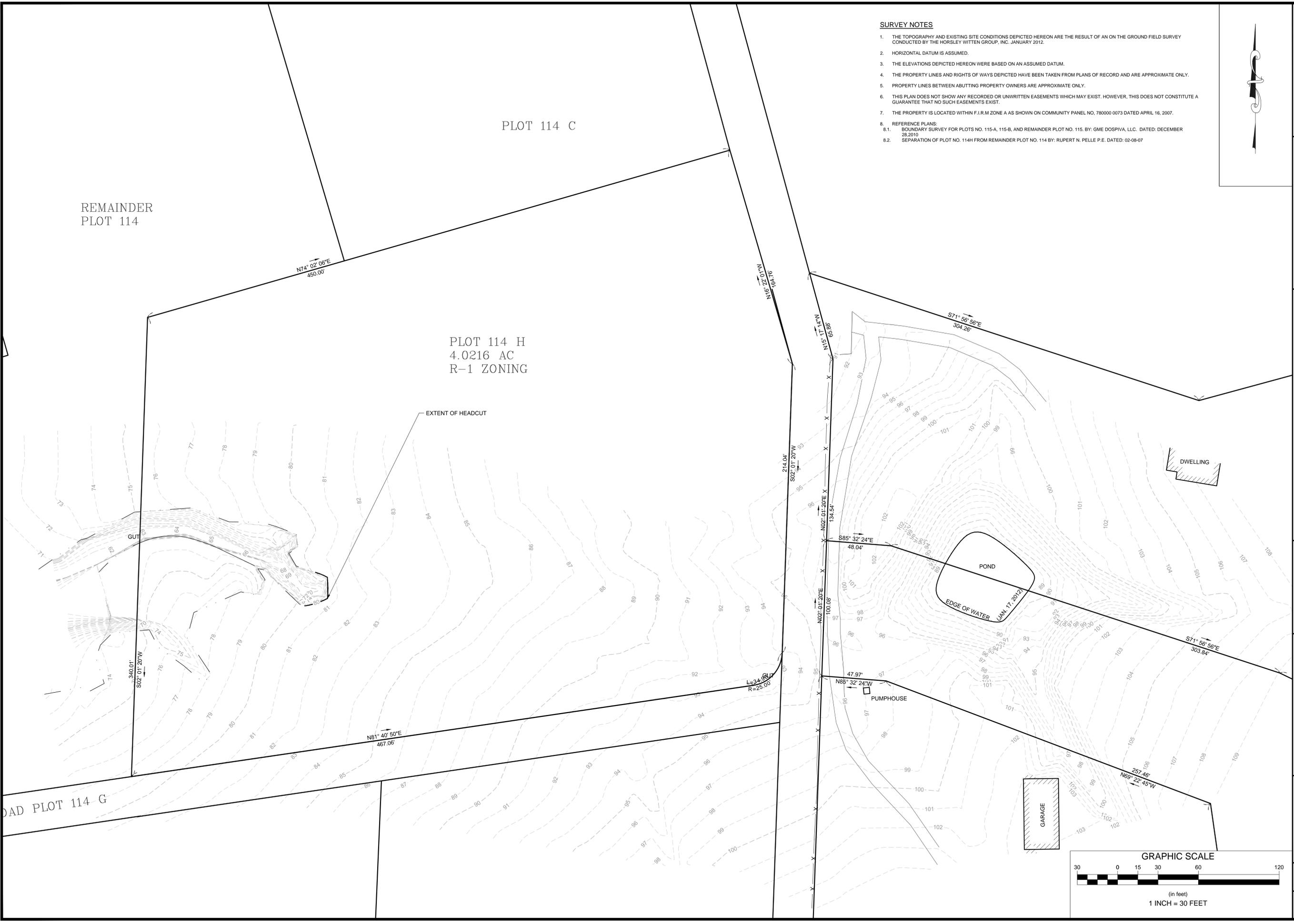
Project information including: Plan Site: GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI CONSTRUCTION PLANS; Date: JULY 11, 2016; Designed By: KMH; Checked By: ACKRAC.

Client and contractor information: Prepared For: Green Cay Farm LLP; Survey Provided By: Horsley Witten Group, Inc. Includes contact details for both parties.

Professional Engineer registration information for Kristopher M. Houle, No. 689-TE, State of the U.S. Virgin Islands.

Project and sheet identification: Project Number: 15130; Sheet: 2 of 5; Sheet Number: C-2.

last modified: 07/15/16 printed: 07/15/16 by gg H:\Projects\2015\15130 NFWF Green Cay Gut\Drawings\15130-ex.dwg



**SURVEY NOTES**

1. THE TOPOGRAPHY AND EXISTING SITE CONDITIONS DEPICTED HEREON ARE THE RESULT OF AN ON THE GROUND FIELD SURVEY CONDUCTED BY THE HORSLEY WITTEN GROUP, INC. JANUARY 2012.
2. HORIZONTAL DATUM IS ASSUMED.
3. THE ELEVATIONS DEPICTED HEREON WERE BASED ON AN ASSUMED DATUM.
4. THE PROPERTY LINES AND RIGHTS OF WAYS DEPICTED HAVE BEEN TAKEN FROM PLANS OF RECORD AND ARE APPROXIMATE ONLY.
5. PROPERTY LINES BETWEEN ADJUTING PROPERTY OWNERS ARE APPROXIMATE ONLY.
6. THIS PLAN DOES NOT SHOW ANY RECORDED OR UNWRITTEN EASEMENTS WHICH MAY EXIST. HOWEVER, THIS DOES NOT CONSTITUTE A GUARANTEE THAT NO SUCH EASEMENTS EXIST.
7. THE PROPERTY IS LOCATED WITHIN F.I.R.M ZONE A AS SHOWN ON COMMUNITY PANEL NO. 780000 0073 DATED APRIL 16, 2007.
8. REFERENCE PLANS:
  - 8.1. BOUNDARY SURVEY FOR PLOTS NO. 115-A, 115-B, AND REMAINDER PLOT NO. 115. BY: GME DOSPIVA, LLC. DATED: DECEMBER 28, 2010
  - 8.2. SEPARATION OF PLOT NO. 114H FROM REMAINDER PLOT NO. 114 BY: RUPERT N. PELLE P.E. DATED: 02-08-07



Revisions	Date	By	Appr. Description
1	07/15/16	KMH	ACK FINAL DESIGN REVIEW

**Horsley Witten Group, Inc.**  
Sustainable Environmental Solutions  
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100 State Street, Suite 200  
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508-833-3150 fax

Checked By: JCR/ROC  
Drawn By: DWW  
Designed By: ...  
Date: JULY 11, 2016

Plan Set:  
**GREEN CAY GUT HEADCUT REPAIR  
EAST END, ST. CROIX, VI  
CONSTRUCTION PLANS**

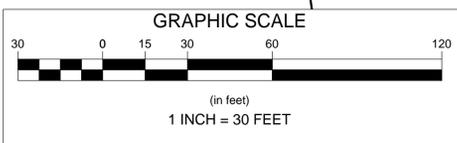
Plan Title:  
**EXISTING CONDITIONS**

Prepared For:  
**Green Cay Farm LLP**  
3034 Estate Green Cay  
Christiansburg, VI 01820  
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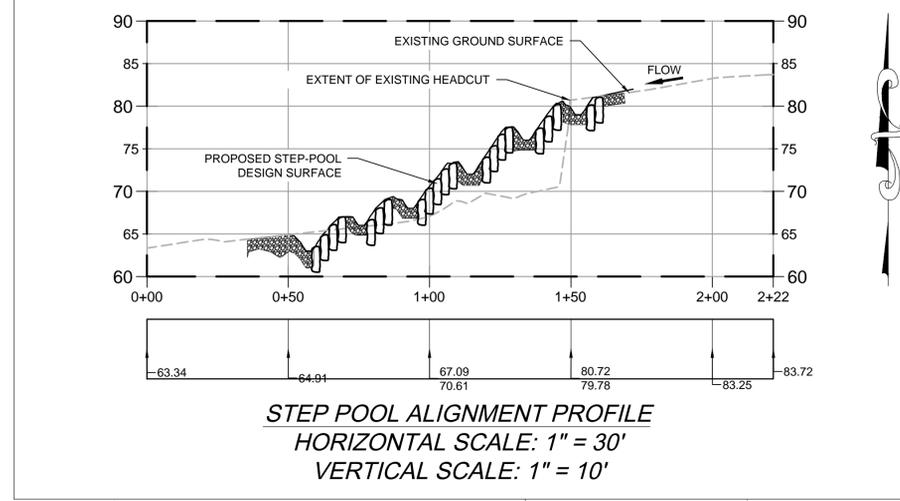
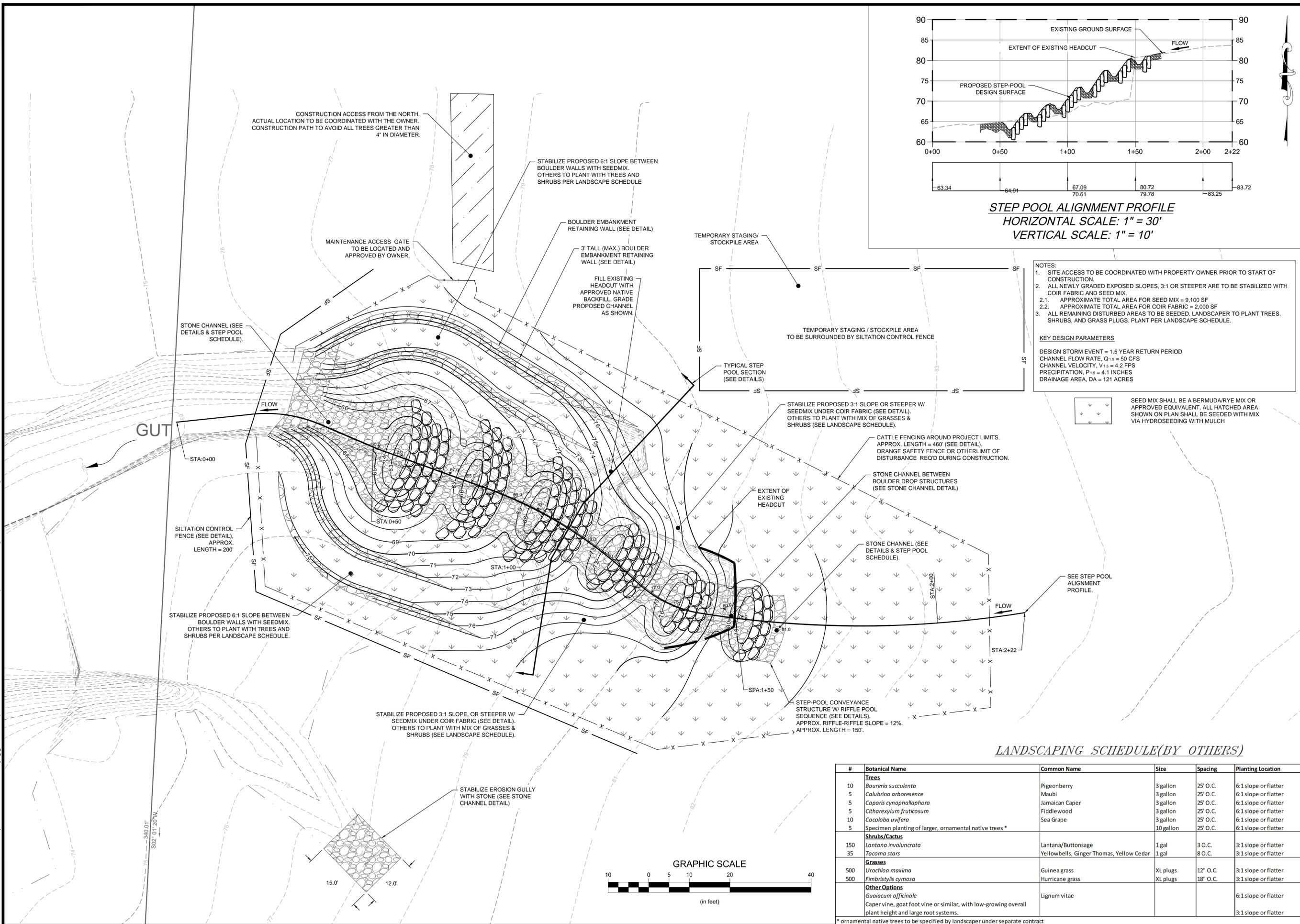
Survey Provided By:  
**Horsley Witten Group, Inc.**  
90 Route 6A  
Sandwich, MA 02563  
Phone: (508) 833-6600  
Fax: (508) 833-3150  
Dated: January 18, 2012



Project Number: 15130  
Sheet: 3 of 5  
Sheet Number: C-3



last modified: 07/15/16 printed: 07/15/16 by gg H:\Projects\2015\15130 NFWF Green Cay Gut\Drawings\15130-GD.dwg



**NOTES:**

- SITE ACCESS TO BE COORDINATED WITH PROPERTY OWNER PRIOR TO START OF CONSTRUCTION.
- ALL NEWLY GRADED EXPOSED SLOPES, 3:1 OR STEEPER ARE TO BE STABILIZED WITH COIR FABRIC AND SEED MIX.
  - APPROXIMATE TOTAL AREA FOR SEED MIX = 9,100 SF
  - APPROXIMATE TOTAL AREA FOR COIR FABRIC = 2,000 SF
- ALL REMAINING DISTURBED AREAS TO BE SEED. LANDSCAPER TO PLANT TREES, SHRUBS, AND GRASS PLUGS. PLANT PER LANDSCAPE SCHEDULE.

**KEY DESIGN PARAMETERS**

DESIGN STORM EVENT = 1.5 YEAR RETURN PERIOD  
 CHANNEL FLOW RATE, Q<sub>1.5</sub> = 50 CFS  
 CHANNEL VELOCITY, V<sub>1.5</sub> = 4.2 FPS  
 PRECIPITATION, P<sub>1.5</sub> = 4.1 INCHES  
 DRAINAGE AREA, DA = 121 ACRES

SEED MIX SHALL BE A BERMUDA/RYE MIX OR APPROVED EQUIVALENT. ALL HATCHED AREA SHOWN ON PLAN SHALL BE SEED WITH MIX VIA HYDROSEEDING WITH MULCH

**LANDSCAPING SCHEDULE(BY OTHERS)**

#	Botanical Name	Common Name	Size	Spacing	Planting Location
<b>Trees</b>					
10	<i>Boureria succulenta</i>	Pigeonberry	3 gallon	25' O.C.	6:1 slope or flatter
5	<i>Calubrina arborea</i>	Maubi	3 gallon	25' O.C.	6:1 slope or flatter
5	<i>Coparis cynophallophora</i>	Jamaican Caper	3 gallon	25' O.C.	6:1 slope or flatter
5	<i>Citharexylum fruticosum</i>	Fiddlewood	3 gallon	25' O.C.	6:1 slope or flatter
10	<i>Coccoloba uvifera</i>	Sea Grape	3 gallon	25' O.C.	6:1 slope or flatter
5	Specimen planting of larger, ornamental native trees *				
<b>Shrubs/Cactus</b>					
150	<i>Lantana involucrata</i>	Lantana/Buttonsage	1 gal	3 O.C.	3:1 slope or flatter
35	<i>Tacoma stars</i>	Yellowbells, Ginger Thomas, Yellow Cedar	1 gal	8 O.C.	3:1 slope or flatter
<b>Grasses</b>					
500	<i>Urochloa maxima</i>	Guinea grass	XL plugs	12" O.C.	3:1 slope or flatter
500	<i>Fimbristylis cymosa</i>	Hurricane grass	XL plugs	18" O.C.	3:1 slope or flatter
<b>Other Options</b>					
	<i>Guaicum officinale</i>	Lignum vitae			6:1 slope or flatter
	Caper vine, goat foot vine or similar, with low-growing overall plant height and large root systems.				
	3:1 slope or flatter				

\* ornamental native trees to be specified by landscaper under separate contract

**Revisions**

Rev.	Date	By	Appr.	Description
1	07/15/16	KMH	ACK	FINAL DESIGN REVIEW

**Horsley Witten Group, Inc.**  
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Checked By: ACK/RAC  
 Design By: KMH  
 Date: JULY 11, 2016

Plan Set: **GREEN CAY GUT HEADCUT REPAIR**  
**EAST END, ST. CROIX, VI**  
**CONSTRUCTION PLANS**

Prepared For: **Green Cay Farm LLP**  
 5024 Estate Green Cay  
 Christiansburg, VI 00820  
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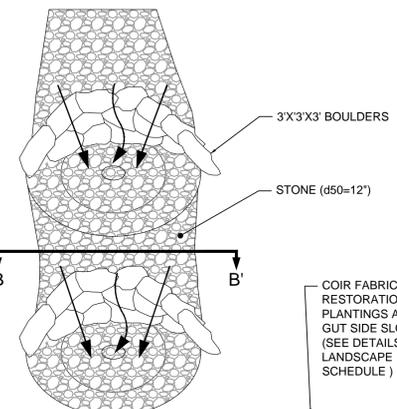
Survey Provided By: **Horsley Witten Group, Inc.**  
 90 Route 6A  
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 Date: JAN. 18, 2012

Registration: **PROFESSIONAL ENGINEER**  
 KRISTOPHER M. HOULE  
 689-TE

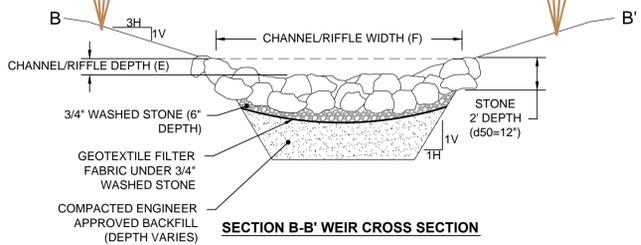
Project Number: **15130** Sheet: **4 of 5**

Sheet Number: **C - 4**

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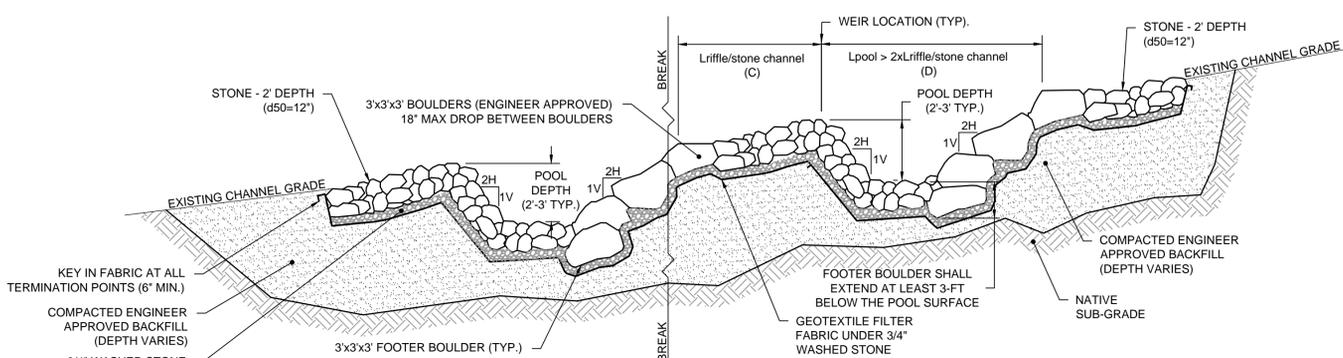


STEP-POOL SEQUENCE (TYPICAL)

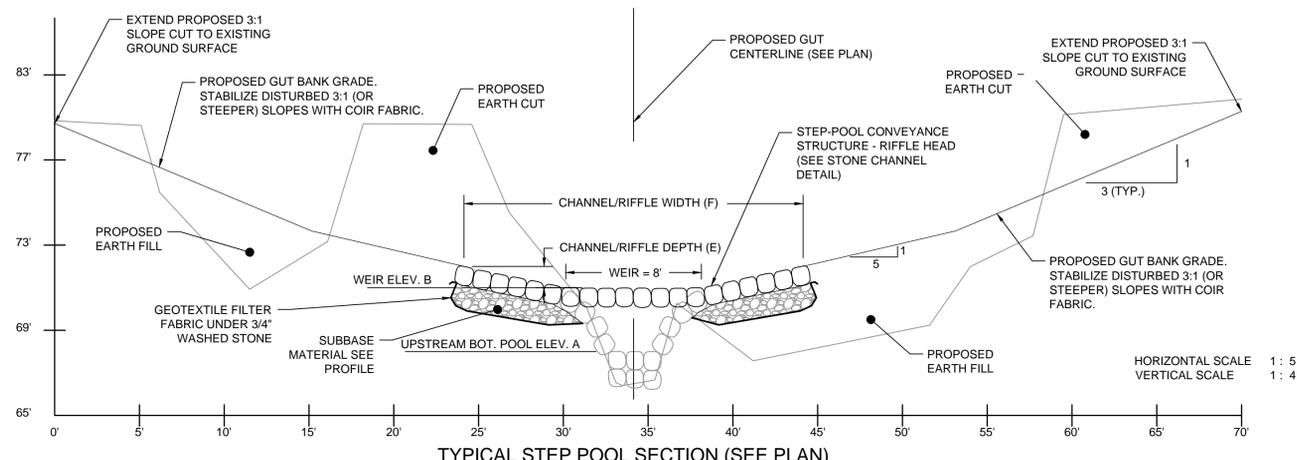


SECTION B-B' WEIR CROSS SECTION

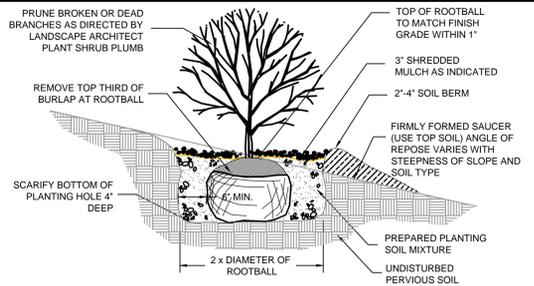
TYPICAL STEP-POOL SEQUENCE DETAIL NOT TO SCALE



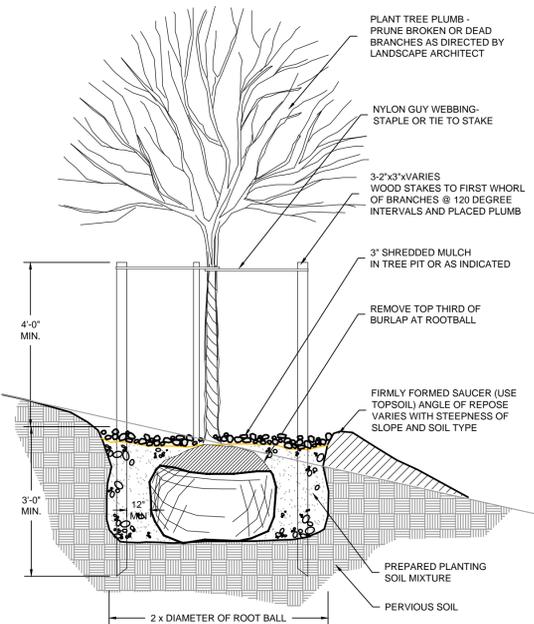
TYPICAL STEP-POOL CONVEYANCE STRUCTURE CROSS SECTION DETAIL NOT TO SCALE



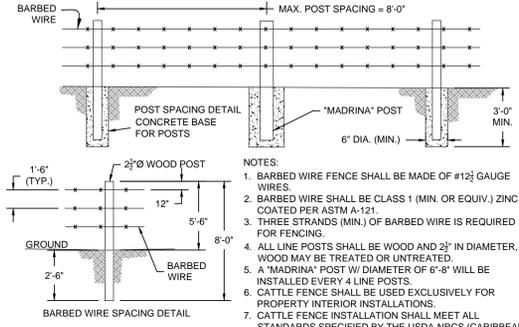
TYPICAL STEP POOL SECTION (SEE PLAN)



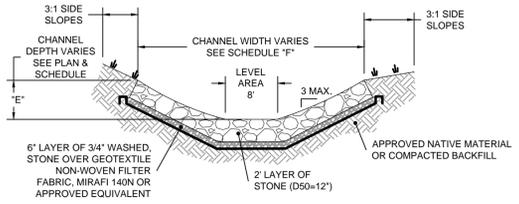
SHRUB PLANTING ON SLOPE DETAIL (BY OTHERS) NOT TO SCALE



TREE PLANTING ON SLOPE DETAIL (BY OTHERS) NOT TO SCALE



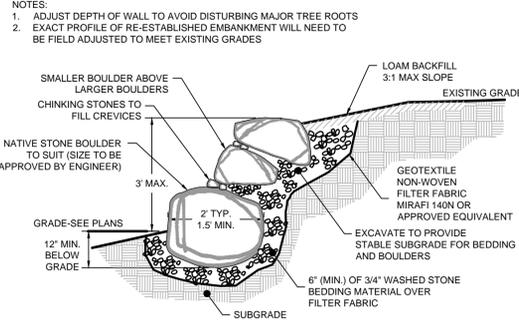
INTERIOR CATTLE FENCING DETAIL NOT TO SCALE



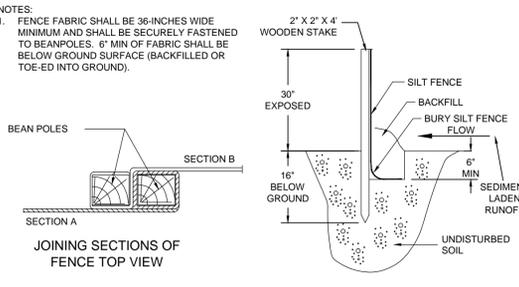
TYPICAL STONE CHANNEL DETAIL NOT TO SCALE

STEP POOL SCHEDULE:							
	ELEV. A	ELEV. B	C	D	E	F	
STA. Number	Upstream Pool Bottom Elevation (ft)	Weir Elevation (ft)	Upstream Pool Depth (ft)	Lrifle/stone channel (ft)	Lpool (ft)	Channel/Rifle Depth (ft)	Channel/Rifle Width (ft)
0+56	62.00	65.00	3.00	12.00	8.00	8.00	25.00
0+73	65.00	67.00	2.00	4.00	8.00	8.00	22.00
0+93	67.00	69.00	2.00	5.00	10.00	8.00	20.00
1+10	71.00	73.00	2.00	3.00	8.00	19.00	11.00
1+31	75.00	77.00	2.00	4.00	8.00	20.00	12.00
1+49	78.00	80.00	2.00	5.00	10.00	20.00	12.00
1+61	81.00	-	-	3.00	-	8.00	16.00

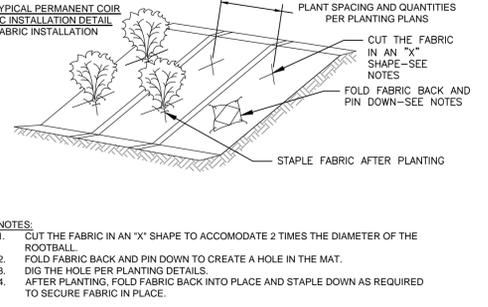
Slope within stone channel will be 3:1  
Rifle @ station 0+96 will be the start of stone channel that meets existing waterway  
Stone channel @ station 1+61 will be the start of step pool conveyance



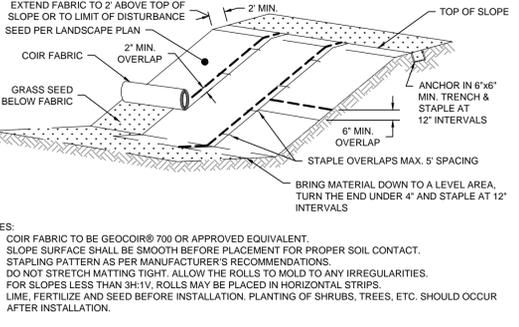
BOULDER RETAINING EMBANKMENT WALL NOT TO SCALE



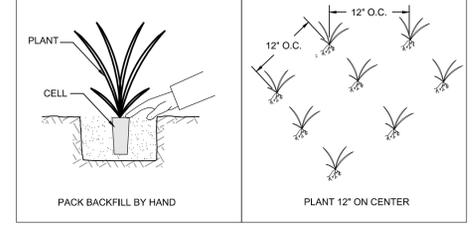
SILTATION CONTROL FENCE NOT TO SCALE



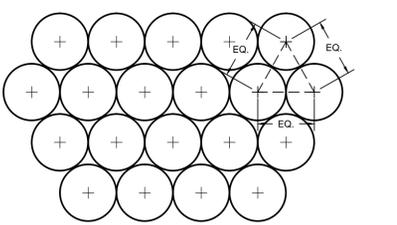
PLANTING IN COIR FABRIC DETAIL (BY OTHERS) NOT TO SCALE



COIR FABRIC INSTALLATION DETAIL NOT TO SCALE



PLUG PLANTING DETAIL (BY OTHERS) NOT TO SCALE



PLANTING SPACING DETAIL (BY OTHERS) NOT TO SCALE

Revisions: 07/15/16 KMH ACK FINAL DESIGN REVIEW

Horsley Witten Group, Inc. Sustainable Environmental Solutions 80 Route 6A Sandwich, MA 02563 508-833-6600 voice 508-833-3150 fax

GREEN CAY GUT HEADCUT REPAIR EAST END, ST. CROIX, VI CONSTRUCTION PLANS

PROFESSIONAL ENGINEER KRISTOPHER M. HOULE 689-TE

Project Number: 15130 Sheet: 5 of 5

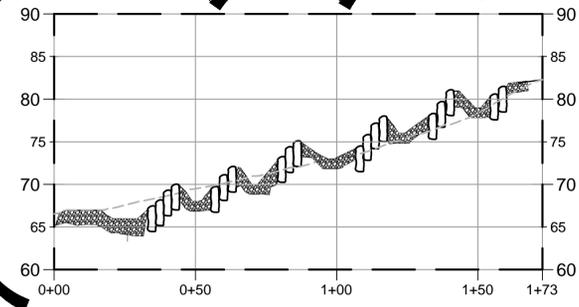
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**STEP POOL SCHEDULE:**

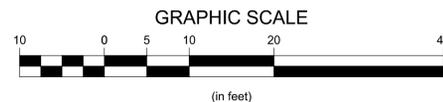
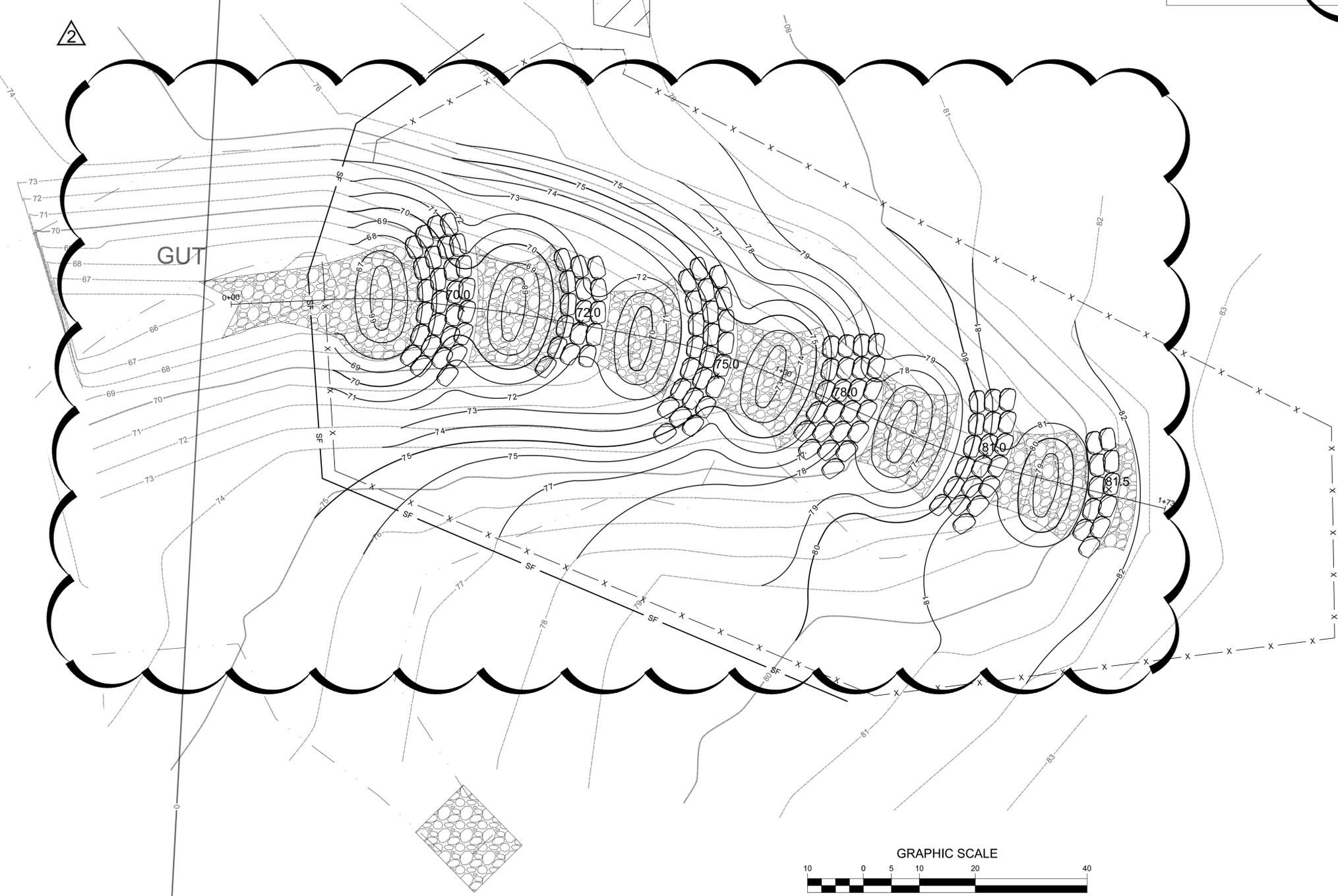
	ELEV. A	ELEV. B		C	D	E	F
STA. Number	Upstream Pool Bottom Elevation (ft)	Weir Elevation (ft)	Upstream Pool Depth (ft)	Lrifle/stone channel (ft)	Lpool (ft)	Channel/Rifle Depth (in)	Channel/Rifle Width (ft)
0+26	66.00	67.00	1.00	12.00	8.00	8.00	25.00
0+50	68.00	70.00	2.00	4.00	8.00	8.00	22.00
0+71	70.00	72.00	2.00	5.00	10.00	8.00	20.00
0+98	73.00	75.00	2.00	3.00	8.00	19.00	11.00
1+23	76.00	78.00	2.00	4.00	8.00	20.00	12.00
1+50	79.00	81.00	2.00	5.00	10.00	20.00	12.00
1+64	82.00	*	*	3.00	*	8.00	16.00

Slope within stone channel will be 3:1  
 Rifle @ station 0+26 will be the start of stone channel that meets existing waterway  
 Stone channel @ station 1+73 will be the start of step pool conveyance  
 Upstream Pool Depth will not exceed a max height of 3'



**STEP POOL PROFILE PROFILE**  
 HORIZONTAL SCALE: 1" = 10'  
 VERTICAL SCALE: 1" = 3'

- NOTES:
1. REVISED EXISTING TOPOGRAPHY FROM ROB CINTRON ON OCTOBER 10, 2016
  2. PROPOSED EROSION CONTROL TO BE FIELD LOCATED



<p>Revisions</p> <table border="1"> <tr> <th>Rev.</th> <th>Date</th> <th>By</th> <th>Appr.</th> <th>Description</th> </tr> <tr> <td>1</td> <td>07/15/16</td> <td>KMH</td> <td>ACK</td> <td>FINAL DESIGN REVIEW</td> </tr> <tr> <td>2</td> <td>10/10/16</td> <td>SSG</td> <td>RAC</td> <td>STEP POOL REALIGNMENT</td> </tr> </table>		Rev.	Date	By	Appr.	Description	1	07/15/16	KMH	ACK	FINAL DESIGN REVIEW	2	10/10/16	SSG	RAC	STEP POOL REALIGNMENT
Rev.	Date	By	Appr.	Description												
1	07/15/16	KMH	ACK	FINAL DESIGN REVIEW												
2	10/10/16	SSG	RAC	STEP POOL REALIGNMENT												
<p>Horsley Witten Group, Inc.                  Sustainable Environmental Solutions                  90 Route 6A                  Sandwich, MA 02563                  508-833-6600 voice                  508-833-3150 fax</p>																
<p>Prepared For:                  Green Cay Farm LLP                  5024 Estate Green Cay                  Christianssted, VT 00820                  Phone: ...                  Fax: ...</p>	<p>Checked By:                  ACK/RAC</p>															
<p>Survey Provided By:                  Horsley Witten Group, Inc.                  90 Route 6A                  Sandwich, MA 02563                  Phone: (508) 833-6600                  Fax: (508) 833-3150                  Dated: JAN. 18, 2012</p>	<p>Designed By:                  KMH</p>															
<p>Project Number: 15130</p>																
<p>Sheet: 4 of 5</p>																
<p>Sheet Number: C - 4</p>																

Plan Site:  
**GREEN CAY GUT HEADCUT REPAIR**  
 EAST END, ST. CROIX, VT  
 CONSTRUCTION PLANS

Plan Title:  
**GRADING PLAN**

# **Attachment B**

Geographic Consulting Inc Final Landscape Planting Report

## Summary

Native trees, shrubs and vines were planted along with fast-growing grasses on the banks of the Green Cay Head Cut Repair Project during the week of December 26-30, 2016. A wide variety of native plant material was established to; control soil erosion, stabilize banks and enhance the native forest habitat on site. All plants for this project were grown on St. Croix in Geographic Consulting's native plant nursery. A total of 377 plants were established on the banks. Specifically; 114 trees and shrubs in 1 gallon pots, 214 4" grass plugs, 36 trees and shrubs in 3-gallon pots and 13 native vines. Additional details of the quantities and sizes of all plants appear in Table 1.

**Table 1** Names, sizes and quantities of the plants established at the Green Cay headcut restoration project.

Common Name	Botanical Name	1 gallon	3 gallon
Century Plant	<i>Agave eggersiana</i>	4	3
Pigeon berry	<i>Boureria succulenta</i>	47	9
Jamaican Caper	<i>Capparis cynophallophora</i>	1	0
Fiddlewood	<i>Citharexylum fruticosum</i>	6	3
Geiger Tree	<i>Cordia nitida</i>	21	0
Sea Grape	<i>Cocoloba uvifera</i>	6	0
Orange Manjack	<i>Cordia rickseckeri</i>	7	14
Calabash	<i>Crescentia cujete</i>	5	0
Maidenberry	<i>Crossopetalum rhacoma</i>	0	2
Frangipani	<i>Plumeria alba</i>	0	1
Fish Poison	<i>Piscidia carthagenensis</i>	0	2
Water Mampoo	<i>Pisonia subcordata</i>	0	2
Pink Poui	<i>Tabebuia heterphylla</i>	17	0
<b>SUBTOTAL</b>		<b>114</b>	<b>36</b>
<b>Vines</b>			
Morning glory	<i>Ipomea pes-caprea</i>	5	3
Beach Bean	<i>Canavalea rosea</i>	2	3
<b>SUBTOTAL</b>		<b>7</b>	<b>6</b>
<b>Grasses</b>		<b>4" plugs</b>	
Guinea grass	<i>Urochloa maxima</i>	12	
Foxtail grass	<i>Setaria</i> spp.	50	
Zoysia grass	<i>Zoysia</i> spp.	100	
Hurricane grass		14	
Stiffleaf			
Eustachys grass	<i>Eustachys petraea</i>	33	
Crows foot grass	<i>Dacyloctenium aegyptium</i>	5	
<b>SUBTOTAL</b>		<b>214</b>	

**Grand Total- All sizes, all species**

**377**

### Plant Installation

Native woody plants in one-gallon pots and extra-large grass plugs were established in linear transects on the North and South banks of the stream after construction. A mixture of grasses and native trees, shrubs and, vines was utilized in each transect. Plants were spaced at approximately 6 feet on center within rows. Rows are also spaced approximately 6 feet apart. There are 10 transects in total, oriented along the contour of the sloped banks. The transect locations are depicted in Figure 1. The number of plants in each transect is described in Table 2.

**Table 2** Quantities of plants installed in each of the 10 transects on the Green Cay Gut banks. The Transect locations are indicated in Figure 1.

Transect	No. of plants
N1	33
N2	44
N3	11
N4	9
N5	9
S1	15
S2	13
S3	24
S4	27
S5	33
<b>Total</b>	<b>218</b>

Larger native plants in three-gallon pots were also established at strategic points. The trees were planted by first digging holes with an 18” hydraulic auger mounted on a skid steer. The trees were then hand-planted and back-filled with native soil, in accordance with Best-Management – Practices.

Grasses and native trees, shrubs, vines were selected for this project for three purposes; 1) stabilize newly constructed stream banks, 2) prevent soil erosion and 3) enhance the quality of the native dry forest habitat. The habitat at the start of the project was relatively low quality with low native plant diversity and many exotic species. This project established 163 native plants (including trees, shrubs and vines) from 14 unique genera and two species within the genus *Cordia*.. The green lines in Figure 1 indicate where the grasses were concentrated.

Each native plant provides a particular enhancement to the habitat as a whole. For example, geiger tree, orange manjack, pink poui and agave each flower at different times of the year with blooms that produce abundant nectar for birds and insects. This nectar is a critical food source to native wildlife during the dry season. Pigeonberry and fiddlewood produce copious amounts of juicy, berry-like fruit that are eaten birds and bats. Water mampoo and pink poui flowers are



favorites for hummingbird. Together, these plants increase the native plant diversity of the site and provide enhanced wildlife habitat. In addition to holding soil and enhancing native forest habitat, many of these tree species are also attractive. Eight of the species planted on site are featured in the publication, "Native Trees for Community Forests" for their use as ornamentals in landscaping.

A variety of grasses was also planted. The 214 grass plugs have been effective in mitigating soil erosion. The grasses were installed within the rows described in Table 2, as well as erosion prone portions of the site. Large bunch grasses like guinea grass and stiff leaf Eustachy's grass were planted within the transects with the small trees and vines. Zoysia grass and other species were concentrated in areas most prone to soil erosion (Table 1 describes the quantities of grass plugs planted, by species). In particular, the upland portion of the site on the east side had areas of uneven terrain on relatively steep slopes. We planted the majority of our 4" grass plugs in this area because it could not easily be covered with erosion matting. The location of the grass plugs is depicted in Figure 1 with a broad green line.

### **Plant Descriptions and Benefits**

The trees, shrubs, and vines used in this project are all locally produced, native species. The species were carefully selected for their unique characteristics that make them well suited to restorations of stream banks on the dry east-end of St. Croix. In general, they are all drought tolerant and produce large root systems. The root systems will stabilize the bank into the future, but also ensure the plants are less likely to die during the difficult establishment phase.

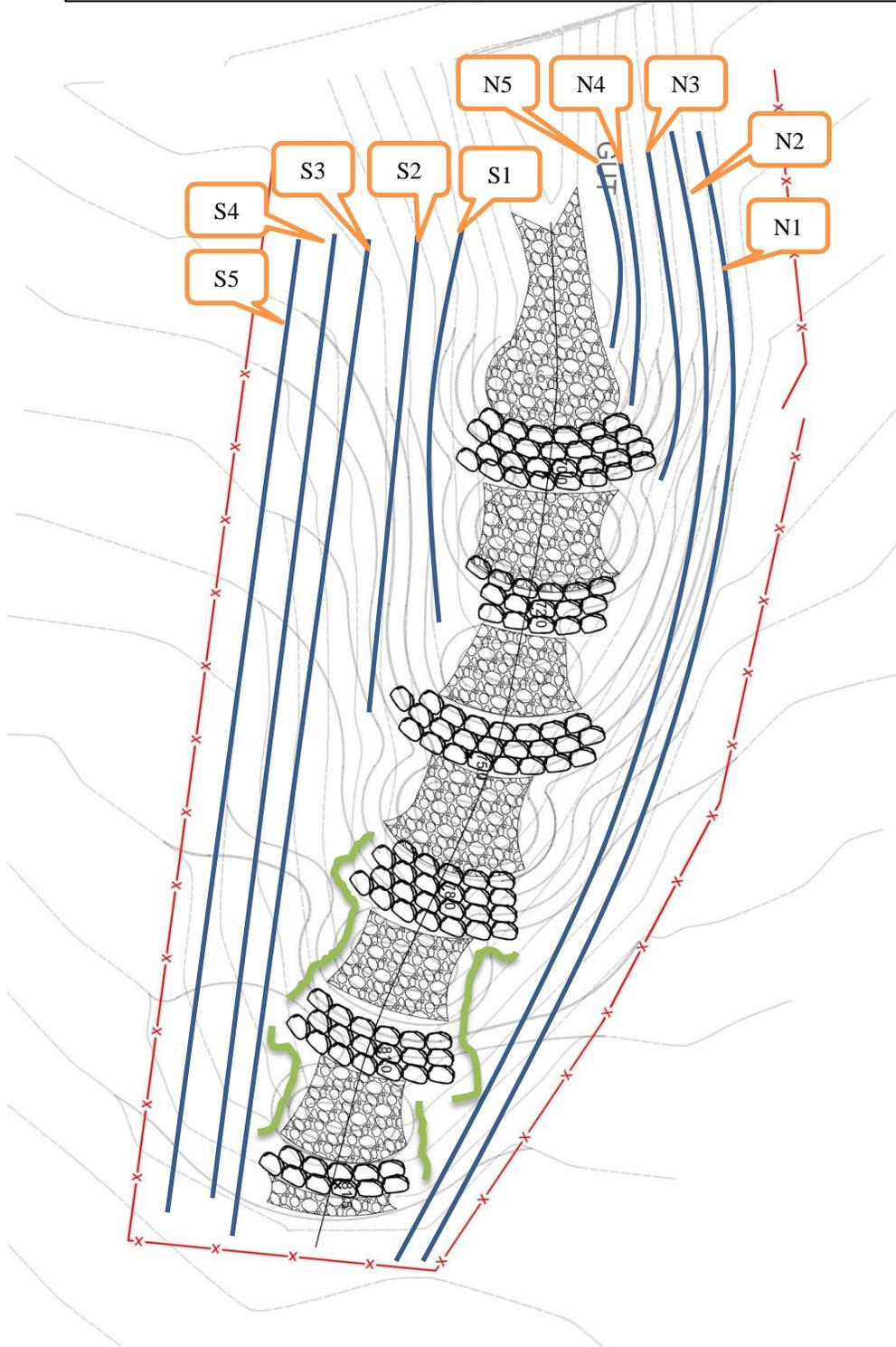
From an ecological perspective, guts or streams have always been a magnet for the flora and fauna of the Virgin Islands dry forest. The gut at this site has not provided quality habitat in many years. This diverse native planting will help return the site to a functioning ecosystem. Table 3 describes some attributes of the featured plants.

**Table 3 Descriptions and benefits of some of the native plants installed at the Green Cay Head Cut Repair Project**

Genus & species	FAMILY	Common name	Description
<i>Agave eggersiana</i>	Asparagaceae	St. Croix Century Plant	The St. Croix agave, or century plant is among St. Croix's rarest and most unique plants and is found nowhere else in the world. The succulent shrub can reach 8 feet across. The century plant's flowers are an essential part of the dry forest, providing large quantities of nectar to countless birds, bats and insects. It has exceptional drought and wind tolerance. Despite the name century plant, it lives only 10 or so years and then produces flowers on a 20 foot spike and dies. This endangered plant is in even greater peril today due to introduced agave weevils. Conservation is essential. <i>6 feet tall</i>
<i>Bourreria succulenta</i>	Boraginaceae	Pigeon berry	One of the most common trees in the dry forests of the Virgin Islands. It produces fruits and flowers throughout the year, and is an abundant food producer, as the name implies. <i>30 feet tall</i>
<i>Canavalea rosea</i>	Fabaceae	Beach bean	A pantropical coastal vine with an attractive flower. The vines can spread to 20 feet long in every direction and is grown into a dense, low mat. Seeds are dispersed by water. <i>3 feet tall, spreading to 40 feet diameter.</i>
<i>Capparis cynophallophora</i>	Capparaceae	Jamaican caper	One of the most beautiful trees in the Virgin Islands. The small flowering tree is becoming a popular ornamental. The crown is naturally compact and the pink blooms are showy. The shiny leaves remain, dark-green and glossy even in severe drought. <i>30 feet tall.</i>
<i>Citharexylum fruticosum</i>	Verbenaceae	Fiddle wood	Another common tropical hardwood tree that is an abundant producer of nectar and fruit throughout the year. <i>40 feet tall.</i>
<i>Coccoloba uvifera</i>	Polygonaceae	Seagrape	The most iconic coastal tree in the Caribbean has exceptional tolerance to drought, wind and salt. The abundant, grape-like fruits are an essential part of the Caribbean coastal habitat. <i>60 feet tall.</i>
<i>Cordia rickseckeri</i>	Boraginaceae	Orange manjack	The tree produces large nectar-rich, orange blooms in the dry season, providing resources for wildlife when they are otherwise scarce. The unique tree is native to only the dry forests of Puerto Rico and the Virgin Islands. <i>25 feet tall.</i>
<i>Cordia sebestena</i>	Boraginaceae	Large leaf geiger	A close relative to the orange manjack that also produces nectar-rich flowers. Geiger's fruit are white and even larger than its cousins' and are a favorite food for bats. <i>25 feet tall.</i>

<i>Crescentia cujete</i>	Bignoniaceae	Calabash	This unusual, attractive native tree produces long-spreading, distinct branches. Flowers are borne directly on the main branches and trunk only and have an unpleasant odor. The large fruit has a hard shell and can grow to a remarkable 16" in diameter. The woody shells are used in local craft making. <i>30 feet tall.</i>
<i>Ipomea pes-caprea</i>	Convolvulaceae	Beach morning glory vine. Goat-foot vine	Another pantropical creeping vine that tolerates salt well enough to grow in beach sand. It produces an enormous root system, and even roots out of nodes in the vine. It does not climb enough to smother other vegetation. Seeds are carried by water, making it likely that lower portions of the gut will be colonized also. <i>3 feet, spreading over 60 feet in diameter.</i>
<i>Piscidia carthagenensis</i>	Fabaceae	Fish poison tree	This often scraggly-looking tree suddenly bursts into beauty when it becomes covered in showy pink flowers. The unusual fruit are ruffled green pods making it recognizable from a great distance. The native Tainos and Carib people used the bark and roots to stupefy fish. <i>45 feet tall.</i>
<i>Pisonia subcordata</i>	Nyctaginaceae	Water mampoo	This common, fast-growing, with smooth bark and large trunk is an attractive ornamental when large. Its habit of growing partially exposed roots give it an almost bonsai look. <i>40 feet tall</i>
<i>Plumeria alba</i>	Apocynaceae	White frangipani	This genus produces the flowers from which the Hawaiian lays are made. This Caribbean species is highly ornamental with long linear leaves clustered at the end of branches. The flowers grow in showy white clusters. <i>20 feet tall</i>
<i>Tabebuia heterophylla</i>	Bignoniaceae	Pink poui	A common hard wood species known for is large, trumpet-shaped pink flowers. It is resistant to wind, salt and drought. Green seed pods open when mature and papery winged seeds are dispersed by the wind. <i>45 feet tall.</i>

**Figure 1. Location and orientation of the 10 transects on which plants were established and Green Cay. Grasses for erosion prevention are depicted in green**





**Table 4 Plant number and species for the large plants installed at Green Cay. These numbers correspond to the numbers in the map in Figure 2.**

Map #	Plant species	Map #2	Plant species2
			Citharexylum
1	Cordia rickseckeri	21	fruticosum
2	Ceiba pentandra	22	Cordia rickseckeri
3	Piscidia carthagenensis	23	Canavalea rosea
4	Piscidia carthagenensis	24	Cordia rickseckeri
5	Bouyeria succulenta	25	Bouyeria succulenta
6	Citharexylum fruticosum	26	Cordia rickseckeri
7	Cordia rickseckeri	27	Cordia rickseckeri
8	Bouyeria succulenta	28	Bouyeria succulenta
9	Pisonia subcordata	29	Cordia rickseckeri
10	Bouyeria succulenta	30	Cordia rickseckeri
11	Bouyeria succulenta	31	Cordia rickseckeri
12	Crossopetalum rhacoma	32	Canavalea rosea
13	Cordia rickseckeri	33	Canavalea rosea
14	Citharexylum fruticosum	34	Cordia rickseckeri
15	Agave eggersiana	35	Bouyeria succulenta
16	Agave eggersiana	36	Agave eggersiana
17	Cordia rickseckeri	37	Bouyeria succulenta
18	Plumeria alba	38	Agave eggersiana
19	Cordia rickseckeri	39	Ipomea pes-caprea
20	Cordia rickseckeri	40	Ipomea pes-caprea
		41	Ipomea pes-caprea
		42	Pisonia subcordata

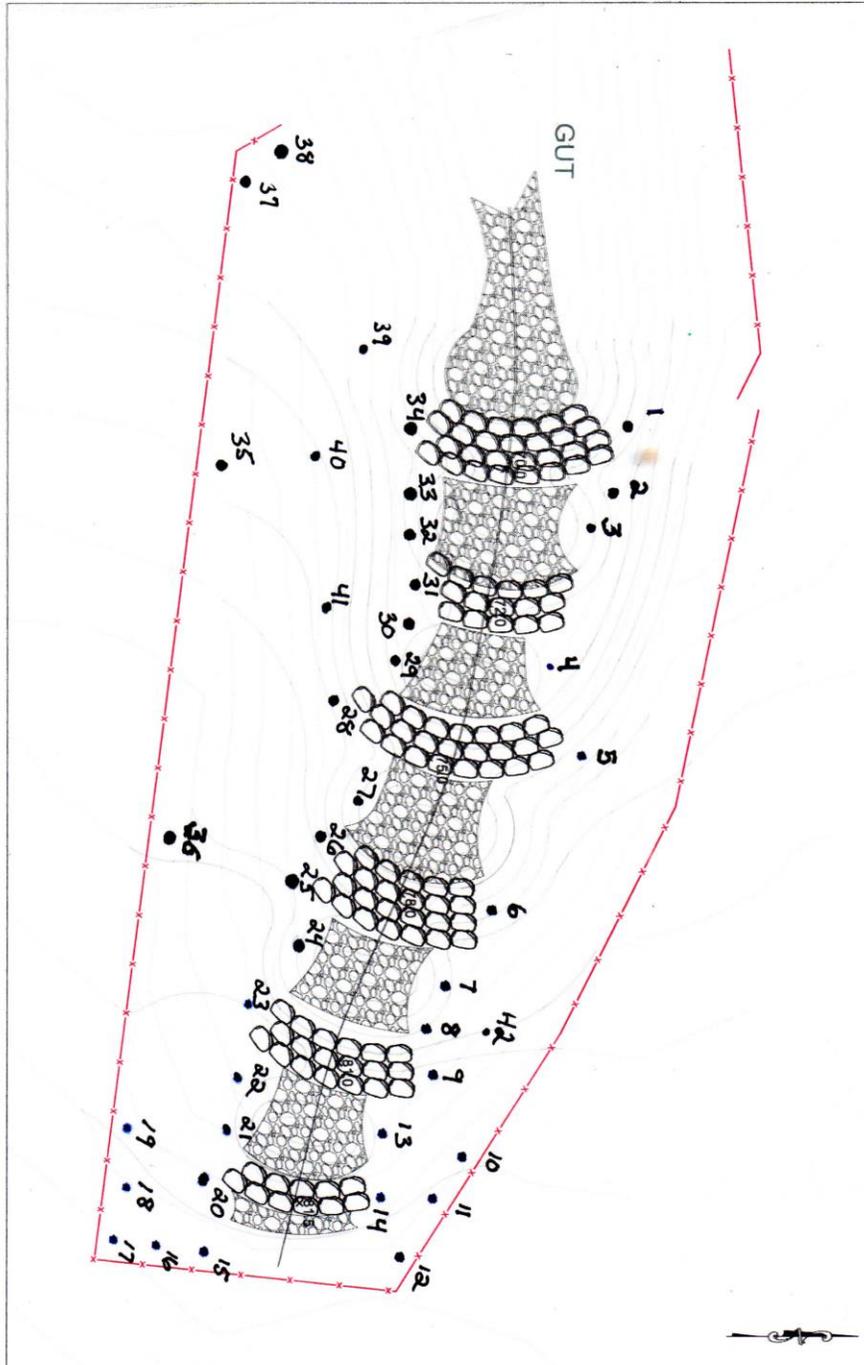


Figure 2 Locations of large plants in 3 gallon pots or greater. The numbers correspond with table 4



## References

- Brandeis, T., E. Helmer, H. Marcano-Vega, and A. Lugo. 2009. Climate shapes the novel plant communities that form after deforestation in Puerto Rico and the U.S. Virgin Islands. *Forest Ecology and Management*. 258. 1704-1718.
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- Jones, K., 1995 Native Trees for Community Forests. St. George Village Botanical Garden of St Croix, Inc. 124 pp