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Introduction

Timberneck Creek is located in Gloucester County, Virginia (Figure 1). It is a long, but narrow creek that empties into the York River. The mouth is a wide embayment, but farther north, the creek narrows to about 400 ft wide and extends for about 2 miles to its marshy headwaters. The interior of the creek is irregular with many very small lateral creeks/marsh drainages emptying into the Timberneck. Timberneck Creek has never been dredged and a federally-defined channel does not exist at the site. As a new dredging project, the channel design must balance safety, economic, and sustainability requirements. The channel also must be wide and deep enough to safely accommodate vessel traffic but not so large as to require excessive dredging or habitat modification (Figure 2).

The Catlett Islands occur at the mouth of Timberneck Creek and display a ridge-and-swale geomorphology. The Islands consist of multiple parallel ridges of forested wetland hammocks, forested upland hammocks, emergent wetlands and tidal creeks surrounded by shallow subtidal areas that once supported beds of submerged aquatic vegetation (Catlett Islands, 2020). The Chesapeake Bay National Estuarine Research Reserve owns most of the islands (460 acres) except for 79 acres on the northern tip adjacent to Cedarbush Creek which is privately owned (Figure 2). The Islands are adjacent to the new State Park. Creek morphology is similar today as it was in 1937 (Figure 3) with Catlett Islands abutting the upland. The Islands have had a low to medium (between -1 and -5 ft per year) erosion rate between 1937 and 2017 (Figure 4) (Hardaway et al, 2020). The interior shorelines of Timberneck have very low erosion rates.

The new Machicomoco State Park occurs adjacent to the west shore of Timberneck Creek and is slated to open during 2021. It covers 644 acres between Timberneck and Cedarbush Creeks. The Park has boat slips for users to access the site. In addition, the public Williams Landing, which is a working waterfront consisting of a public pier and boat ramp, occurs just upriver of the Park on the eastern side of the Creek. The land use of the adjacent uplands is fallow agriculture with narrow tree buffers along the west shoreline, but the eastern side of the Creek is generally more developed with waterfront homes and piers. Creating a defined channel that provides safe access for both recreational and commercial users is needed. The data collected for this project was used to develop the dredging and disposal strategies for the channel.

Channel Condition Survey & Sediment Sampling

Channel Condition Survey/ Base Mapping

The channel condition surveys were performed by licensed surveyors at Waterway Surveys & Engineering, Ltd to determine the depth inside the creek. As this site is not a federally-designated channel and has never been dredged, the survey covered enough area to define the proposed channel both inside and outside the creek, on either side of the proposed channel, inside the creek in the area of the proposed turning basin, and far enough seaward to reach the proposed channel design depth in the natural system. Soundings were taken using a single beam sonar system operating at 208 kilohertz, and a differential global positioning system (DGPS) was used to obtain horizontal positions.

Coordinates were taken in US survey feet and referred to the Virginia State Plane coordinate system south zone based on NAD83 (Figure 5). Sounding were taken in April and May 2020 in feet and referred to mean lower low water (MLLW). MLLW, National Tidal Epoch of 1983-2001, was determined by the National Ocean Service (NOS) at Timberneck. The mean tide range is 2.67 ft based on NOS observations.

Survey points were imported to Esri ArcMap, and a vector-based triangular irregular networks (TIN) surface was created. A TIN is a representation of a continuous surface consisting entirely of triangular facets. The vertices of these triangles are created from field recorded spot elevations from the bathymetric survey. From the TIN, a digital elevation model (DEM) was created. A DEM is a 3D computer graphics model of elevation data to represent terrain. In this case, the raster DEM grid size was 5 ft and uses colors to represent the bathymetry (Figure 6). The DEM shows the proximity of the main York River channel at Timberneck. Within about 3,000 ft of its mouth, depths increase to at least -35 ft. The DEM can be used to calculate the amount of material that will be removed during dredging by assigning the channel grids to the desired dredge depth and determining the difference between the existing bathymetry and channel DEMs.

Sediment Sampling – Physical and Chemical

A geotechnical analysis provides a sediment profile through direct sampling and testing studies of the in-situ benthic material. Eight 10-foot vibracores were taken by Athena Technologies, Inc. in the channel (Figure 7). The cores were photographed (Appendix A), logged (Appendix B), and sampled by VIMS to provide the types, configuration, and geotechnical character of the subbottom soils present. Grain size analysis included percent gravel, sand, silt, and clay as well as a detailed representation of the sand portion using the Rapid Sediment Analyzer (RSA) settling tube (Appendix C). Percent moisture also was determined.

The Evaluation of Dredged Material Proposed for Discharge in the Waters of the U.S. – Testing Manual was developed as a joint effort by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (EPA&USACE, 1998) and is referred to as the "Inland Testing Manual (ITM)." The purpose of the manual was to "establish procedures applicable to the evaluation of potential contaminant-related environmental impacts associated with the discharge of dredged materials in inland waters, near coastal waters and surrounding environs." The ITM was primarily developed to establish testing protocols associated with the disposal of dredged material discharges associated with navigation dredging.

The ITM utilizes a tiered approach to determining test requirements for dredged material disposal. There are four tiers: Tier I is an evaluation based on existing information; Tier II includes a chemical evaluation of identified contaminants of concern; Tier III is associated with general toxicity and bioaccumulation tests; and Tier IV provides for project specific toxicity and bioaccumulation tests.

The development of testing requirements always starts with a Tier I evaluation which is an analysis based on existing information. The evaluation can be based on previously collected physical, chemical or biological data; physical sediment characteristics (ie. is the material comprised of sand, gravel or inert materials); or if the dredged material is associated with known sources of contamination. If there is no available chemical data at the dredging site, but the material is a sandy or inert material or there are no known sources of contamination or contaminant pathways to the dredging site, then there is "no reason to believe" that the disposal of the dredged material would have an adverse impact at the disposal site. Once it has been determined that there is "no reason to believe," then the dredged material passes the Tier I and no additional evaluation is required. If, however, there is "reason to believe" that there is the potential for contaminants to exist at the dredging site, then a Tier II evaluation would be initiated. The "contaminants of concern" must be identified and a then a sampling plan should be designed to address the concentration of those specific contaminants in the site sediment and water. The results of the Tier II evaluation determine the need for evaluation at higher tiers. If the dredging site passes a Tier I evaluation, the only other time that chemical testing may be required is for disposal of dredged material into a regulated area such as a landfill.

However, because this creek has a high percentage of fines and the material will likely go to a confined upland disposal area, two samples were collected from Timberneck Creek in the York River for chemical testing – one at an up-creek location and one at a down-creek location (Figure 7). A grab sampler was used for data collection. The grab sampler was thoroughly cleaned before samples were extracted by rinsing in water, with any excess debris scrubbed off with a brush. Once retrieved with sediment inside, the grab sampler was set on the side of the boat to allow any excess water to drain. The closed grab sampler was then positioned on the side of the boat with the mouth of the sampler hanging over the edge, to prevent the sediment from coming in contact with the surface of the boat and potentially contaminating the sample. Sediment was scooped into sterile glass containers of various sizes provided by *Enthalpy Analytical* using a stainless-steel spoon. Samples were then placed in coolers below 43^{o}F and taken to *Enthalpy Analytical* the following day.

The samples were then tested for a variety of different chemicals, toxins, and metals. Table 1 illustrates what each sample was analyzed for, as well as potential sources. The results are shown in Appendix D, but both sample locations had none of the contaminants in quantities larger than the limits of the tests used.

Table 1. A list of chemicals and metals tested in samples taken from Timberneck Creek as well as their possible source

Analysis:	Source:
MTBEX*	fuel component for gasoline engines
TCLP Silver	Industrial use
TCLP Mercury	Industrial use
TCLP Arsenic	Industrial use
TCLP Lead	Industrial use
TCLP Barium	Industrial use
TCLP Selenium	Industrial use
TCLP Cadmium	Industrial use
TCLP Chromium	Industrial use
PCB**	Commercial electrical equipment
TCLP Predetermination SVOC***	Occurs naturally/Industrial use
TCLP Pest	Industrial use
TCLP Herb	Industrial use
Semi-Volatile Hydrocarbons as TPH Diesel Range Organics****	Compounds in diesel fuel
Organochlorine Pesticides and PCB’s as Aroclor	Pesticides in agriculture
TCLP Organochlorine Herbicides	Pesticides in agriculture/plant removal
TCLP Organochlorine Pesticides and PCB’s	Pesticides in agriculture

Note: TCLP stands for “Toxicity Characteristic Leaching Procedure”
*MTBEX refers to methyl tert-butyl ether (MtBE) which is the analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX)
**PCB refers to polychlorinated biphenyls, a harmful and highly toxic industrial compound
***SVOC refers to Semi Volatile Organic Compounds
****TPH refers to Total Petroleum Hydrocarbons

Benthic and Fisheries Assessment

Timberneck Creek is a small lateral tidal creek located in the mesohaline section of the York River. Salinity ranges from about 11 to 25 ppt (Catlett Islands, 2020) and is relatively stable, with typical daily changes of less than 5 psu (practical salinity units) at a given location (Schaffner et al., 2001). Freshwater flow is from the Pamunkey and Mattaponi Rivers but is relatively low overall, with the York receiving only about 6% of the freshwater entering the Chesapeake Bay from the watershed each year.

Major subtidal benthic habitats in the York River include soft mud and sand bottoms, with only limited distribution of submerged aquatic vegetation and oyster shell (Gillett & Schaffner, 2009). Major taxonomic groups of macrofauna dominating muds and sands include annelids, mollusks and crustaceans. Meiofaunal assemblages of the York’s soft bottoms are dominated by nematodes and copepods. Species distribution patterns are strongly correlated with salinity and bottom type (Gillett & Schaffner, 2009). The benthic communities around the Bay have been assessed using the Index of Biological Integrity. This index ranks the relative value of bottom communities around Chesapeake Bay by comparing values of key benthic community attributes (“metrics”) to reference values expected under non-degraded conditions in similar habitat types. It is therefore a measure of deviation from reference conditions. Overall, the York River has poor ecosystem health (D+) in 2019. It had an overall improvement in health from 2018 particularly in benthic community and water clarity but had decreases in SAV. In 2019, the York River was classified as good, 60 to <80, on the IBI scale (EcoHealth, 2019).

Cores and augers taken for this project included the top benthic horizon. Through ongoing visual assessment, no macroscopic benthic species were noted. This might include various species of polychaetae worms and small clams. This does not mean the benthic community is void but just not sampled by the cores. Despite their relatively small size, macro and meiobenthos are important components of the estuarine ecosystem, serving as critical links between the variety of organic matter sources in estuaries (e.g., phytoplankton, benthic micro- and macroalgae, detritus) and the economically, ecological, and recreationally important finfish and crustaceans that live there (Cicchetti, 1998). Baird & Ulanowicz (1989) estimated that approximately 50% of the fish production in Chesapeake Bay is directly linked to a benthic food web.

The York River system is home to a diversity of fish species, some are year-round residents and others use the river during a particular season or life stage (Hewitt et al., 2009). More than 130 species of fish have been observed in the York. These species include top predators such as sharks, as well as plankton feeders such as bay anchovies. The diversity represented by fish fauna includes members of the shad and herring family, drums, flatfishes, temperate basses, catfishes, sharks, skates, rays, and numerous smaller fishes that serve as forage such as bay anchovy, Atlantic menhaden, and killifish. Historically, fisheries for blue crabs, American shad, striped bass, and Atlantic sturgeon thrived in the Chesapeake Bay region but in recent times, and with the exception of striped bass, these fisheries have declined (Hewitt et al., 2009). Fishes in the York have varying life history patterns, from fast growing species such as alewife, to slow growing, late maturing species such as Atlantic sturgeon. The young of many species use the York River system as a nursery area and depend on the high productivity of this estuary for conferring fast growth and high survival during the first year of life. However, areas of SAV are needed for settlement and protection, but Timberneck Creek had no submerged aquatic vegetation (SAV) within the proposed channel (SAV, 2020) between 2014 and 2019.

Blue crabs are important fisheries in the York and are especially abundant in its shallow areas. Crabs enter a state of low to no activity in the winter, and they often bury in muddy sediments in deeper water during this period (Hewitt et al., 2009). Habitat alterations that result in loss of water quality or quantity may decrease recruitment of young fishes through direct effects on young-of-the-year fish survival, or through disruption of spawning activity (e.g., dam construction, and water withdrawals that affect salinity and flow). Though dredging Timberneck will impact the benthic environment, it may also allow an improvement in Creek water quality with less constricted flows from creek to river. In particular, Timberneck Creek has restricted harvesting for shellfish due to water quality impairments (Figure 8). The area shown in red is completely restricted, and the area shown in green is seasonally condemned between April and October. By deepening the channel area, oxygen concentration in the channel may be higher because of the increase in flushing in the tidal cycle of the channel.

Dredging impacts to fisheries is a concern that has been evaluated and researched by the Corps over the years. Motile forms of biota should be able to avoid the dredging operation; as such, most fish will not be impacted. The main potential impact is by entrainment of the species in the hydraulic dredging operation itself. The proposed project would result in the temporary destruction of marine habitat and the associated benthos in the channel. For oysters, larval stage impacts have been reported. However, after dredging, repopulation of benthic organisms within the dredging will begin quickly (Newell et al., 1998). In estuaries, communities are well adapted to rapid recolonization of deposits because they are typically subject to frequent natural disturbances. Rates of recovery vary from 6-8 months in estuarine muds, possibly 2-3 in sand and gravel habitats.

Sometimes permitting agencies will invoke a time of year (TOY) restriction on dredging when these species are migrating and/or overwintering. In addition, deeper dredging projects at a site will limit the frequency and duration of impacts over time because additional cycles of dredging may not be needed. In general, this project will not cause long-term adverse effects on the surrounding ecosystem. Any effects on the environment should be minimal and be offset by the project benefits of maintaining safe navigation and commerce.

Local private oyster leases occur inside the creek (Figure 9). Outside the creek, the outbound channel crosses both private leases and public grounds. The owners of these private leases will need to be contacted during the permitting process as the proposed dredging will affect their property. Presently, the leases impacted are 18779, 21306, 14075, and 10117. The present owners are individuals and a seafood company. The issue of dredging in public grounds must also be addressed. As a county project, it may not require General Assembly approval; however, the Virginia Marine Resources Commission (VMRC) would make that determination during the permitting process.

Channel Design and Disposal Strategy

Channel Design

When designing the channel at Timberneck, the federally-defined 80 ft wide, 6 ft deep Aberdeen Creek channel located several miles away and also in Gloucester County was used as guidance. Aberdeen Creek also has a turning basin adjacent to its working waterfront. The proposed Timberneck channel is 80 ft wide with 2:1 side slopes, starts at the -8 ft MLLW depth contour on the York River end of the channel, extends 7,200 ft into the creek, and has a 160 ft wide turning basin at Williams Landing.

A channel needs to be at least 6 ft deep so that a buoy-tender can access the site to set and/or maintain aids to navigation (ATONs). At Timberneck Creek, to create a -6 ft MLLW channel and 1 ft of overdepth, approximately **46,300 cy** of material will need to be hydraulically dredged and disposed of (Figure 10). Where the material needs to be dredged from in the channel varies. The calculated DEM depicts the amounts using color. Sections of the channel that require more dredging are shown in red. Sections of the channel where less material needs to be removed are shown in green. Areas deeper than -7 ft MLLW are shown in white because no material needs to be dredged in that section of channel. If dredged to -7 ft, material will have to be removed from the entire channel except for about 500 ft on the most outbound portion.

Typical channel cross-sections depict the change from existing bottom that will occur due to dredging (Figure 11). Each cross-section looks up-creek. Timberneck's natural channel is about 4-5 ft deep. The deepest sections are at Profile A which crosses the proposed turning basin at the William's public landing and at Profile D which occurs where the creek just begins to widen out into the embayment adjacent to Catlett Islands. Also, the channel area adjacent to the boat slips at Machicomico State Park is naturally deep. The shallowest area is Profile B which is about 3.5 ft deep in the proposed channel. Sediment analysis of cores taken in the channel show that much of the material is too fine to be utilized for shoreline beneficial use (Figure 12). All of the material dredged is silt and clay. Cores TC-01 and TC-02 are located closest to the York River (Figure 7). They are slightly sandier than the cores inside the creek that are close to 100% silt and clay.

Two other scenarios were modeled for the proposed Timberneck channel. Should the county seek to pursue a less expensive option, a -5 ft MLLW channel with a 1 ft overdepth would require only about **26,400 cy** of material to be removed. This option reduces both the dredging cost per volume and reduces the footprint needed for a disposal area; however, it is important to note that this channel depth would not resolve the issues cited by the U.S. Coast Guard regarding navigability for a buoy tender and the ATONs could ultimately be decommissioned. If the proposed channel is dredged to -7 ft MLLW with a 1 ft overdepth (total 8 ft dredge cut), the amount of material that will need to be removed is **67,700 cy**, with all of it being silt and clay. This option requires a much larger confined upland disposal site for the silt and clay material that would be dredged.

Disposal Strategy

No potential disposal area has been identified immediately adjacent to Timberneck Creek. However, the proximity of Timberneck Creek to Aberdeen Creek, just 4.5 miles upriver, provides opportunities for dredge material disposal on public land. The Virginia Department of Conservation and Recreation (DCR), Division of State Parks owns property adjacent to Aberdeen Creek (Figure 13). The property was originally purchased to be used as the Middle Peninsula State Park. However, land between Timberneck and Cedarbush Creeks has since been acquired and is being developed into Machicomico State Park. DCR has stated that construction of a containment dyke and placement of dredged material at Machicomico is currently not an option. However, as the DCR property adjacent to Aberdeen is not developed, they are willing to consider utilizing a portion of the property adjacent to Aberdeen to be used as an upland disposal area. Hydraulically-dredged material could be pumped upriver from Timberneck to the Aberdeen placement site.

Three alternatives are suggested for disposal at the DCR property. The first alternative is a conventional confined disposal site created using onsite materials. Containment dikes are used to retain water borne sediments, hydraulic fills and other fills. To provide a storage facility for spoil or other soil materials, it is common practice to first construct a containment dike around the extremity of the area to be filled. The function of the containment dike is to prevent loss of the fill into the surrounding environment. A conventional dike can be constructed by removing trees and excavating material uniformly over the site. This produces material for the exterior dike and provides additional capacity in the "bowl" that is dug. Also, the excavation is shallow so that there is no issue with groundwater. Combining material from Aberdeen, Timberneck and possibly Cedarbush creeks and constructing one large placement area could provide a long-term plan to handle future maintenance dredging events. Also, a larger area will allow the dredged material to dry between dredging events and the dried material can be used to raise the dikes. A conventional disposal area, shown in yellow, would cover about 30 acres (Figure 13).

The other two alternatives use Geotube® units to construct the dike with dredge material as fill (Figure 14). Geotube® is a registered trademark of TenCate Geosynthetics. The tubes come in various sizes, weights, and filtering ability and can be placed into a wide variety of configurations. Typically, they are filled with dredge material to create the dike on the outside of the disposal area and additional material can be placed inside the dike. For the confined disposal site at the DCR property, Geotubes® that are 5 ft tall with a 25 ft circumference and a 10 ft filled width can be stacked along the perimeter of the site to create the dike (Figure 15). Each tube is filled with about 3.8 cy/ft which amounts to 11 cy/ft for all three tubes. If it is possible to create a separate holding area within the placement area for the sandier dredged material, that sediment has the potential for beneficial reuse as foundations for trails, walking paths, etc. In this case, additional Geotubes® could be added to create two inside walls that keep the sandy material in a separate corner of the placement area.

The second alternative is a small placement area, shown in pink on Figure 13. It has a perimeter of about 2,160 ft and covers 5.7 acres. Based on 3.8 cy/ft per tube, the 3-bag configuration will hold about 23,700 cy of material. Additional material can be placed inside the smaller Geotube® confinement area. Inside the confinement area, up to 45,600 cy of additional material can be placed with a 4 ft lift (sediment depth) and 2 ft swell (ponding). The site can be used for placement of dredge material in the future. Once the material inside the confinement area dries, it can be dug up and removed to a landfill or used as upland fill elsewhere. In addition, the Geotubes® themselves can be chopped up and removed to the landfill if desired. However, this area is not large enough for both Aberdeen and Timberneck to use as a disposal area.

The third alternative is the larger placement area shown in orange on Figure 13 which could accommodate dredge material from Aberdeen, Timberneck, and Cedarbush, another channel analyzed for proposed dredging. Based on possible dredging scenarios modeled for this project, the maximum amount of material that could be dredged from all three channels totals about 197,000 (59,000 cy Aberdeen, 68,000 cy Timberneck, 70,000 cy Cedarbush). The larger placement area has a perimeter of 4,000 ft and covers about 18 acres. The 3-bag configuration of Geotubes® would hold about 44,000 cy of material. Any of those three creeks could be dredged first to have enough material to fill the bags using the -7 ft MLLW scenario, but Aberdeen has the sandier material which is better for filling the bags and could be dredged first.

It may be advantageous to create a separate holding area within the placement area that separates sandy dredged material that may have beneficial reuse potential for upland uses such as foundations for trails, walking paths, etc. from the muddy dredge material. In this case, additional Geotubes® could be added to create two inside walls that keep the sandy material in a separate corner of the placement area.

Total Dredge Volume, -5 ft MLLW with 1 ft overdepth: 26,400 cy
Volume need to be placed in Geotubes®: 44,000 cy
This scenario could not be used to fill the bags in the large upland placement model.

Total Dredge Volume, -6 ft MLLW with 1 ft overdepth: 46,300 cy
Volume Placed in Geotubes: 44,000 cy
Volume Placed within Geotube confinement area: 2,300 cy

Total Dredge Volume, -7 ft MLLW with 1 ft overdepth: 67,700 cy
Volume Placed in Geotubes®: 44,000 cy
Volume Placed within Geotube® confinement area: 23,700 cy

Because these channel dredging projects are a priority for Gloucester County, the third alternative with Geotubes and larger placement area is the preferred option. It provides longer-term dredge disposal options for these three creeks that occur on the mid-York River. The -6 ft MLLW with 1 ft overdepth (total dredge depth -7 ft MLLW) is the preferred dredging option because deepening the channel by a foot increases the amount of dredge material by about 1/3 increasing the project cost. Until there is justification for the increase, such as the dredged channel filling quickly impeding its use, the shallower channel is recommended. In addition, the -6 ft depth is needed if ATONs will be placed on the channel. These alternatives are laid out in the Joint Permit Application (Appendix E).

Because the upland disposal site is located on DCR property, Gloucester County will need to work with the state to determine and resolve maintenance issues at the site. Maintenance could include installing access pathways and mowing of vegetation on the site. Once the material inside the confinement area dries, it can be dug up and removed to a landfill or used as upland fill elsewhere. In addition, the Geotubes® themselves can be chopped up and removed to the landfill if desired.

Another potential use for the material from Timberneck has been proposed. In discussions with CBNERR, the reserve managers are interested in a demonstration site on Catlett. In addition to eroding from wave action along its margins, Catlett is losing marsh as it is converted to non-vegetated wetlands and open water due to sea level rise. At the identified area, the marsh grasses have nearly completely disappeared. CBNERR is interested in a layering demonstration project. The 5.5-acre site would be surrounded by low Geotubes® about 2 ft high (Figure 16). These would be filled with dredge material. Approximately 6-8 inches of dredge material would be placed inside the perimeter made by the Geotubes®. The idea is to raise the sediment to allow natural marsh vegetation to take hold. Though this is a beneficial use and the CBNERR managers would like to have a demonstration site, certain issues make this a challenging project. NOAA is the agency in charge of the Research Reserves, and CBNERR needs to obtain permission before embarking on a demonstration project. Permitting is another issue because the project would involve covering 5.5 acres of vegetated and non-vegetated wetlands. The demonstration project also would add to the overall cost of the dredging. The Geotubes® and sediment layering will only take a small portion of the dredge material from Timberneck Creek. Adding it as a second disposal site would increase to the time and effort during dredging growing the overall cost. If these issues can be resolved, this is a great opportunity for a demonstration project that provides a beneficial use of dredge material to reduce the Chesapeake Bay's loss of marsh.

DCR Statement of Approved Land Use for Dredge Material Disposal

DCR recognizes the public need for dredging in Gloucester County, especially Aberdeen Creek and Timberneck Creek which are adjacent to DCR owned State Parks. Over a multi-month period covering late Summer and Fall of 2020, DCR staff including Tom Smith, DCR Deputy Director of Operations; Melissa Baker, Virginia State Parks Director; Ann Zahn Tidewater District Manager for the Virginia State Parks; and MPPDC staff met and discussed the history of the Virginia Waterways Management Fund, public need for dredging and the specific assistance needed from DCR with dredge material storage. Consensus was reached on several predicate questions that will drive how, where and under what conditions dredge material placement and storage is agreeable for DCR and Virginia State Parks. The development of the 2021 Middle Peninsula Park Master Plan will be a critical planning document that shall speak to the appropriateness of dredge material storage sites.

As of this report date, DCR staff request that Machicomoco State Park, adjacent to Timberneck Creek be fully left off the table as a potential dredge material storage site. However, if the following conditions can be met to the satisfaction of DCR and Virginia State Parks, the Middle Peninsula State Park site adjacent to Aberdeen Creek has limited areas that could be utilized for dredge material storage:

- Dredge material to be stored at the Middle Peninsula State Park is a significant issue for DCR and must be contaminant free.
    - A chemical/contaminant report on dredge material composition shall be provided to DCR for review prior to any decision on possible material storage location(s).

- Some locations at the Middle Peninsula State Park have significant natural and/or cultural heritage resources.
  - Areas with significant natural and/or cultural heritage resources are not acceptable for material storage at this time (Figure 17).
  - In areas where appropriate and to minimize land disturbance, storage areas can be designed and incorporate products like Geotextile tubes to preserve unknown cultural resources.
- Some locations at the Middle Peninsula State Park will be designated recreational usage areas. An analysis of potential conflicts between recreational use and dredge material storage is needed.
- Based on preliminary information, DCR currently prefers the use of hydraulic piping as the preferred method over trucking, but the final storage location(s) will drive the preferred method of conveyance.
- If the dredge material is of appropriate composition, DCR could benefit from having material for use as trail (foundation) building material.
- DCR understands VIMS and other research institutions are looking at thin layer sediment placement to tidal marshes to enhance coastal resilience. Should this prove effective, meet regulatory requirements and the resources be available, it is one option for possible consideration by DCR.
- DCR may have future dredging needs at Timberneck Creek, but at this time cannot speak to the need and/or the willingness to partner with an applicant to include DCR dredging needs as part of a dredging project.

Cost

Estimated costs were provided by Waterway Surveys & Engineering and TenCate Geosynthetics Americas. The project cost has $700,000 included for mobilization/demobilization so there would be significant savings if the other shallow water draft channels on the York River, Aberdeen and Cedarbush creeks, were combined with the Timberneck dredging project (Table 2). Dredging a shallower channel does not produce a large cost-savings because most of the cost is in mobilization and demobilization. In addition, dredging deeper will increase the useful life of the project, but this has to be balanced with the increase in dredge spoil that would have to be disposed of.

Table 2. Estimated cost for select dredging scenarios at Timberneck Creek. Estimates provided by Waterway Surveys & Engineering.

Creek	Dredge Scenario	Volume (cy)	Mob/Demob	Dredging	Cost
Timberneck	-5 ft MLLW with 1 ft overdredge	26,400	$700,000	$237,600	$937,600
	-6 ft MLLW with 1 ft overdredge	46,300	$700,000	$393,550	$1,093,550
	-7 ft MLLW with 1 ft overdredge	67,700	$700,000	$541,600	$1,241,600

Dredging Mobilization includes all costs for operations accomplished prior to commencement of actual dredging operations. This includes as a minimum the following:

- Transfer of dredge and attendant plant, booster pumps, bulldozers and other like equipment and machinery for site work;
- All initial installation of pipe, if required; and
- All costs for any other associated work that is necessary in advance of the actual dredging operations.

Dredging Demobilization includes general preparation for transfer of plant to its home base, removal of pipelines, cleanup of site of work areas, and transfer of plant to its home base.

Because no location exists adjacent to Timberneck Creek for a confined upland disposal area, the material will have to be pumped upriver to a site on DCR property adjacent to Aberdeen Creek. Disposal costs have been determined for a conventional disposal area as well as a Geotube® disposal area. Combining disposal options for Aberdeen, Timberneck and possibly Cedarbush and constructing one large placement area could provide a long-term plan to handle future maintenance dredging events. A larger area will allow the dredged material to dry between dredging events and the dried material can be used to raise the dikes. A conventional disposal area would cover about 30 acres and cost about $1.2 million to construct as determined by Waterway Surveys & Engineering. The cost includes logging the site and preparing it for the dike. Dike material is dug on-site. Material can be excavated uniformly over the site to produce material for dikes and provide additional capacity in the "bowl" that is dug. Excavation is shallow to reduce groundwater issues.

Table 3. Proposed cost of creating a Geotube upland disposal area on DCR property adjacent to Aberdeen Creek. Costs ($/cy) provided by TenCate Geosynthetics.

Item	Cost/cy	Total Cost
mob/demob	1	$60,000
Site prep		?
Dewater	3	$180,000
Polymer	3	$180,000
Geotube Units	8	$480,000
	Total Cost	**$900,000**

The cost for the preferred disposal area created with Geotubes® is shown in Table 3. The base quantity for estimating costs for the disposal area is 60,000 cy. This material will be used to create a 2:1 Geotube® (2 on the bottom, 1 on top) pyramid perimeter dike 3,700 linear feet long will be created. The free capacity inside the dike is expected to contain 155,000 cy of dredge material. This provides the space for dredge material from Aberdeen, Timberneck and possibly Cedarbush. Logging and other site preparation is not included in the estimate. The area needed for this disposal area is about 18 acres.

Useful Life Estimates

Estimating the useful life of the dredge project is difficult for Timberneck. No data exists because the channel has not previously been dredged. During dredging, the cut of the bottom material should be sufficient to allow slope material to slough off (or cave) to the natural underwater shape of the bottom without encroaching the desired channel dimensions. However, some slumping of the dredge channel side slopes may occur over time causing infilling of the channel. Overall, shoaling within the channel is not linear; it starts fairly quickly after dredging but slows over time as the channel reaches equilibrium.

At Timberneck, post-dredging sedimentation may occur in the same manner as Aberdeen Creek, which has a history of dredging. Sediment is transported along the shoreline and nearshore zone in the York River such that sands may accrete at the creek mouth and in the outbound channel from the York River. However, shoreline hardening up and downriver has reduced the amount of sediment in the York River littoral system which may reduce post-dredging sedimentation rates overall. Inside the creek, the dredge channel will likely fill in with fines brought in by tidal flow and from upland sources. Overall, a rough estimate of useful life of this project is 5-10 years.

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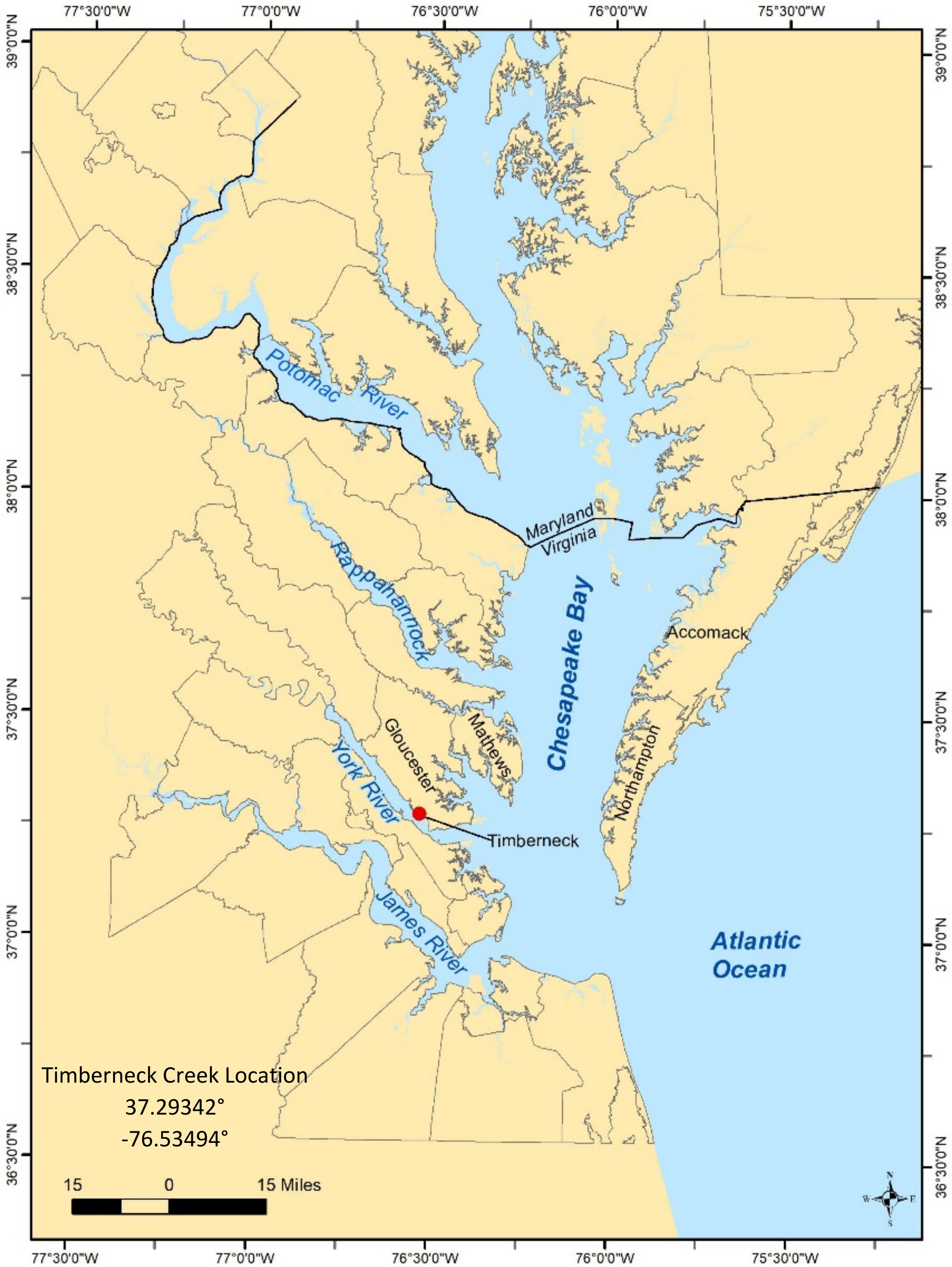


Figure 1. Location of Timberneck Creek within the Chesapeake Bay estuarine system.

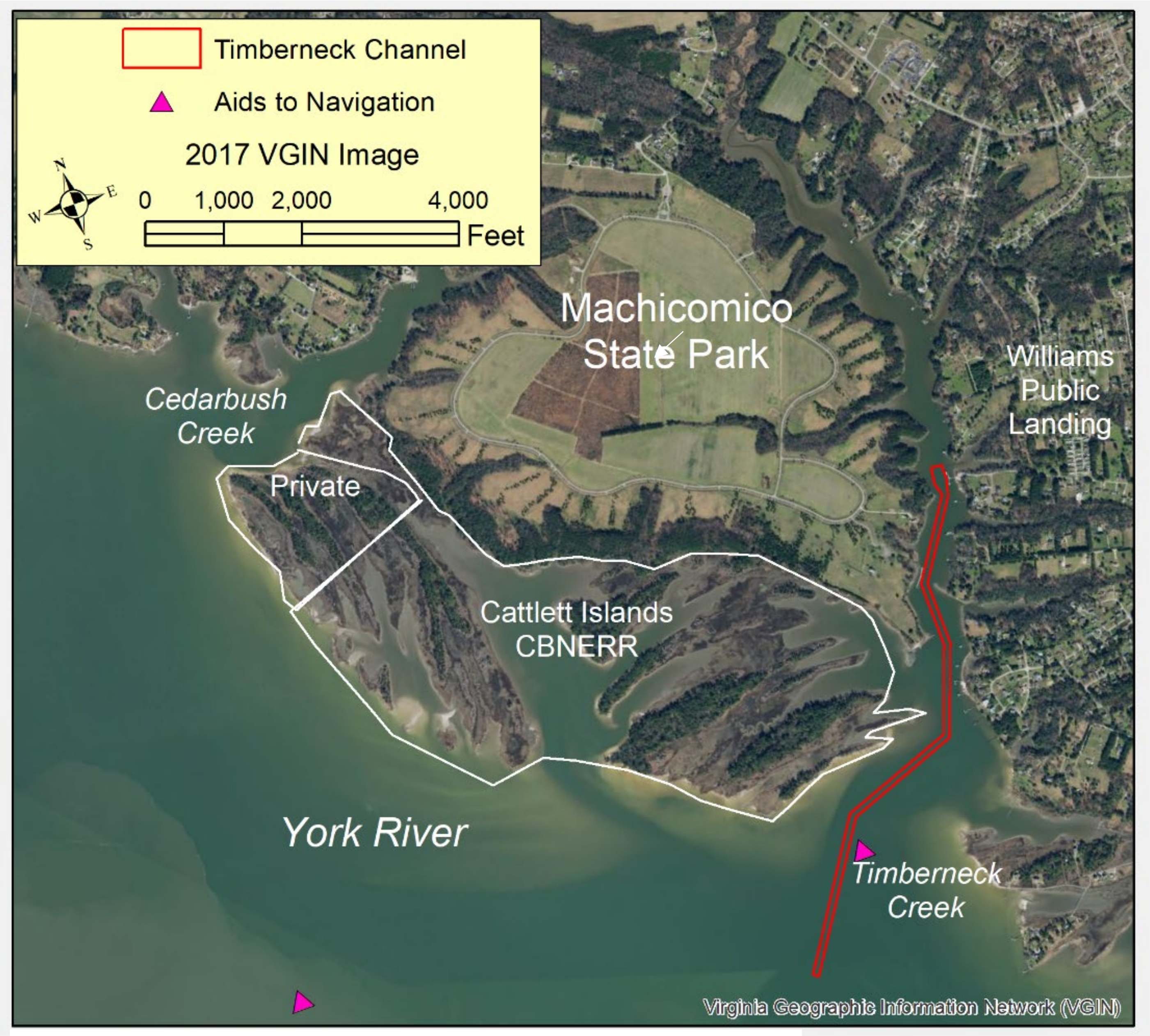


Figure 2. Proposed Timberneck Creek Channel.

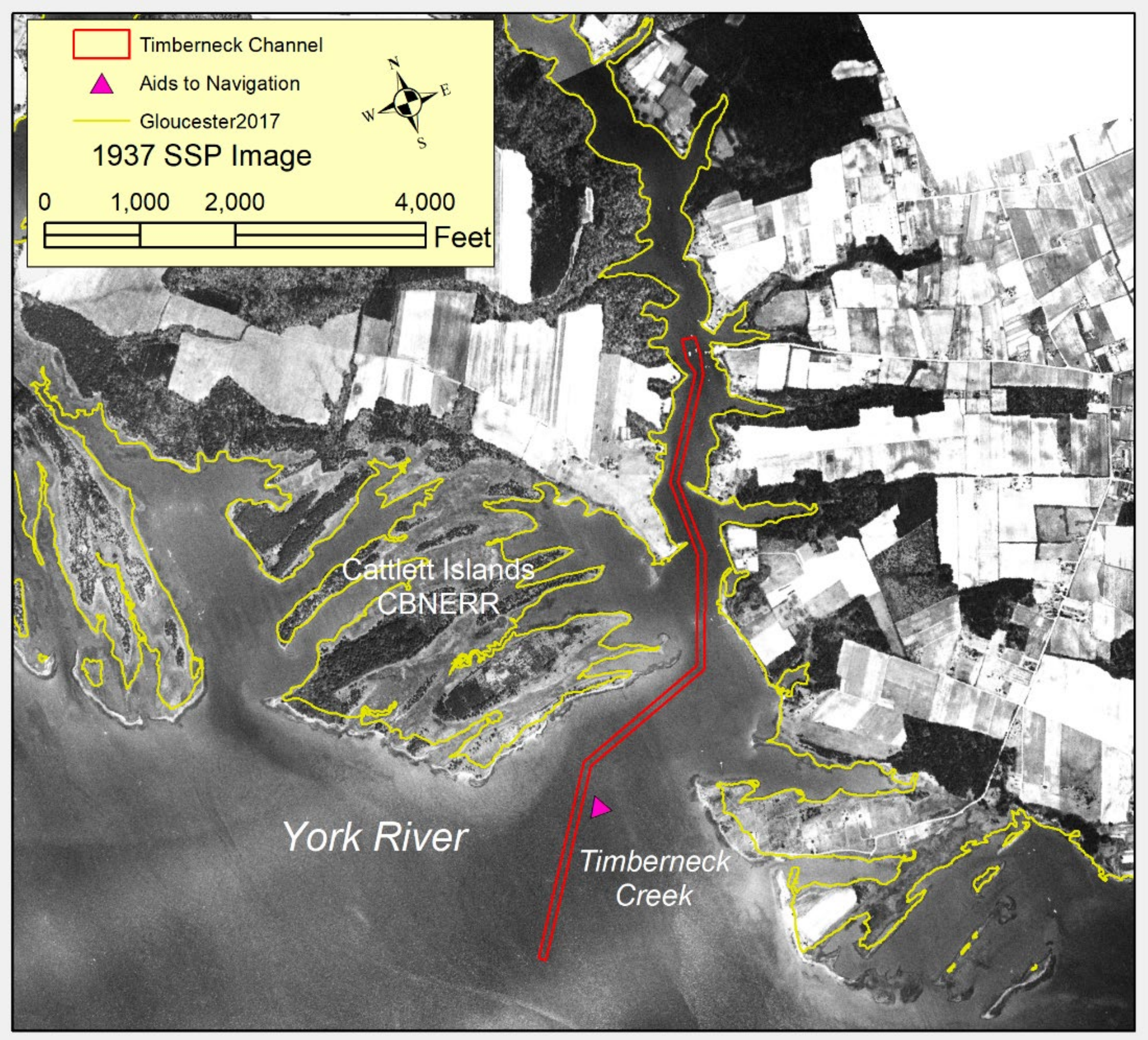


Figure 3. A 1937 rectified image showing Timberneck Creek and the digitized 2017 shoreline. From Shoreline Studies Program Shoreline Change Database.

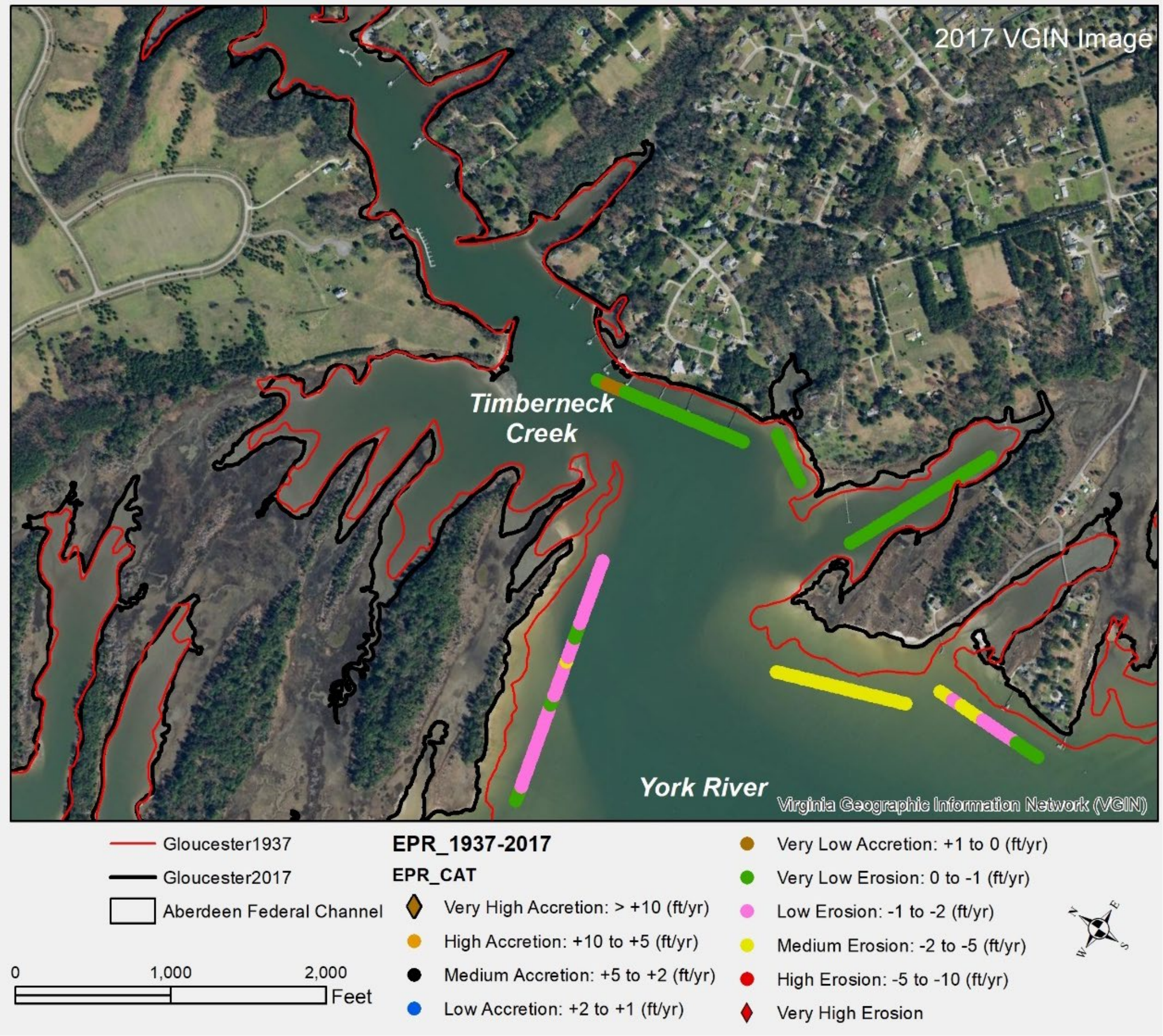


Figure 4. Timberneck Creek channel outline on the 2017 VGIN image showing shoaling at the mouth of the creek between the two spits. Also shown is the 1937 and 2017 shorelines and 1937-2017 end point rate of change categorization (Hardaway et al., 2017).

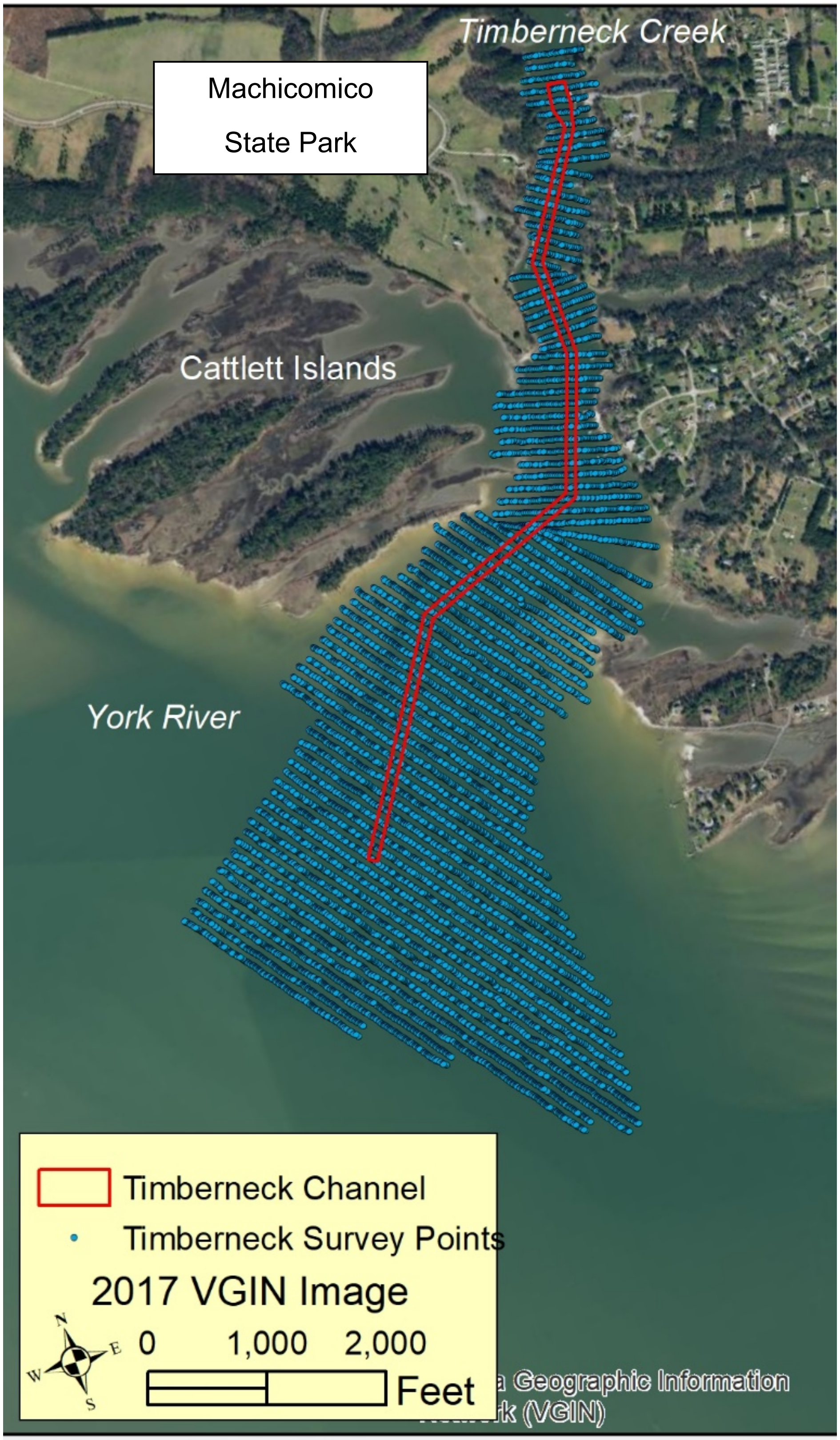


Figure 5. Survey points taken to determine existing bottom elevations.

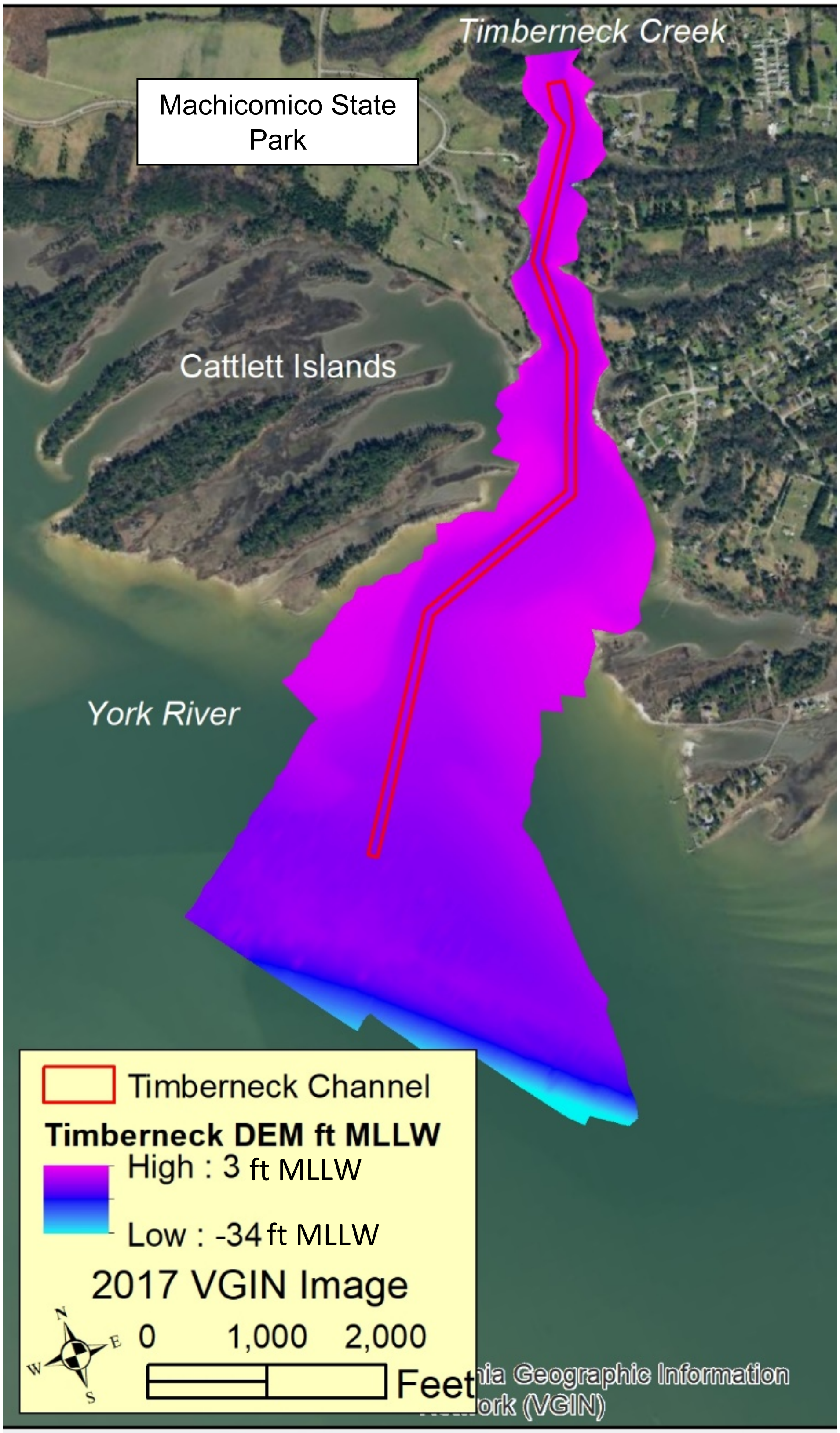


Figure 6. Digital elevation model derived from survey points showing existing conditions.

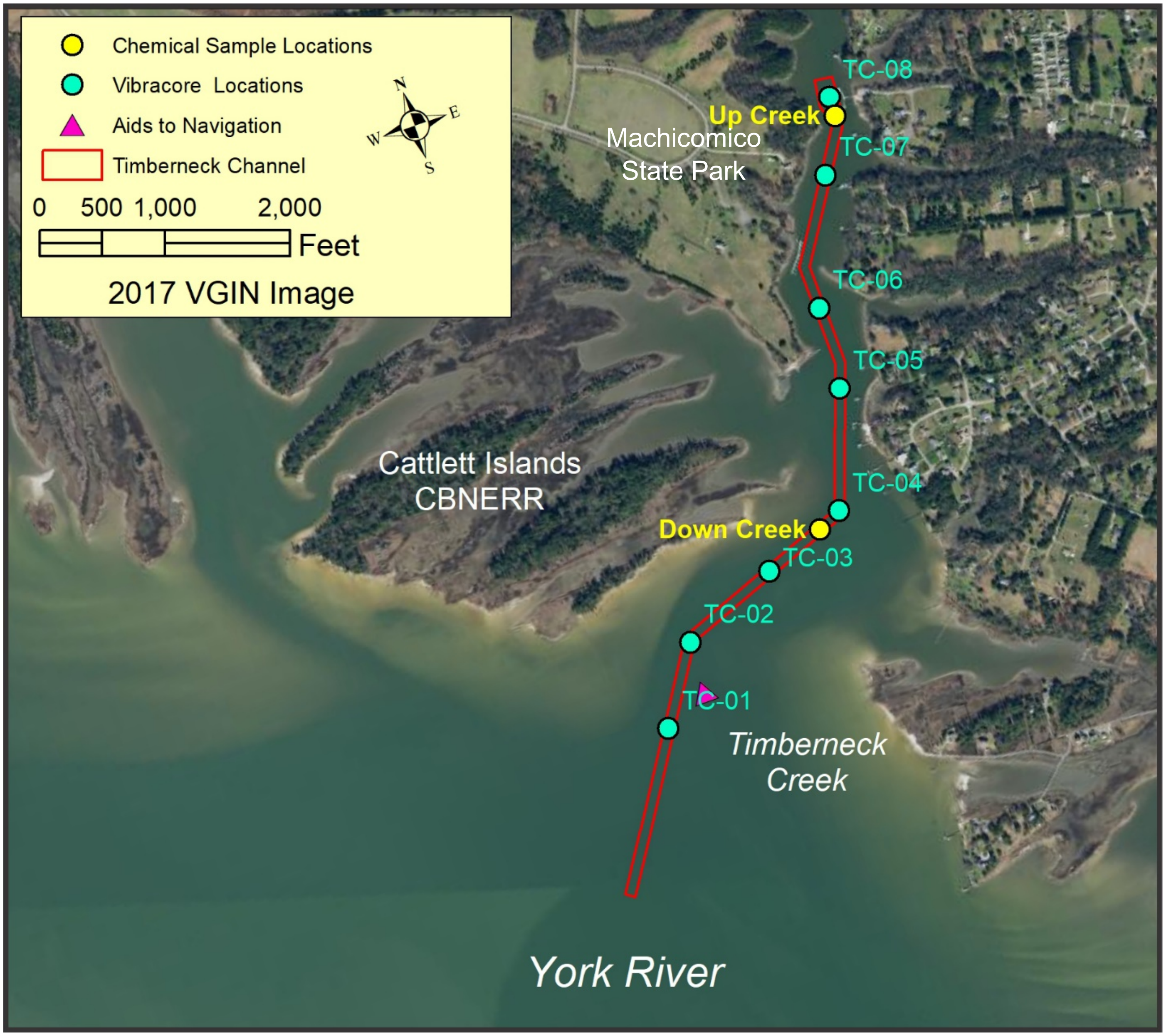


Figure 7. Location of vibracores and chemical sampling taken for this project.

Figure 8. Shellfish condemnation area from a Virginia Dept. of Health July 2020 bulletin. Red is restricted harvesting, green is conditionally approved. webapps.mrc.virginia.gov/public/maps/chesapeakebay_map.php

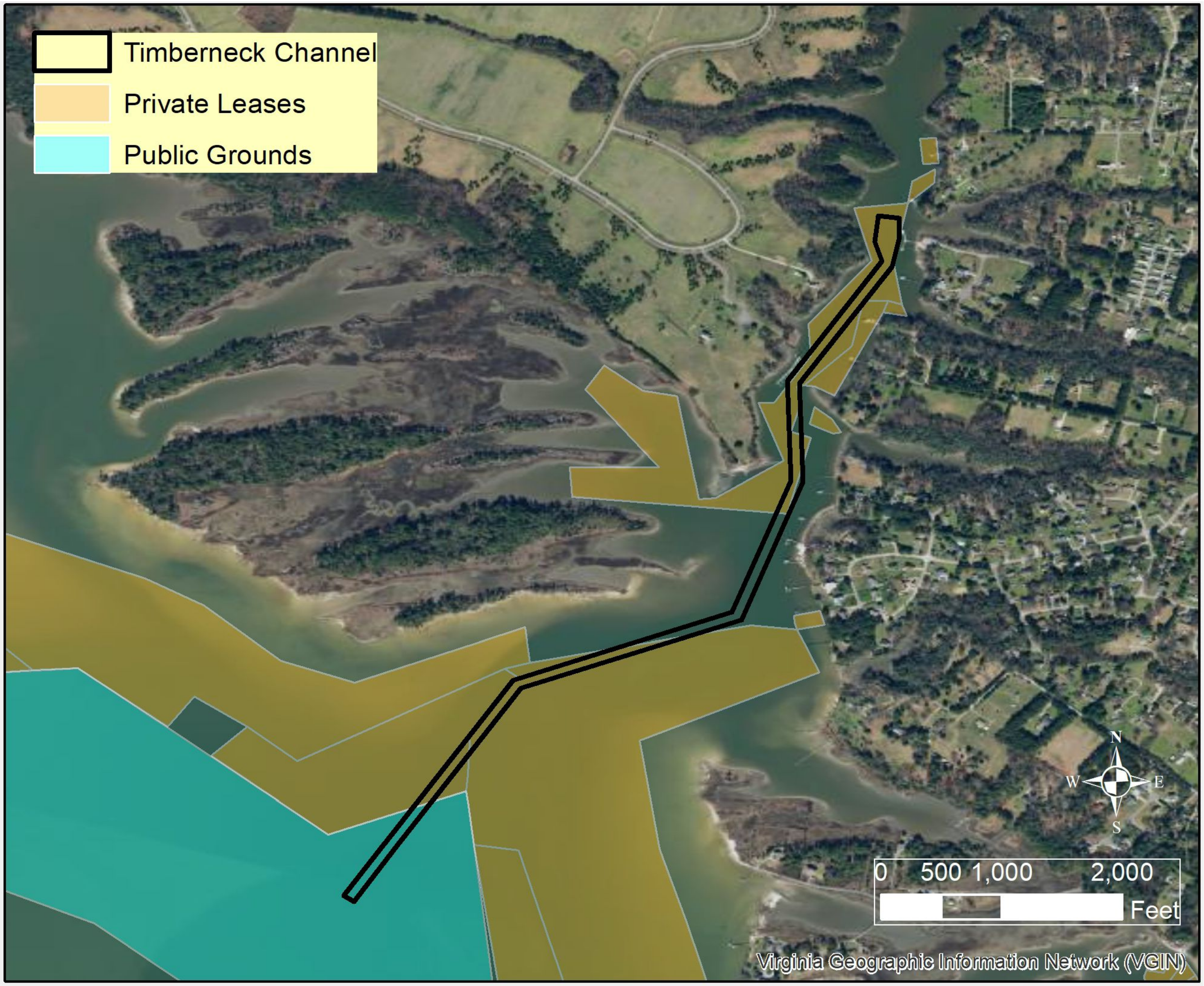
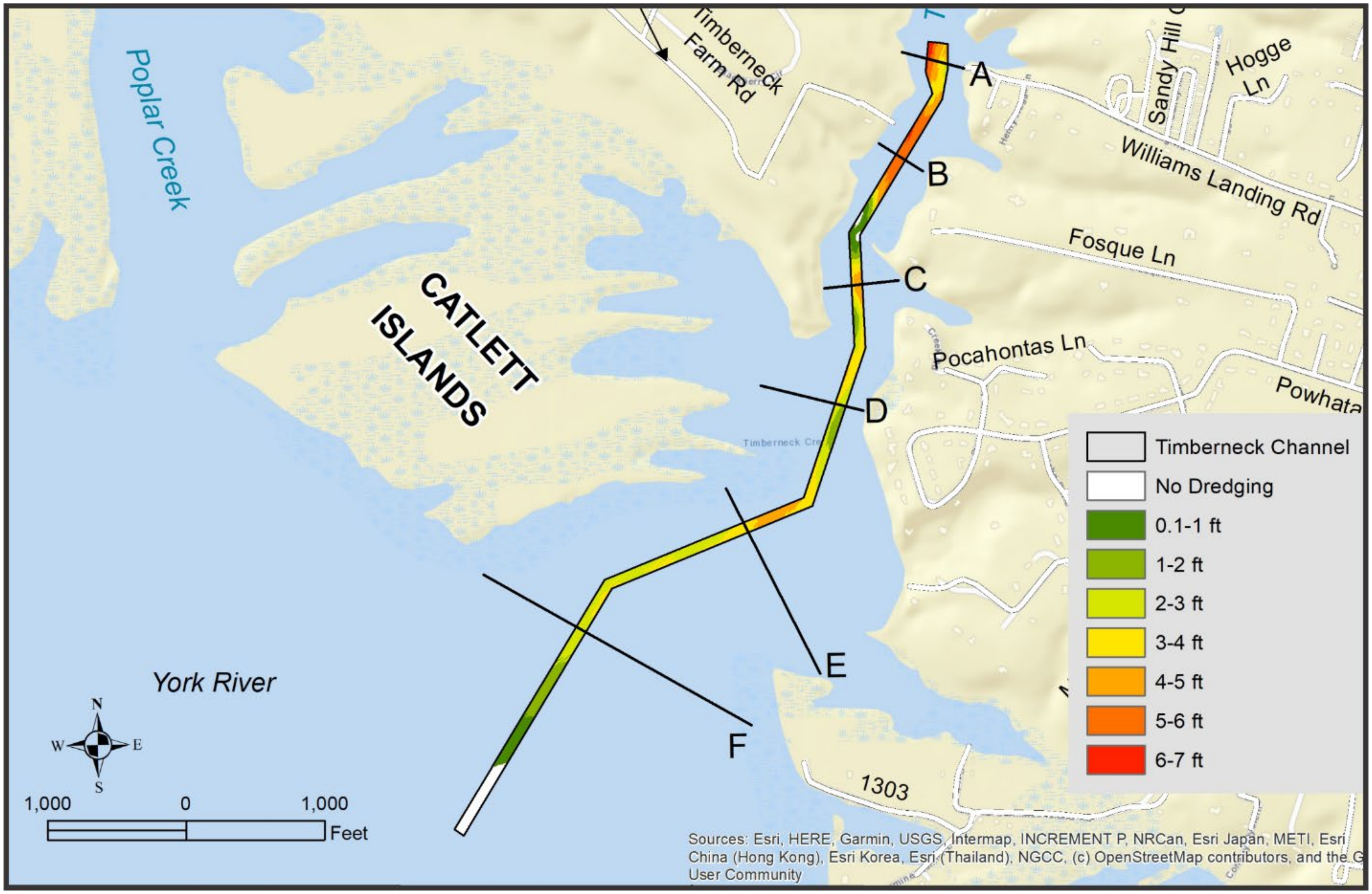


Figure 9. Private oyster ground leases and public bottom that will be affected by the proposed Timberneck navigation channel. webapps.mrc.virginia.gov/public/maps/chesapeakebay_map.php



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the G User Community

Figure 10. Digital elevation model (DEM) showing the locations in the channel that are shallower than -7 ft MLLW. Areas that need more material removed are shown in red. Areas that need less material removed are shown in green. Areas deeper than -7 ft MLLW are shown in white because no dredging need occur. Also shown are the locations of typical cross-sections of the channel.

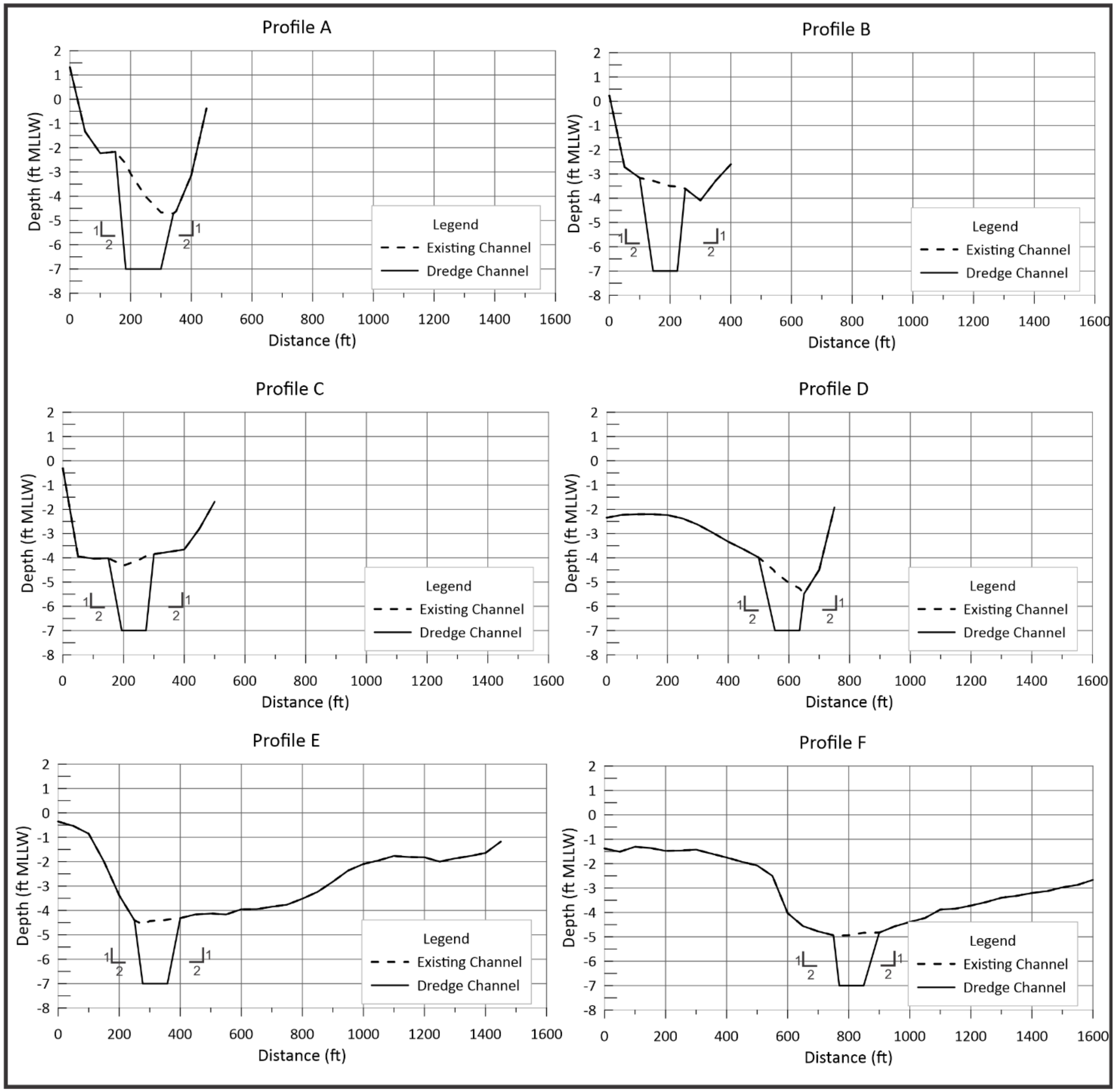


Figure 11. Typical channel cross-sections looking up-creek at Timberneck. Their location is shown on Figure 10.

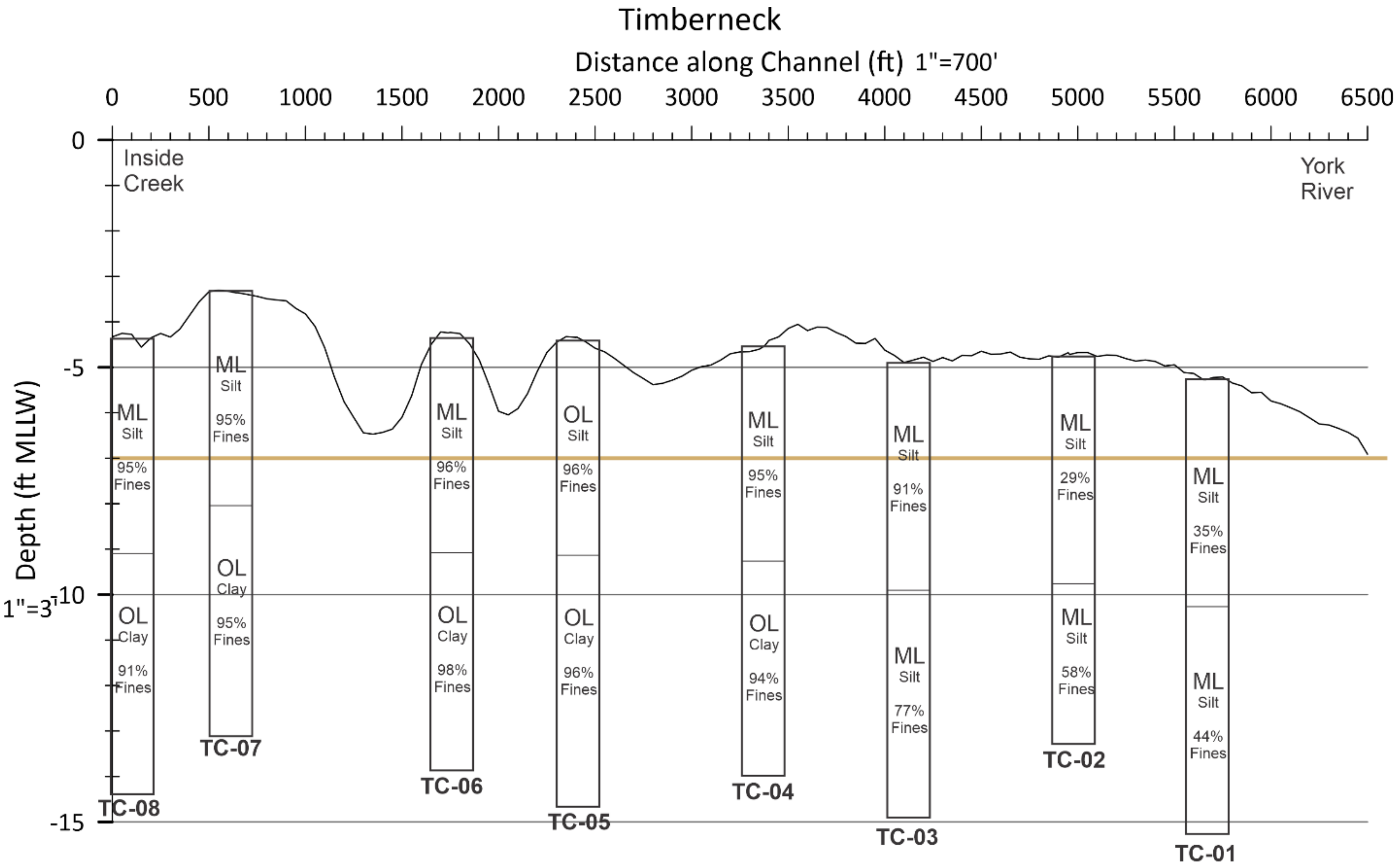


Figure 12. Along-channel cross-section showing the position of the cores and the type of material in the core. The dredge depth is -7 ft MLLW.

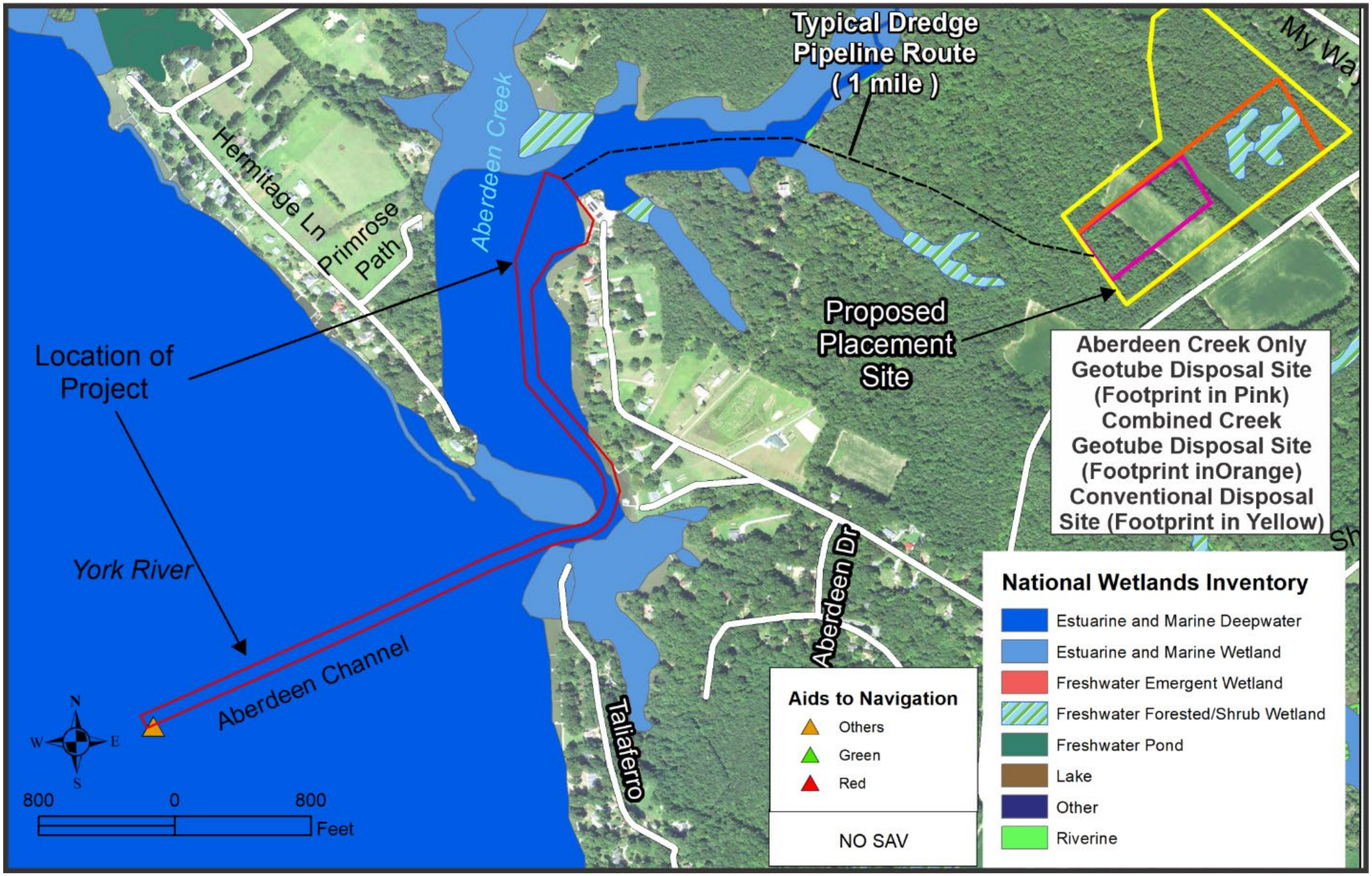


Figure 13. Potential confined upland disposal areas for dredge material placement. DCR property boundary shown in orange. Also shown is the National Wetlands Inventory.

Figure 14. Example photo of a Geotube used for sediment containment. Source: TenCate website

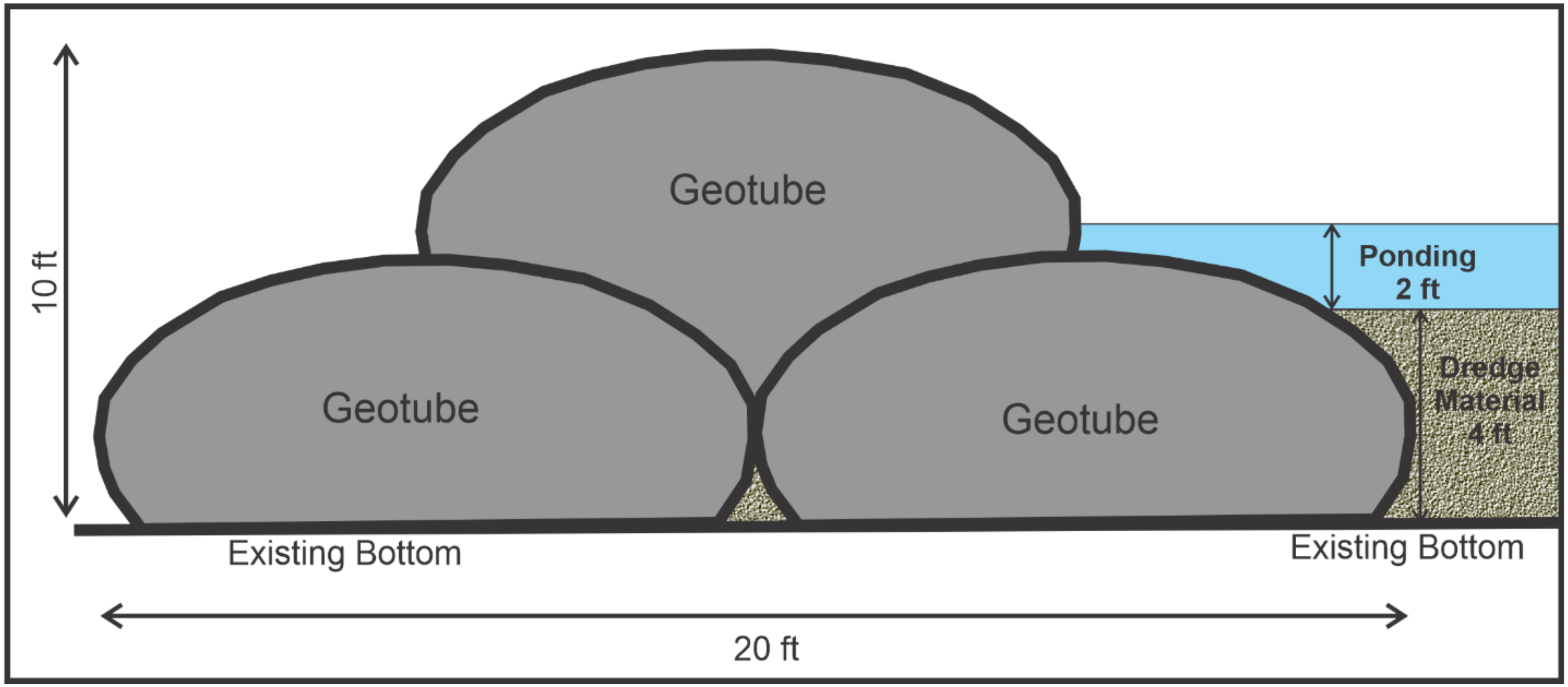


Figure 15. Configuration of Geotube confined upland disposal site.

Figure 16. Location of proposed demonstration project at Catlett Islands using material from Timberneck dredging.

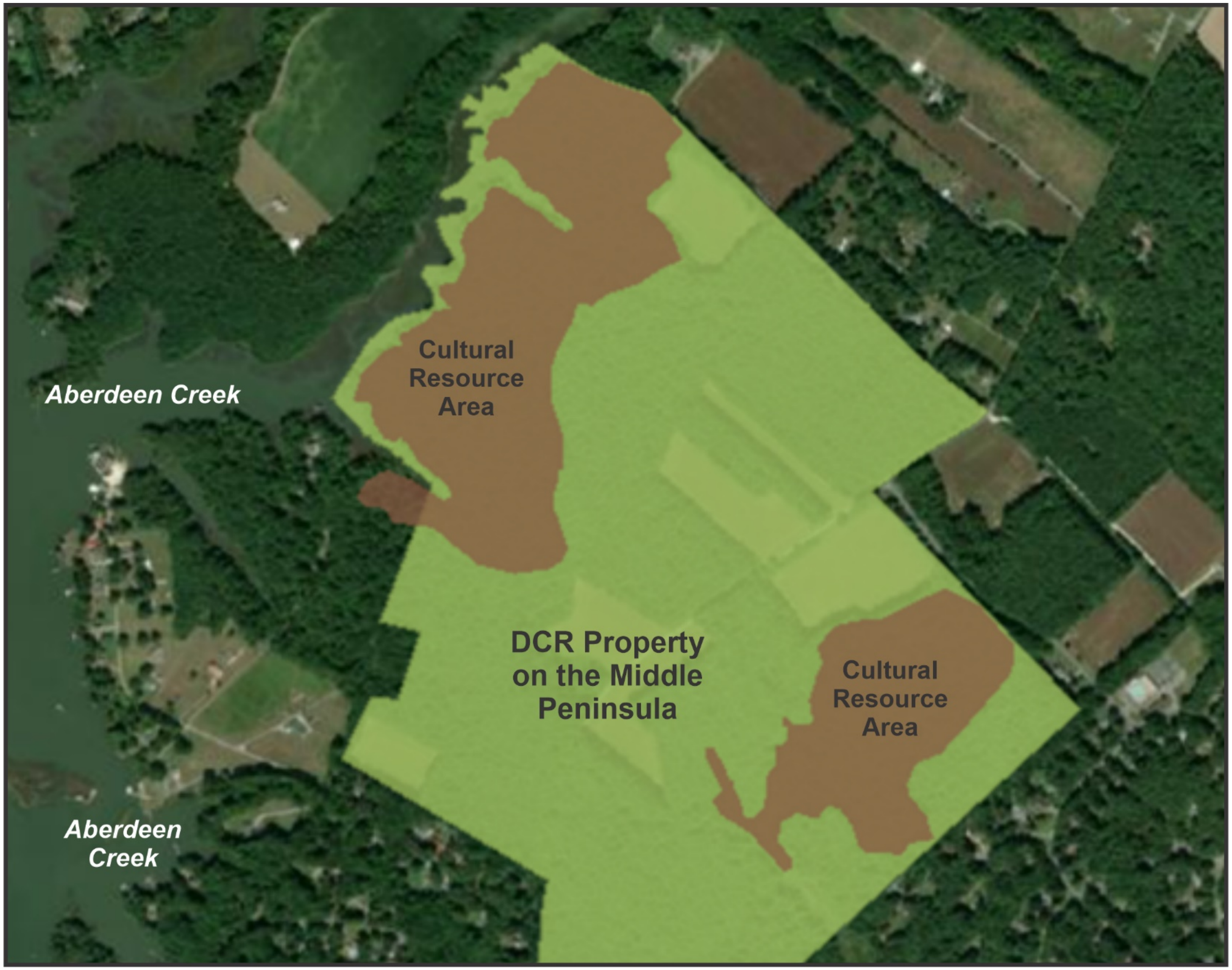
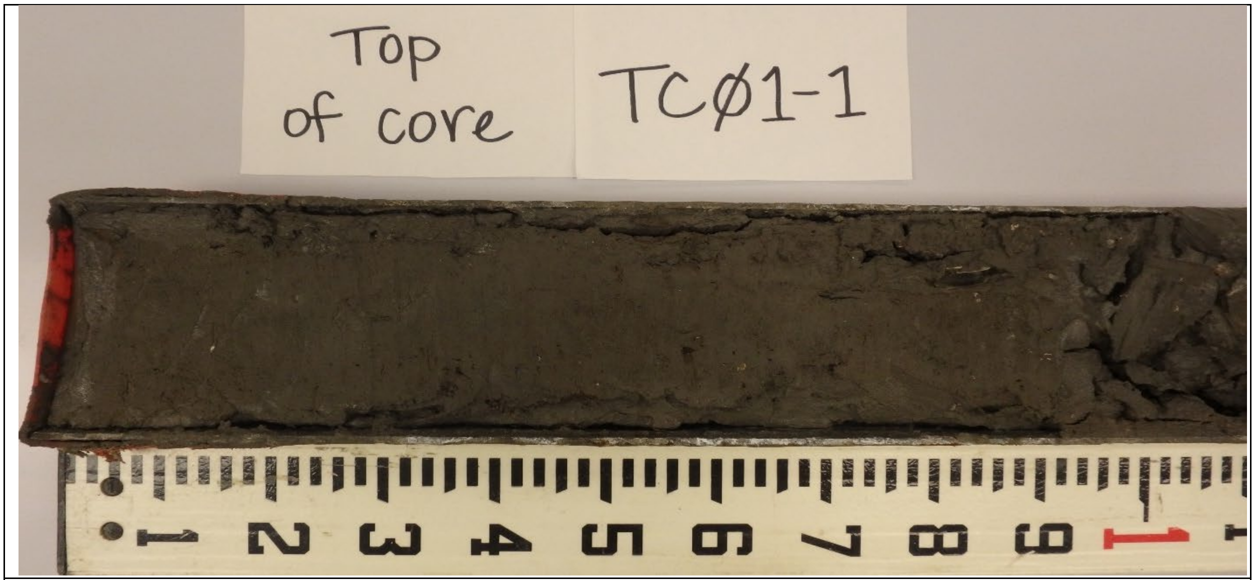


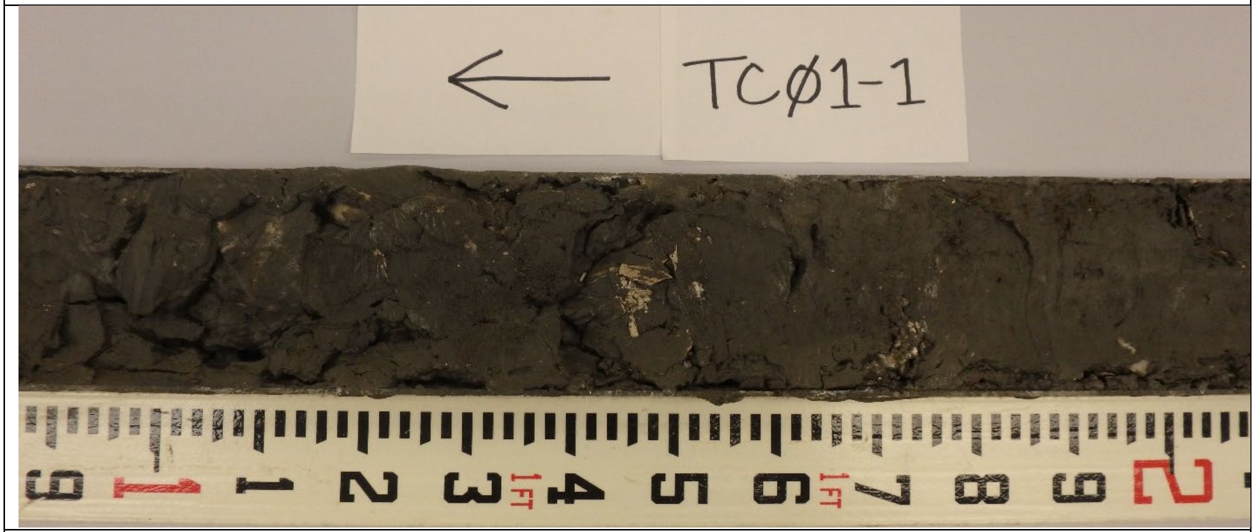
Figure 17. Location of cultural resource areas within DCR property on the Middle Peninsula adjacent to Aberdeen Creek. Source: Tom Smith, Deputy Director of Operations, VA Department of Conservation and Recreation

Appendix A

Core Photographs



Timberneck Creek Core 1 Section 1 0 ft – 1.1 ft



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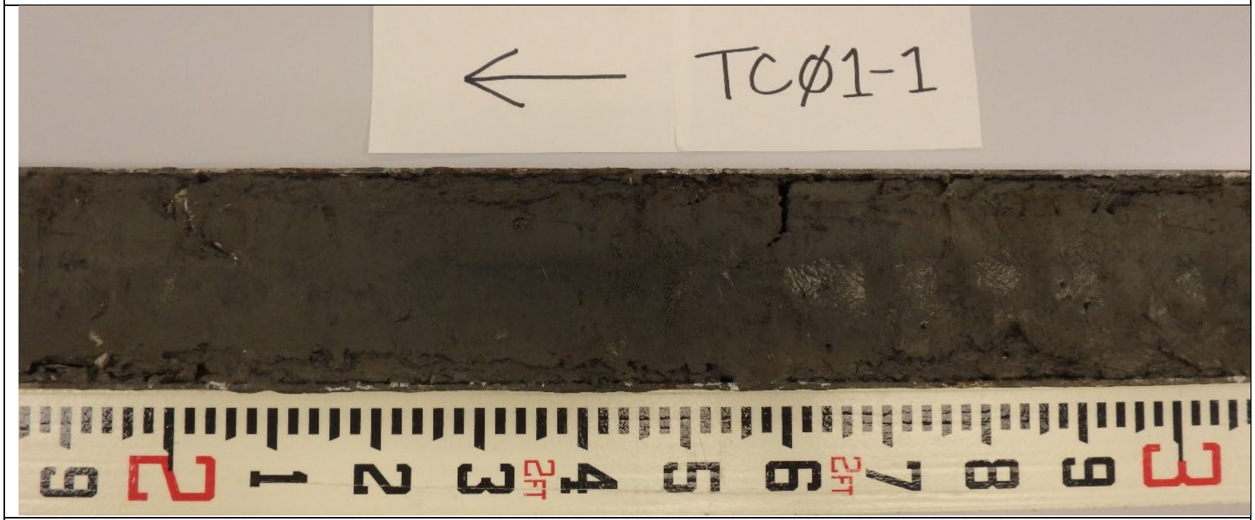

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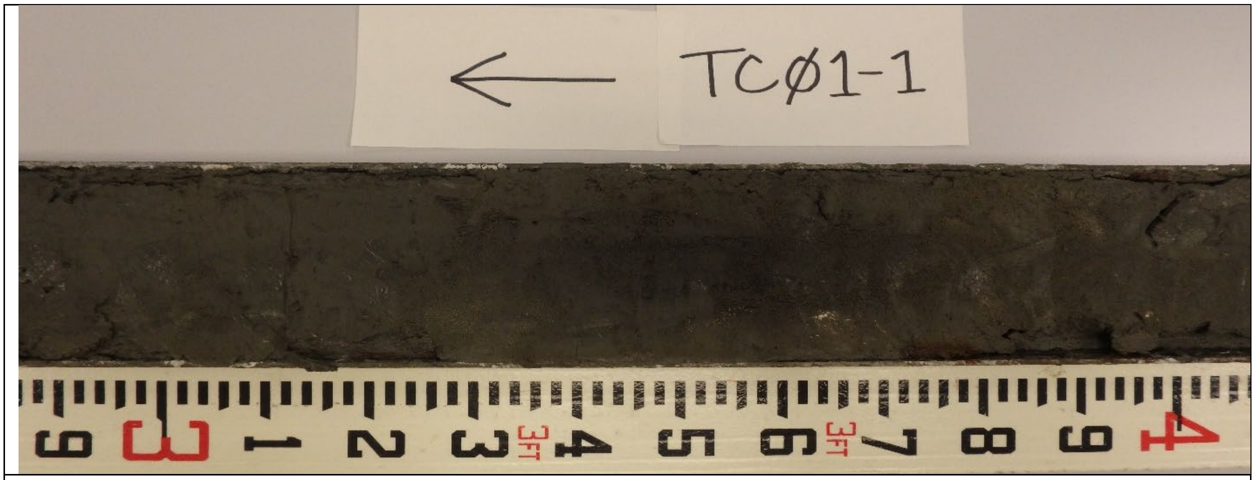

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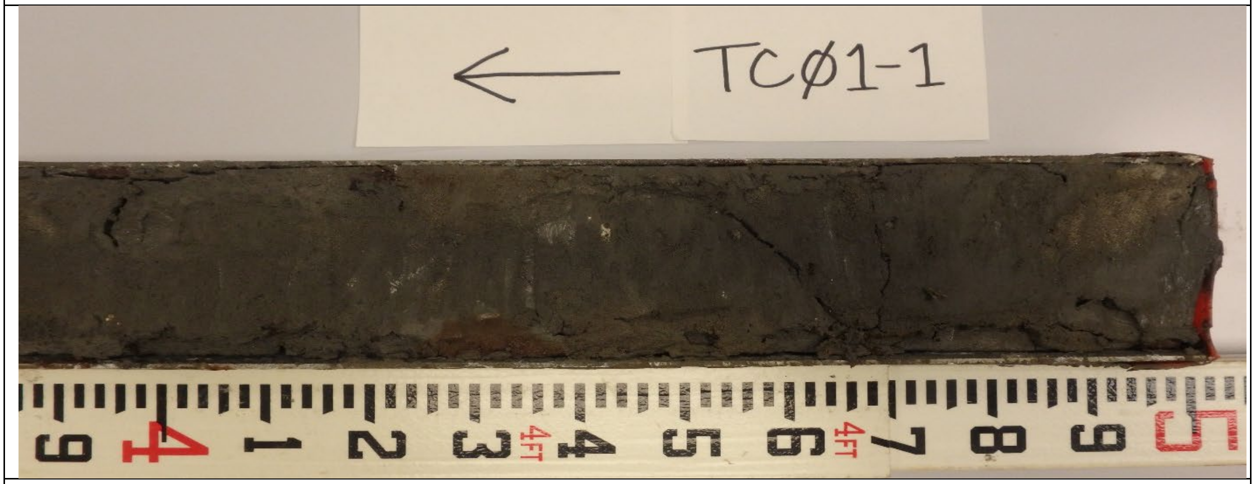

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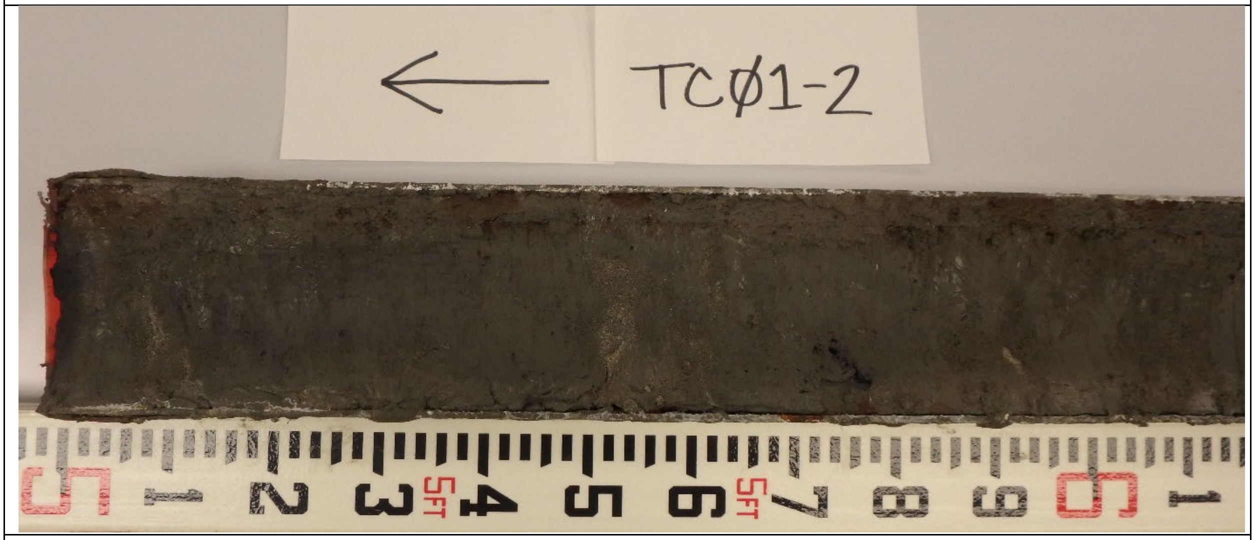
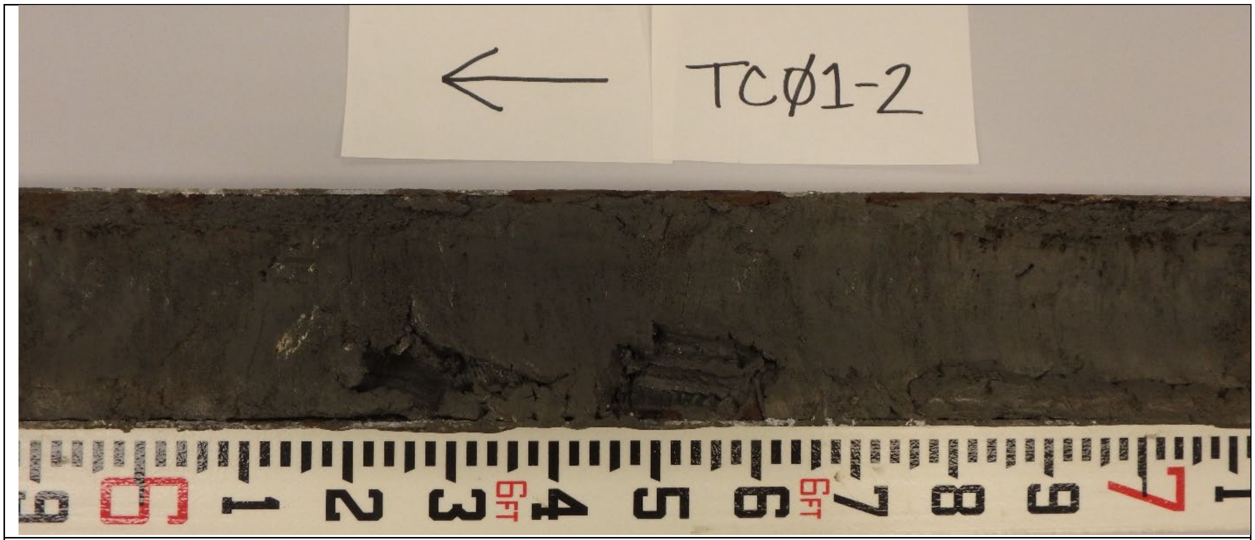


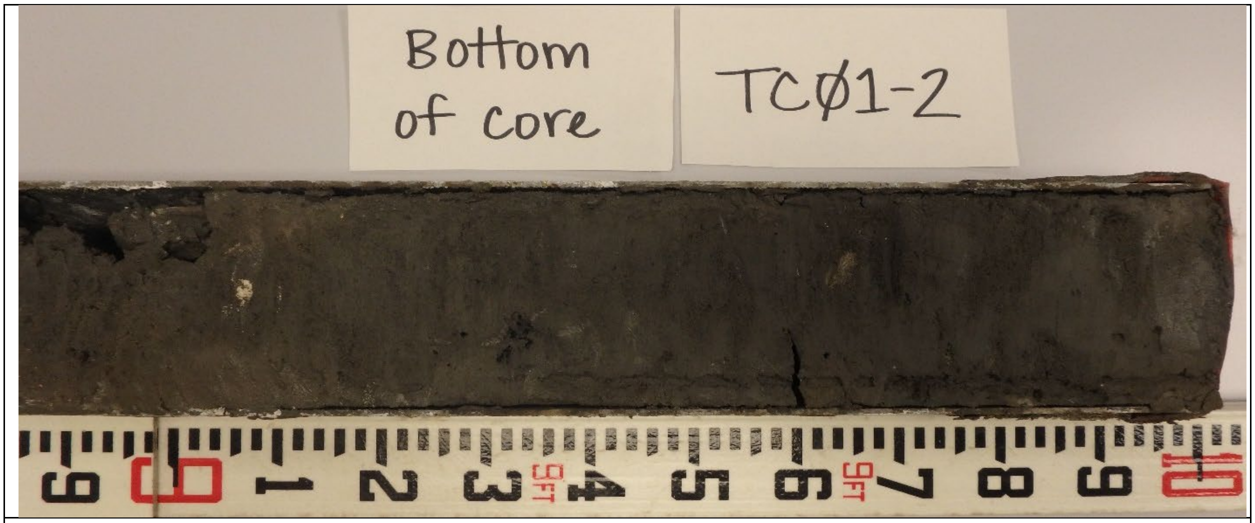
Timberneck Creek Core 1 Section 2 5 ft – 6.1 ft



Timberneck Creek Core 1 Section 2 5.9 ft – 7.1 ft

Timberneck Creek Core 1 Section 2 6.9 ft – 8.1 ft

Timberneck Creek Core 1 Section 2 7.9 ft – 9.1 ft



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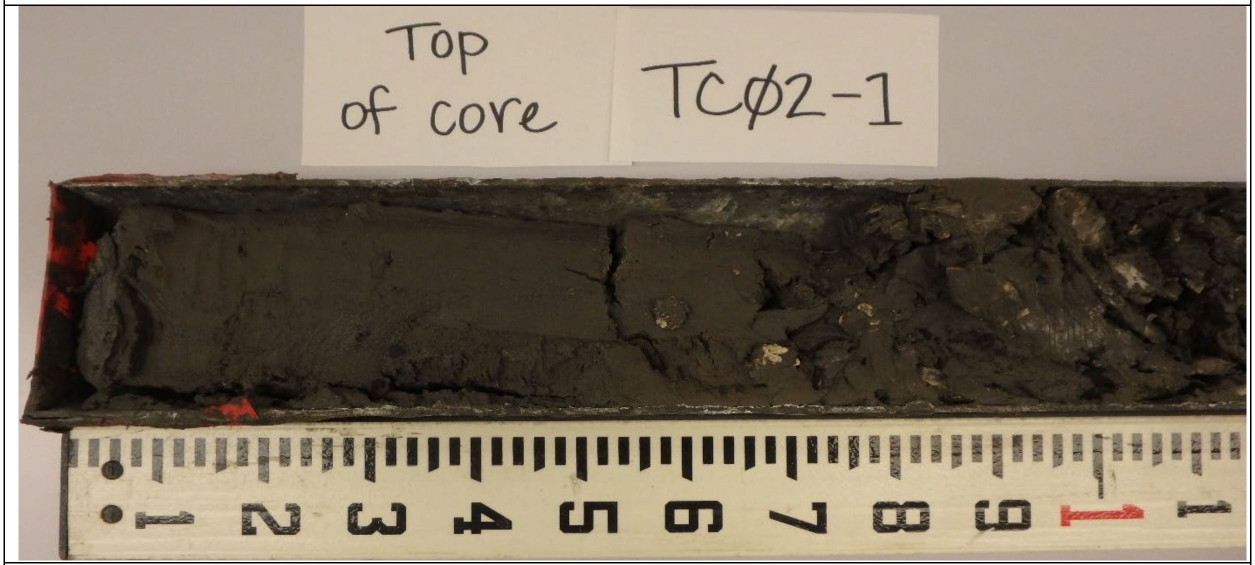

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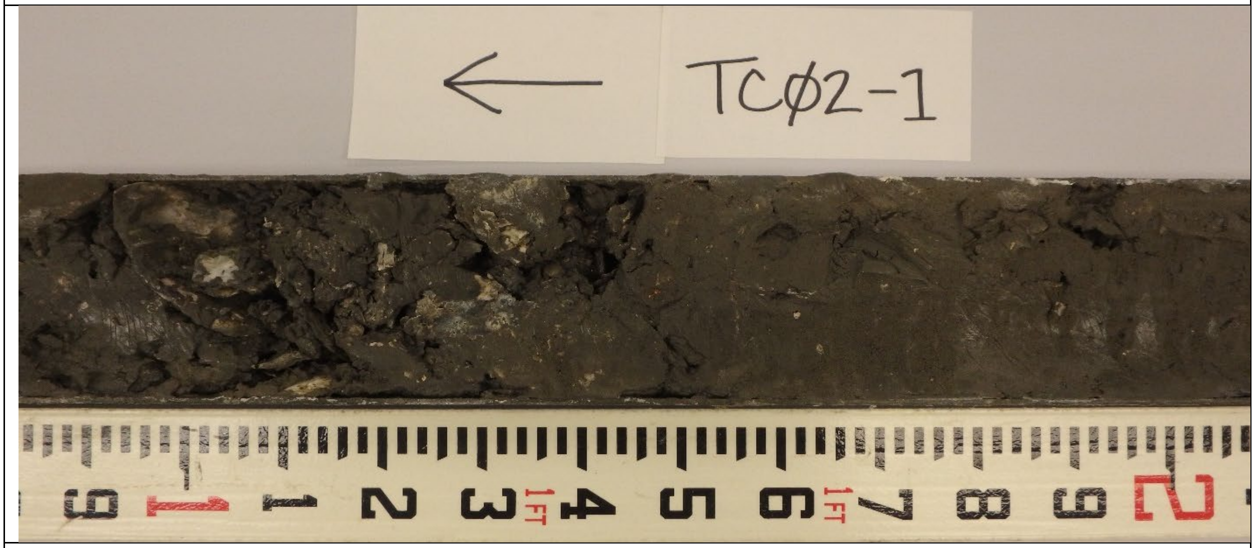

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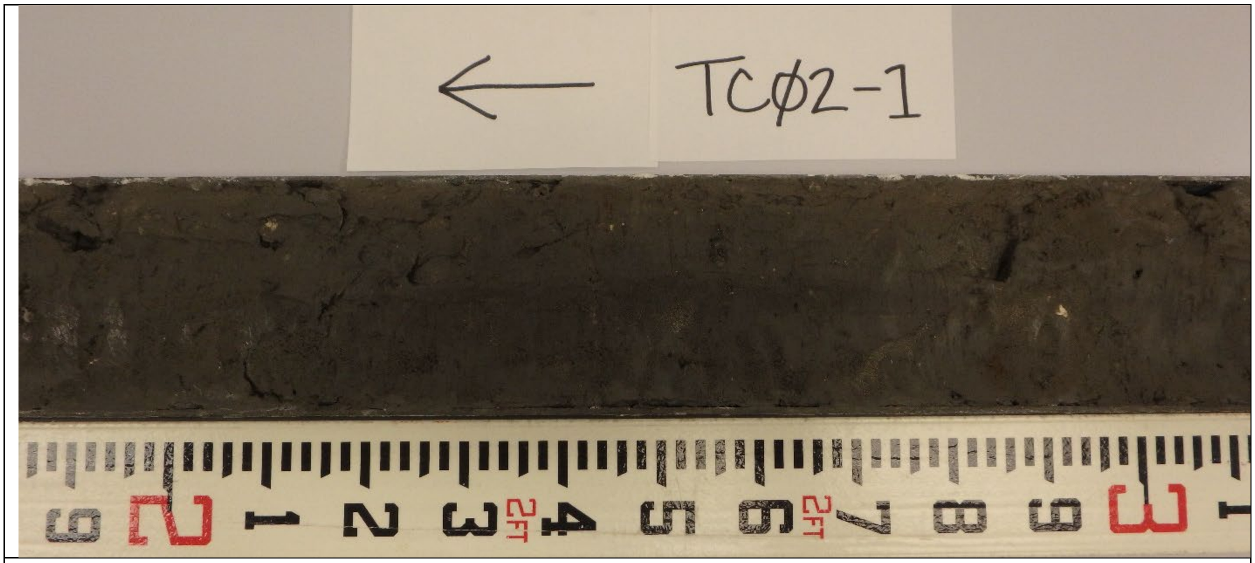

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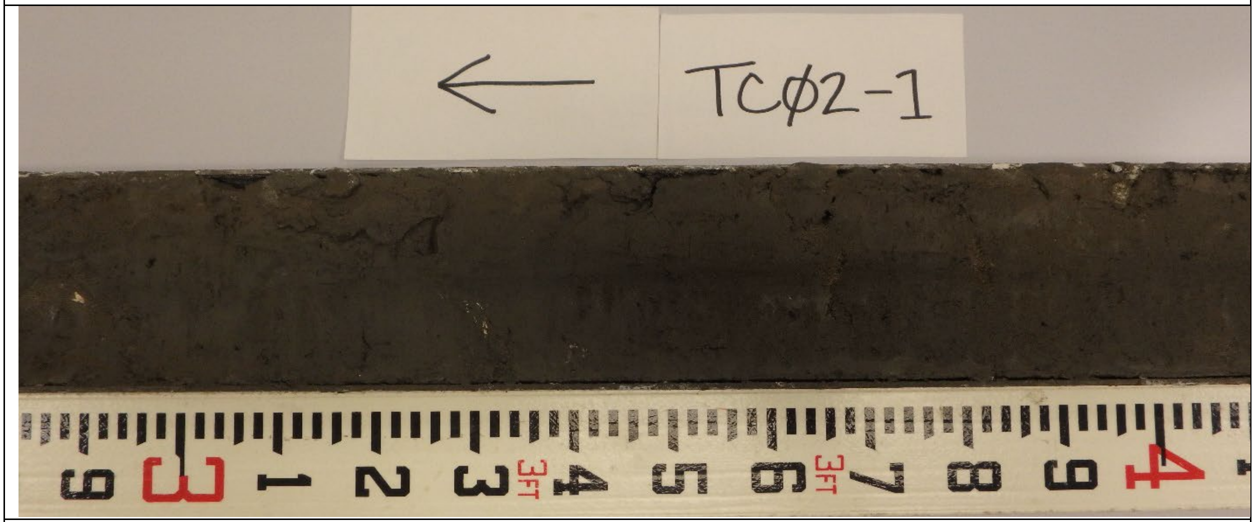

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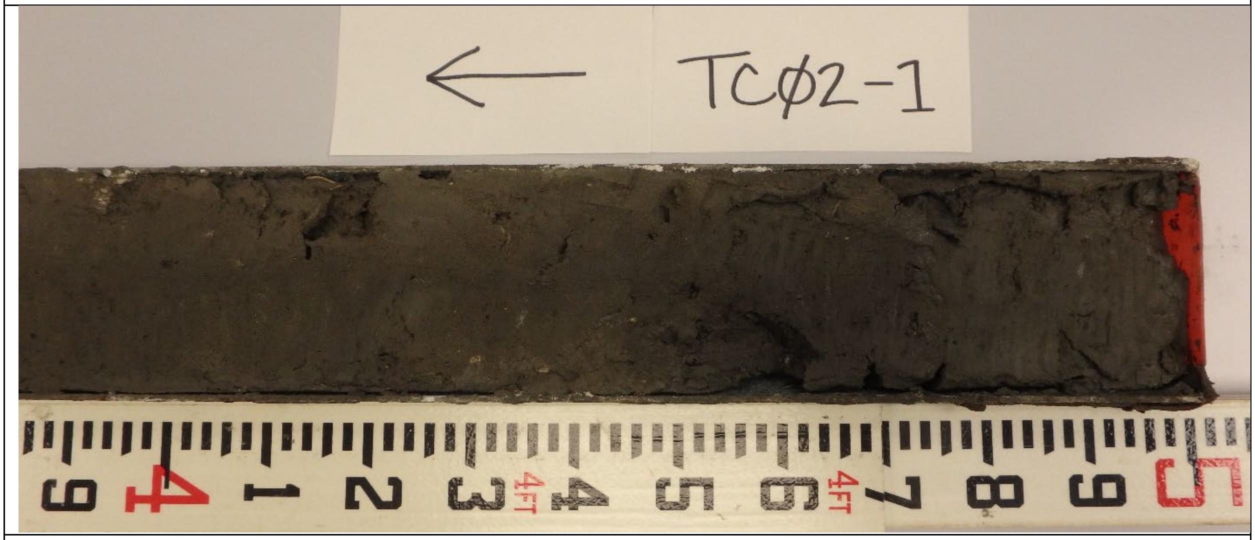

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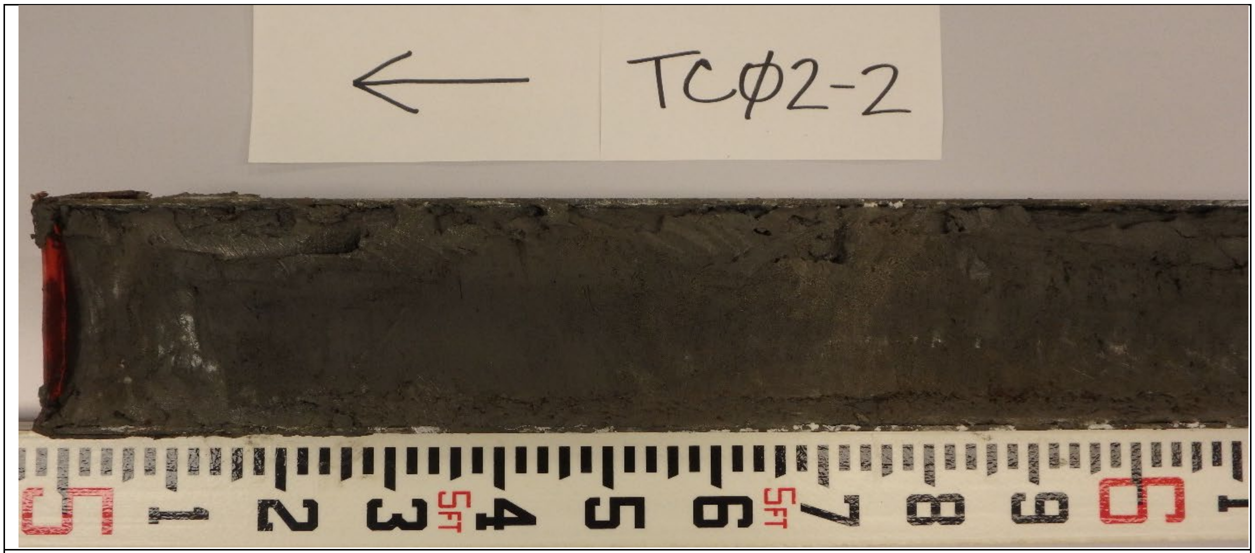

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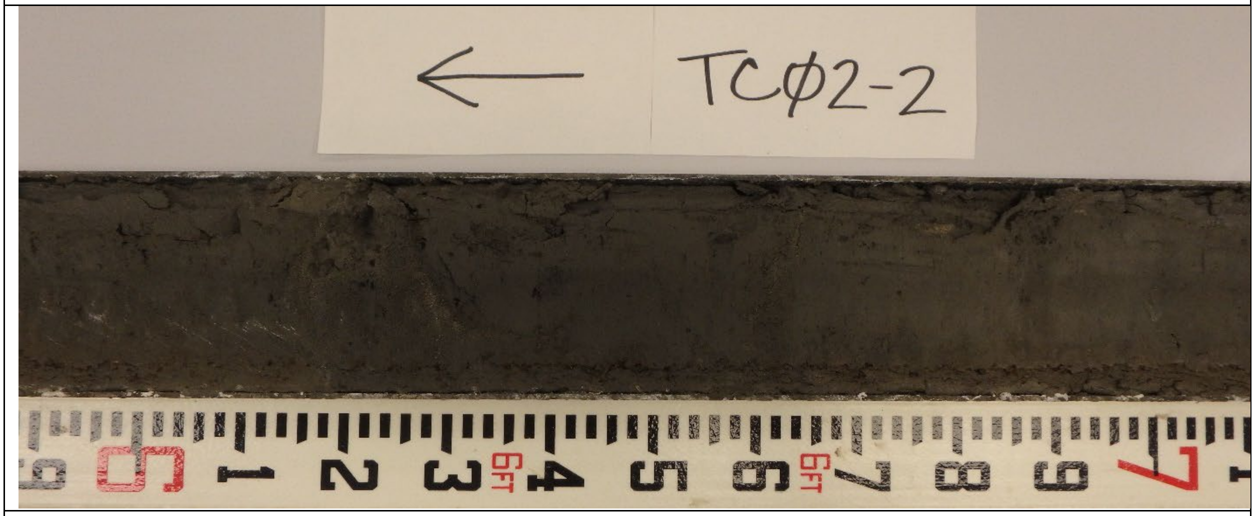

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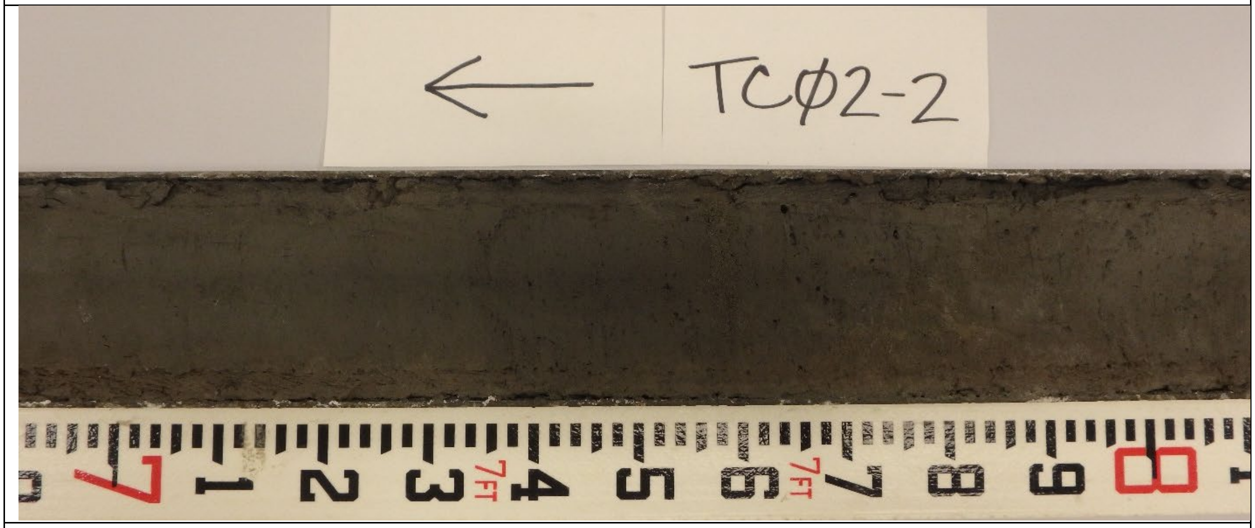

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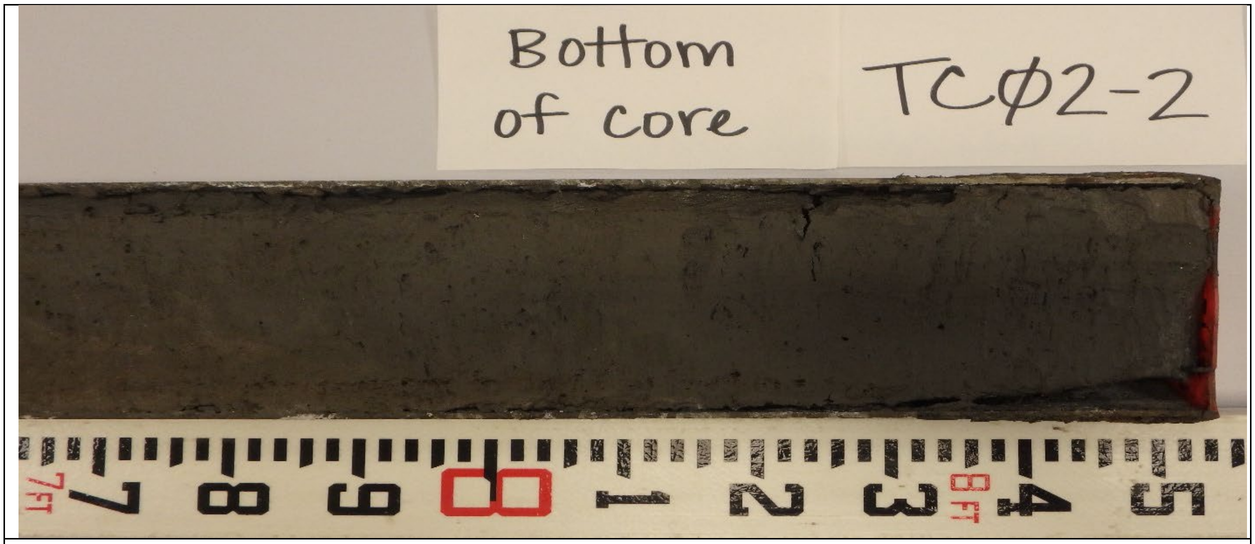

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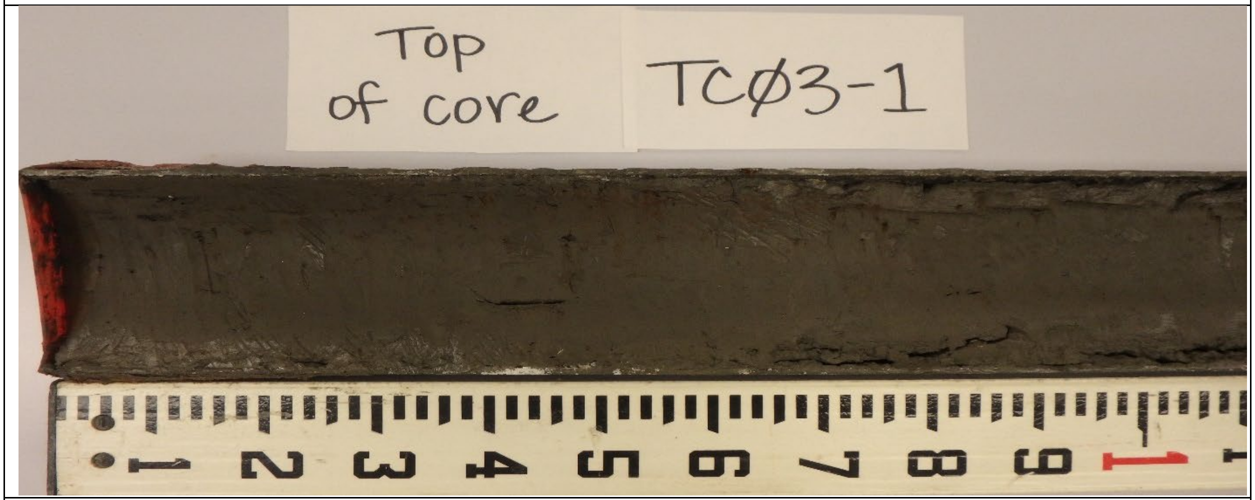

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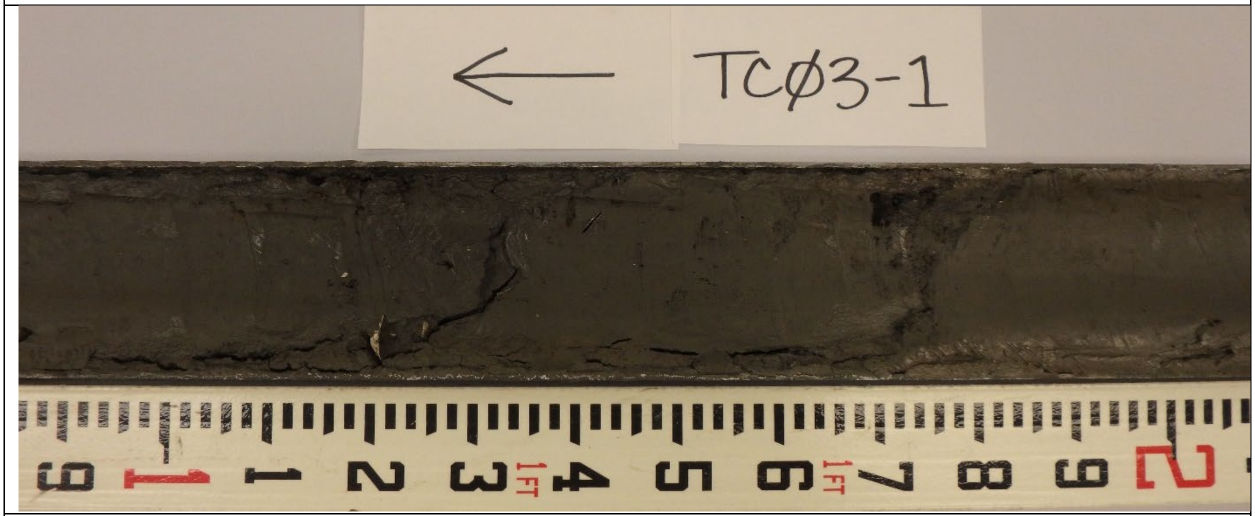

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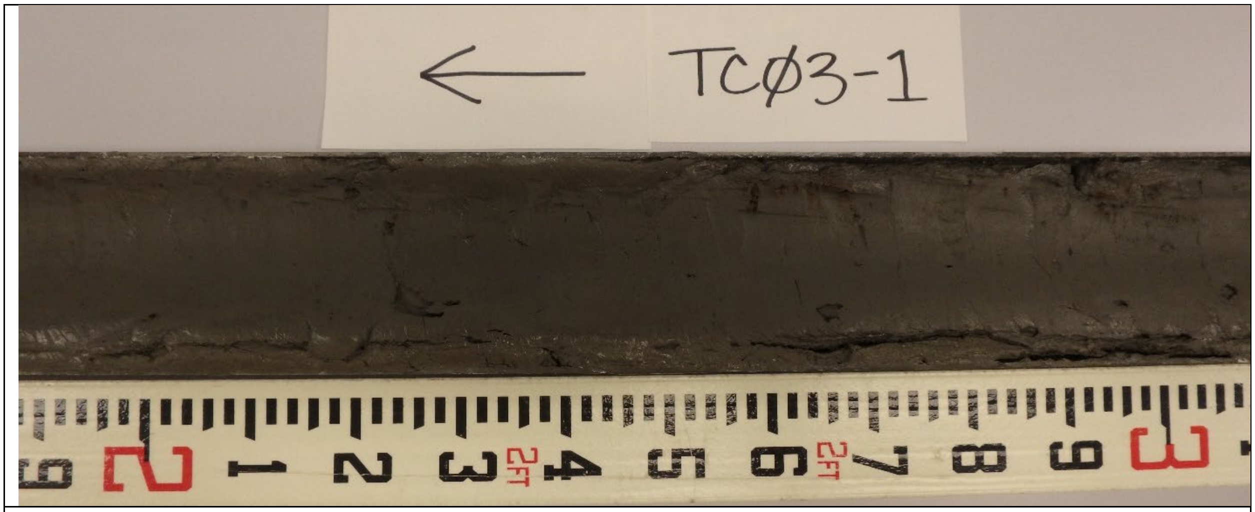

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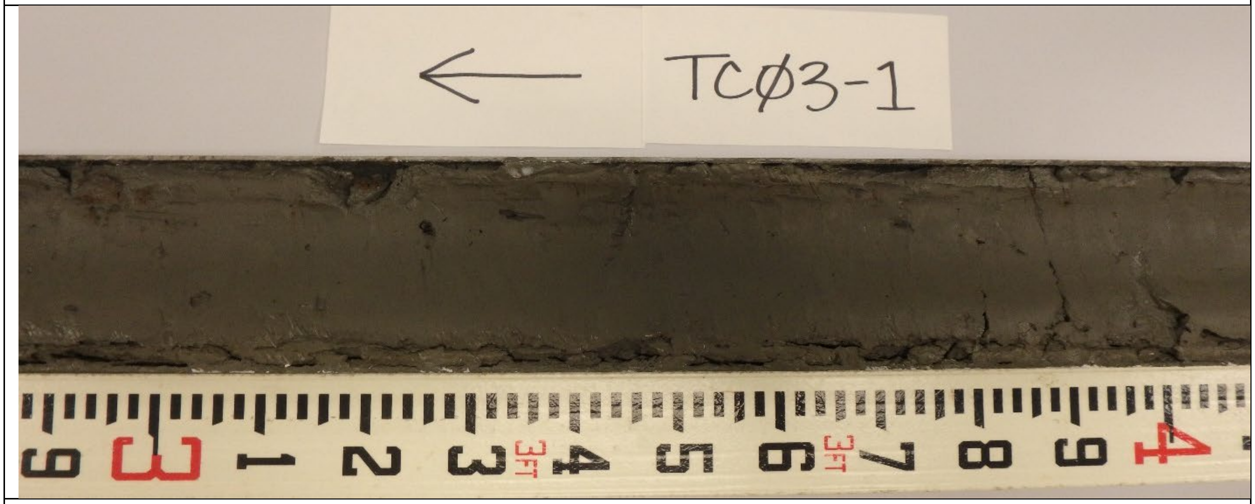

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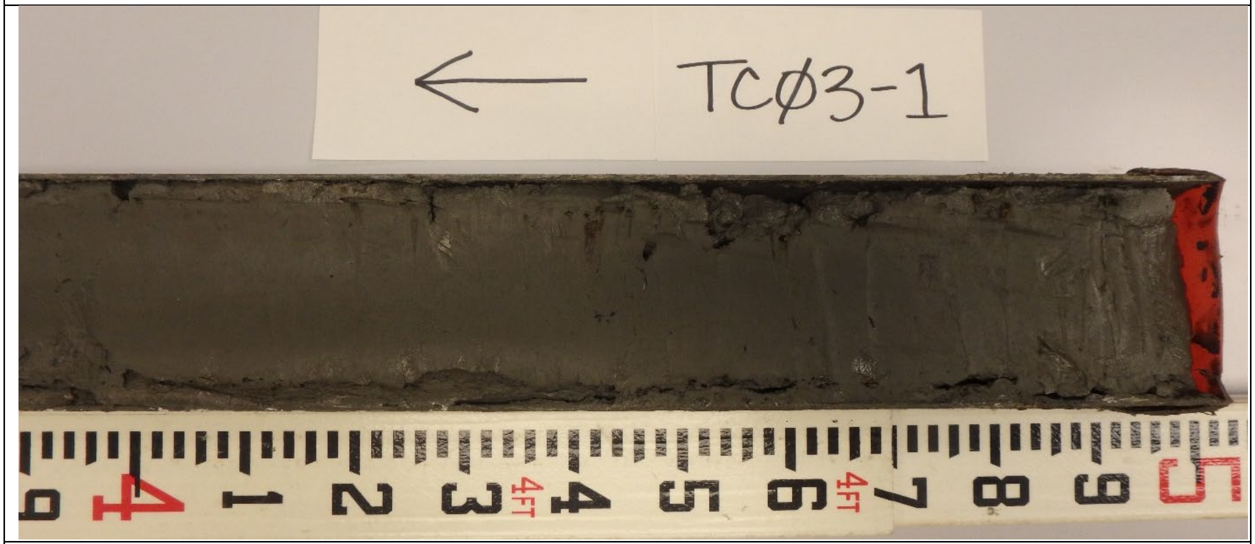

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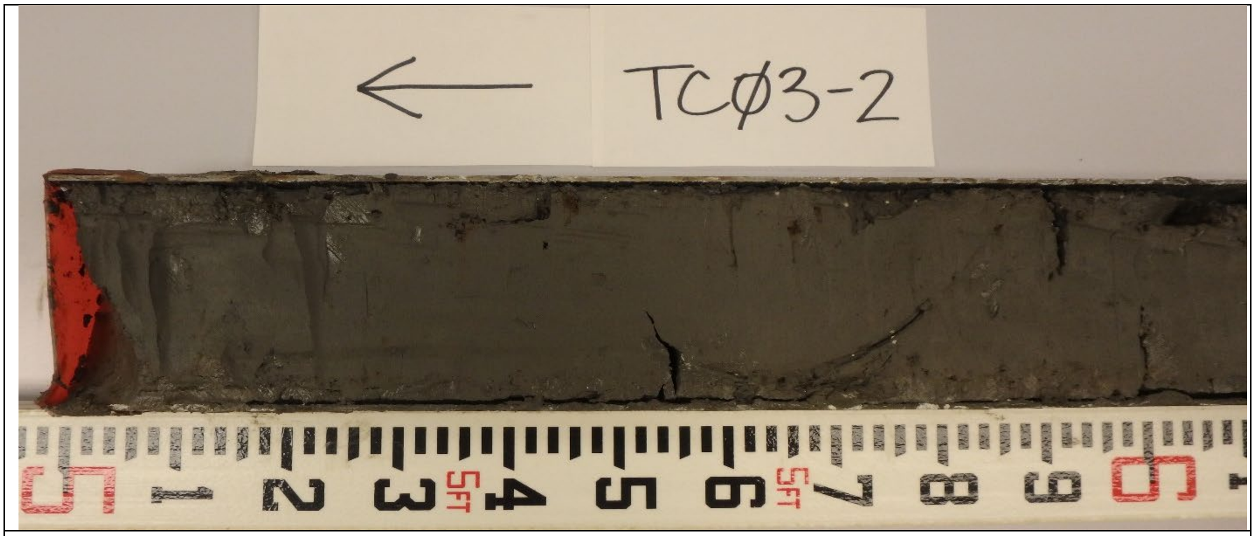

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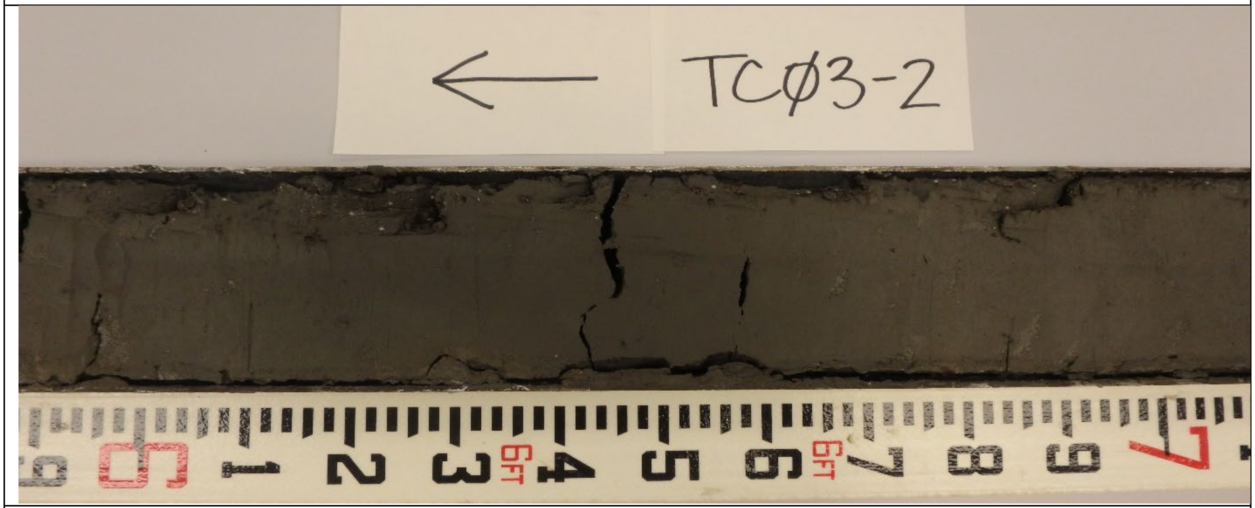

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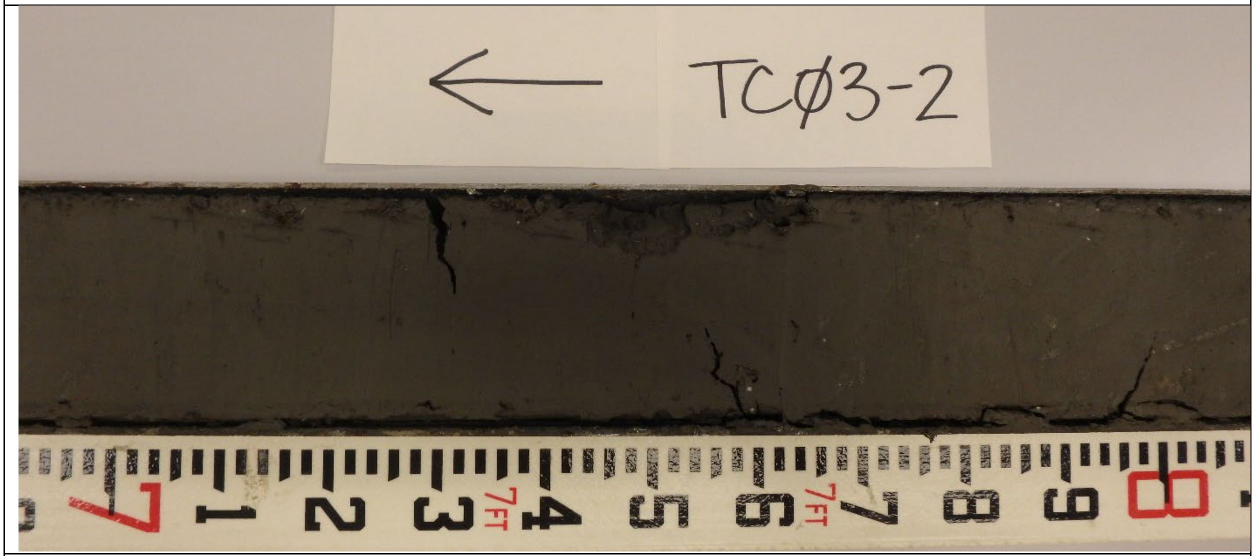

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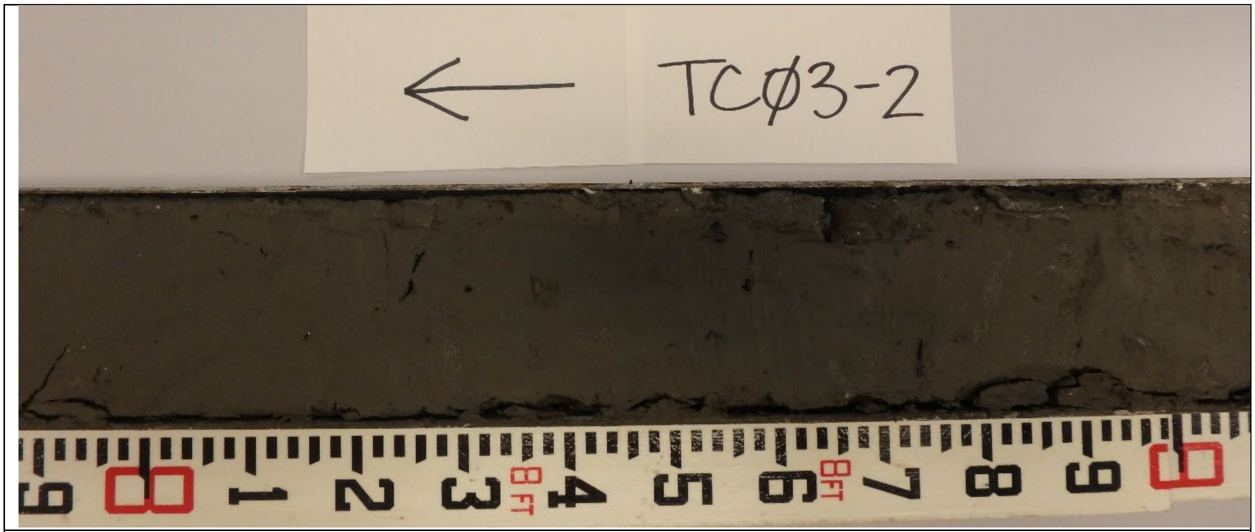

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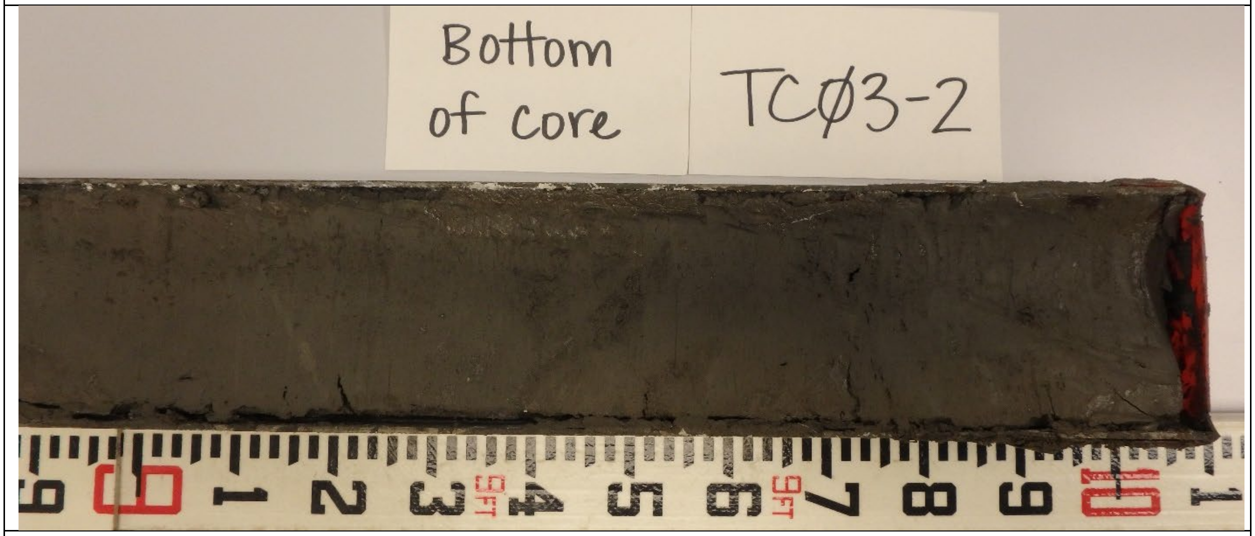

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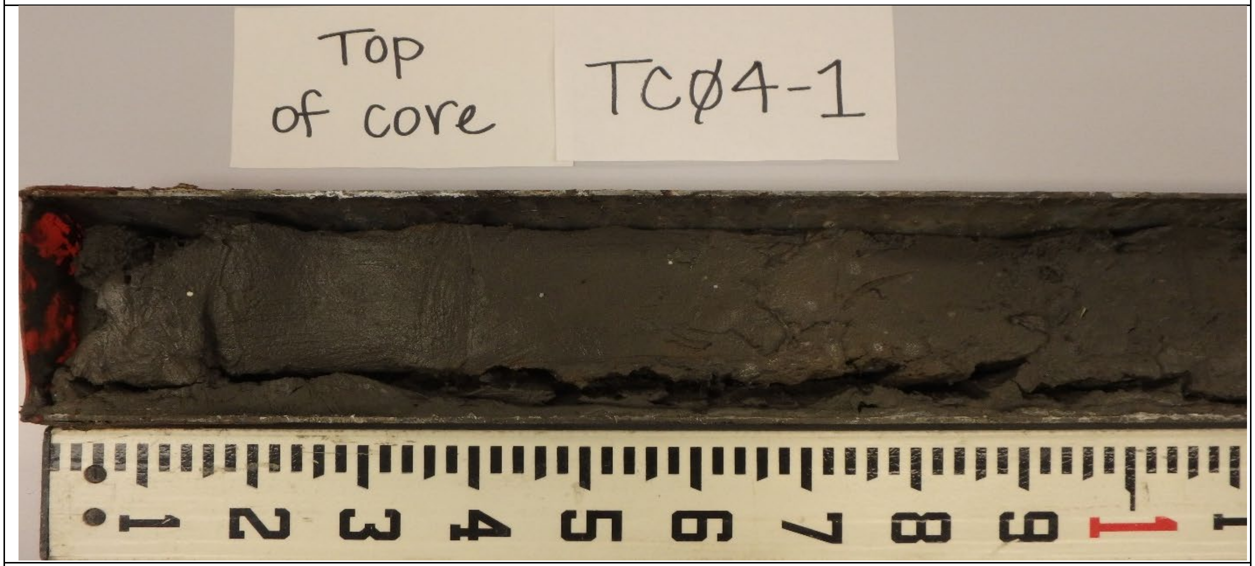

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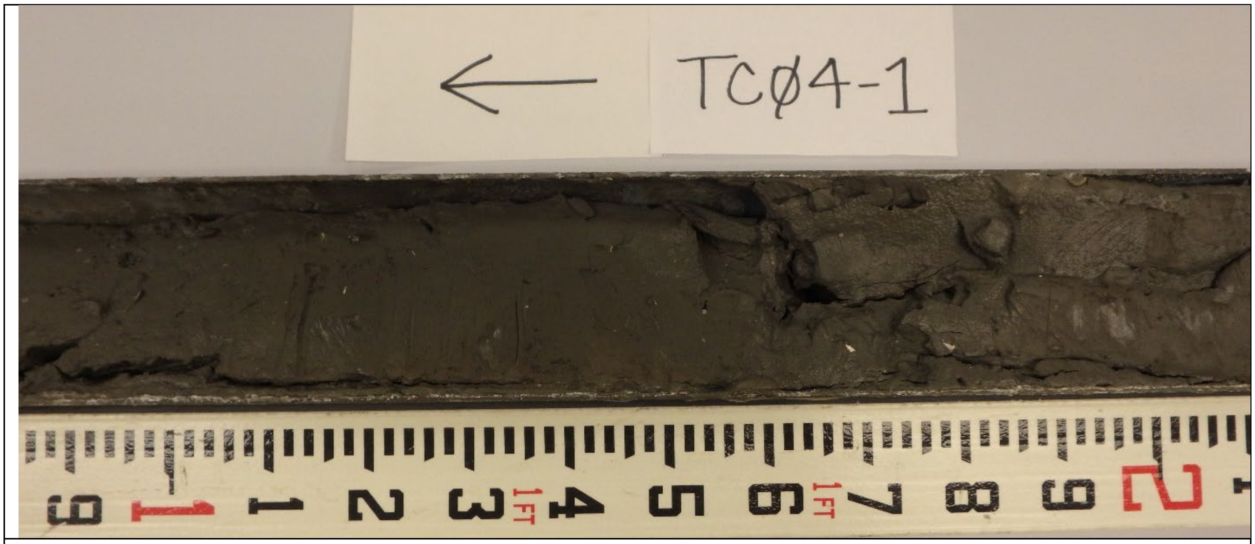

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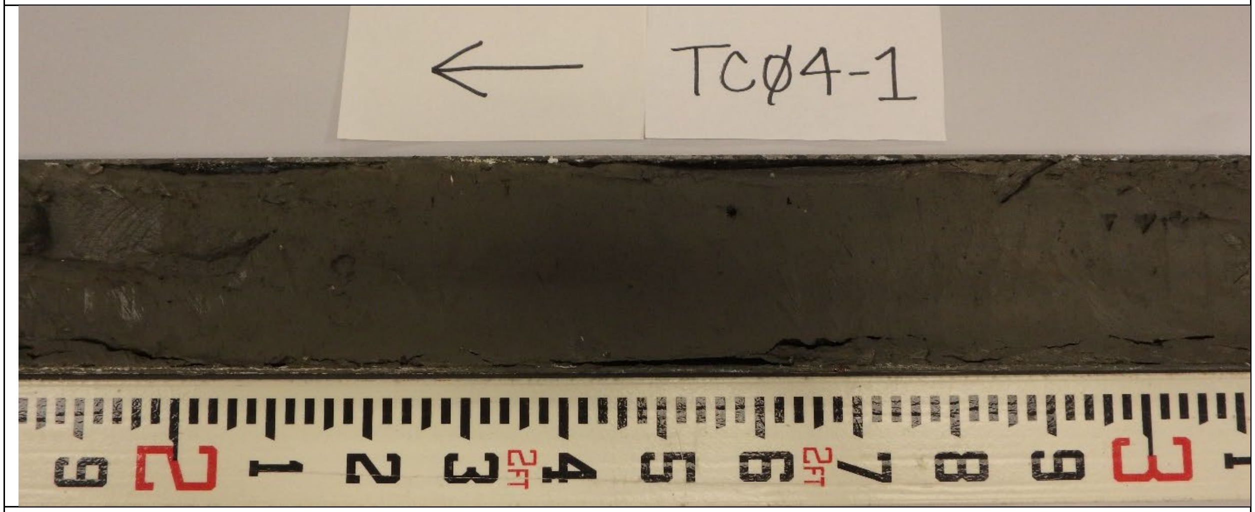

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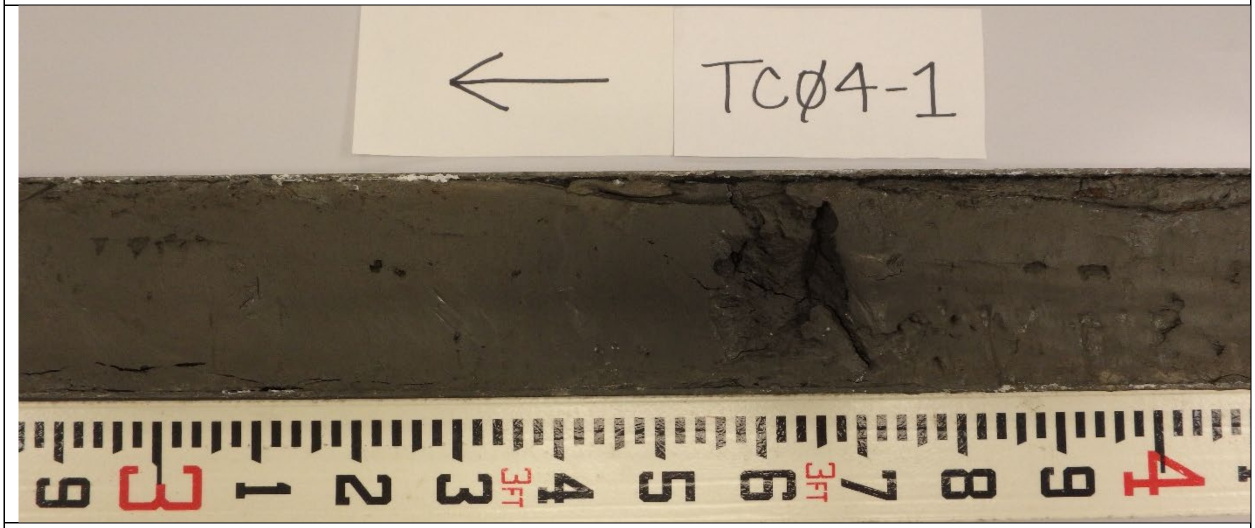

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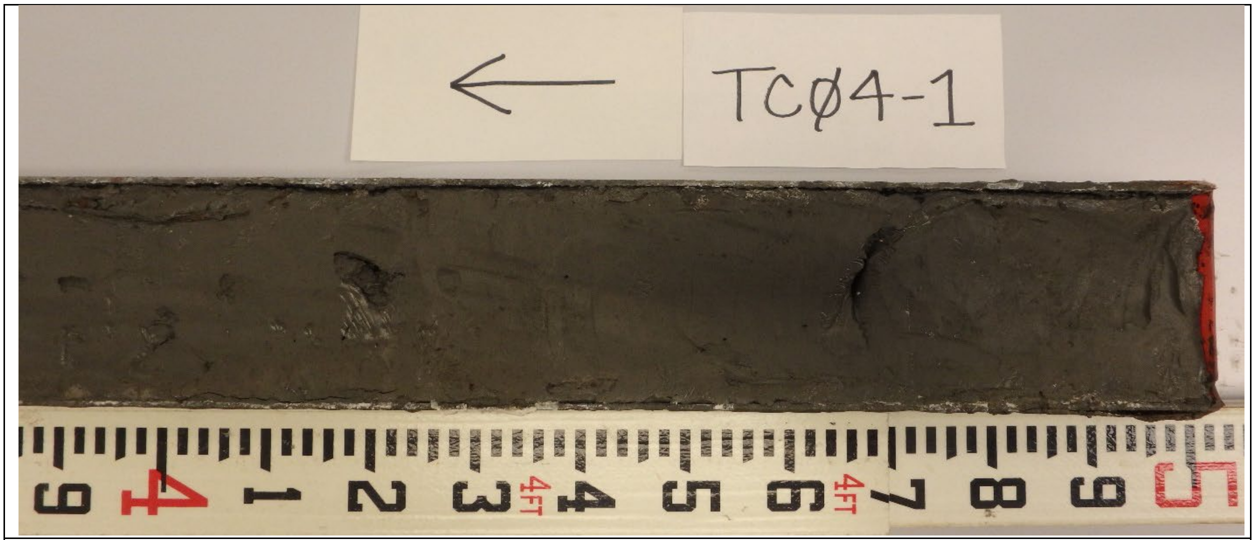

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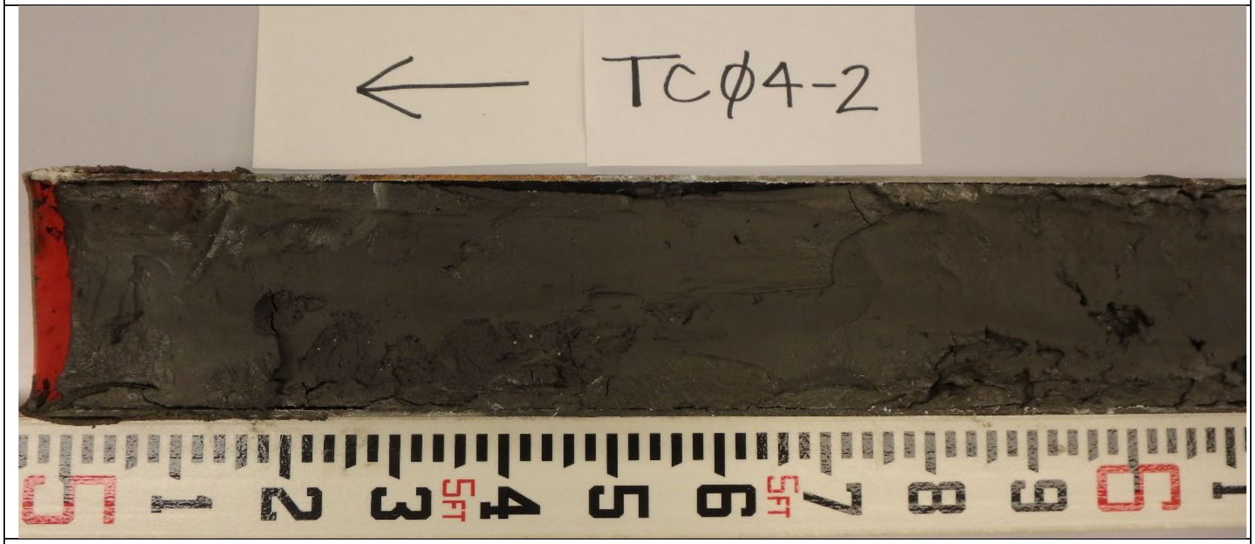

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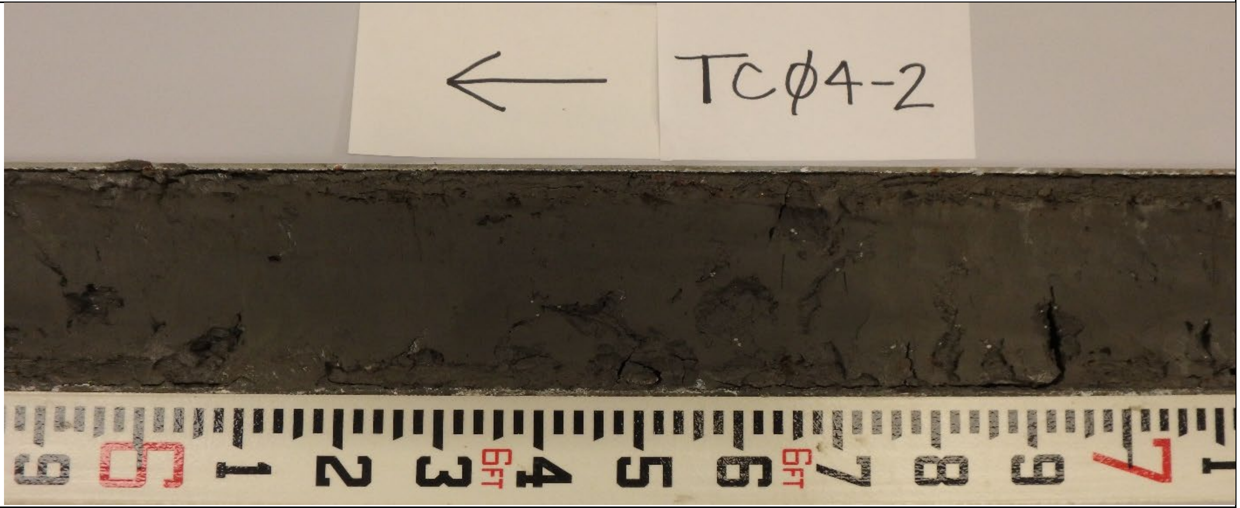
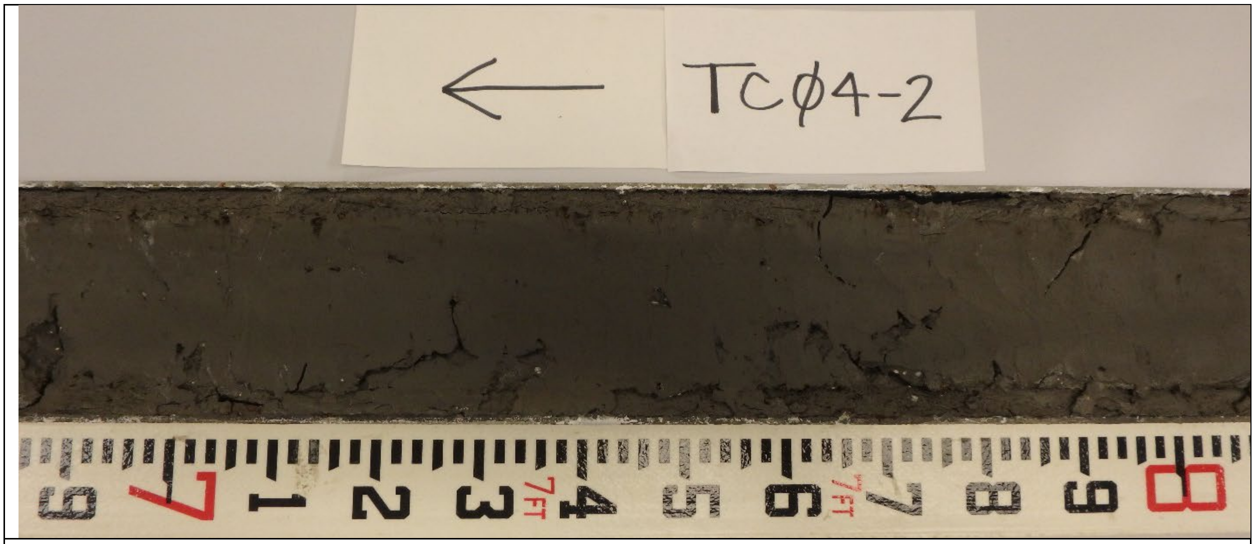
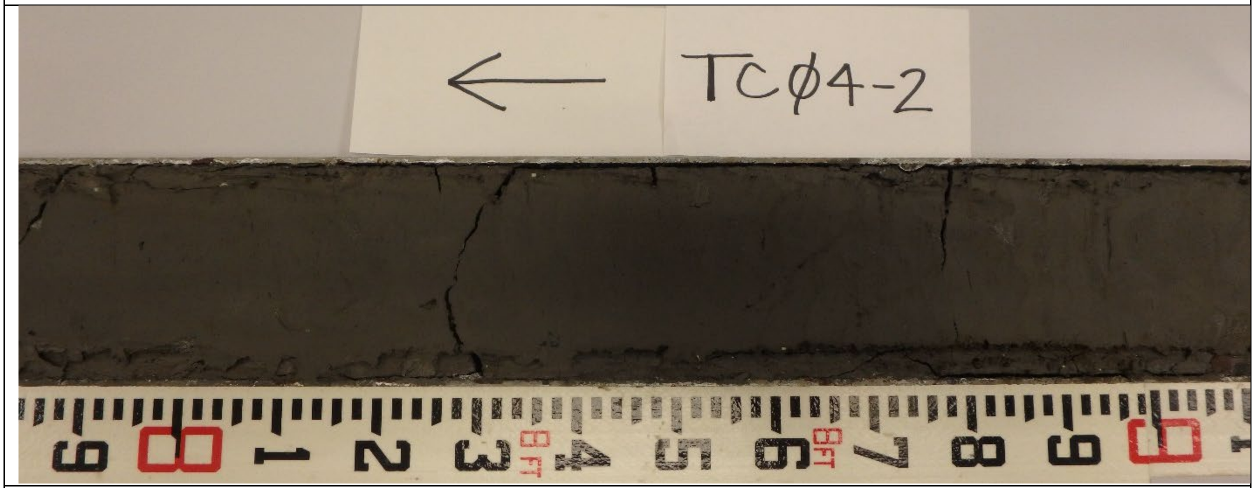


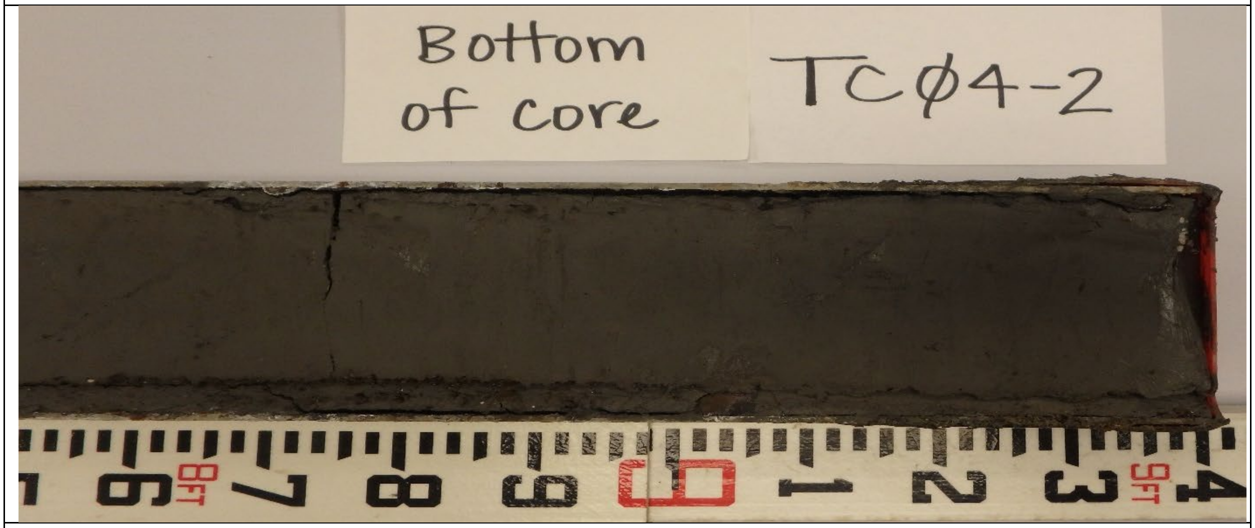
Timberneck Creek Core 4 Section 2 5.9 ft – 7.1 ft



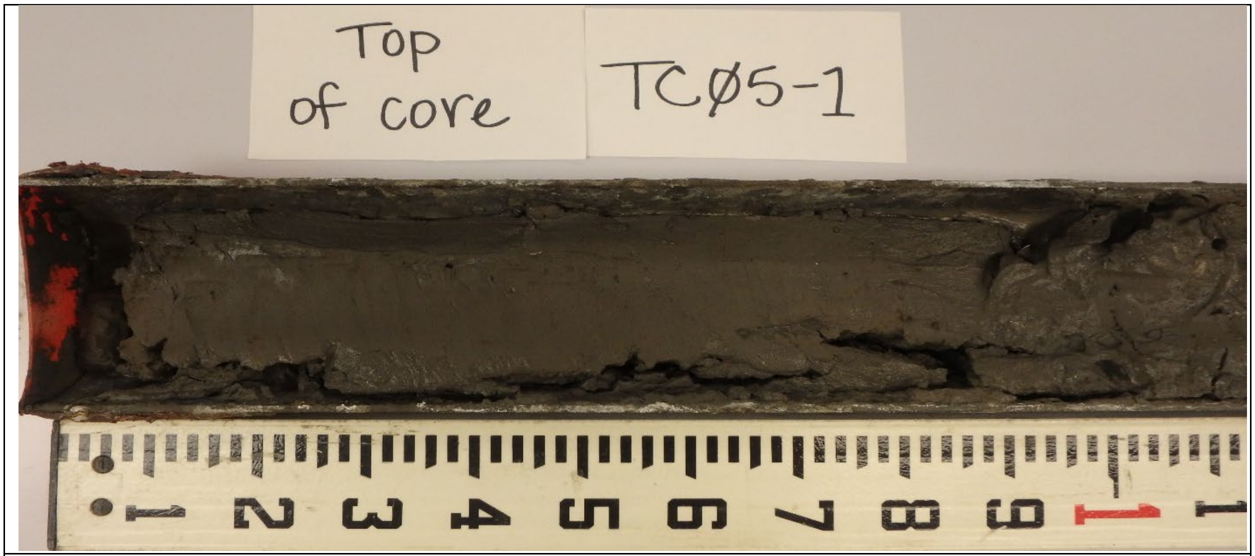
Timberneck Creek Core 4 Section 2 6.9 ft – 8 ft



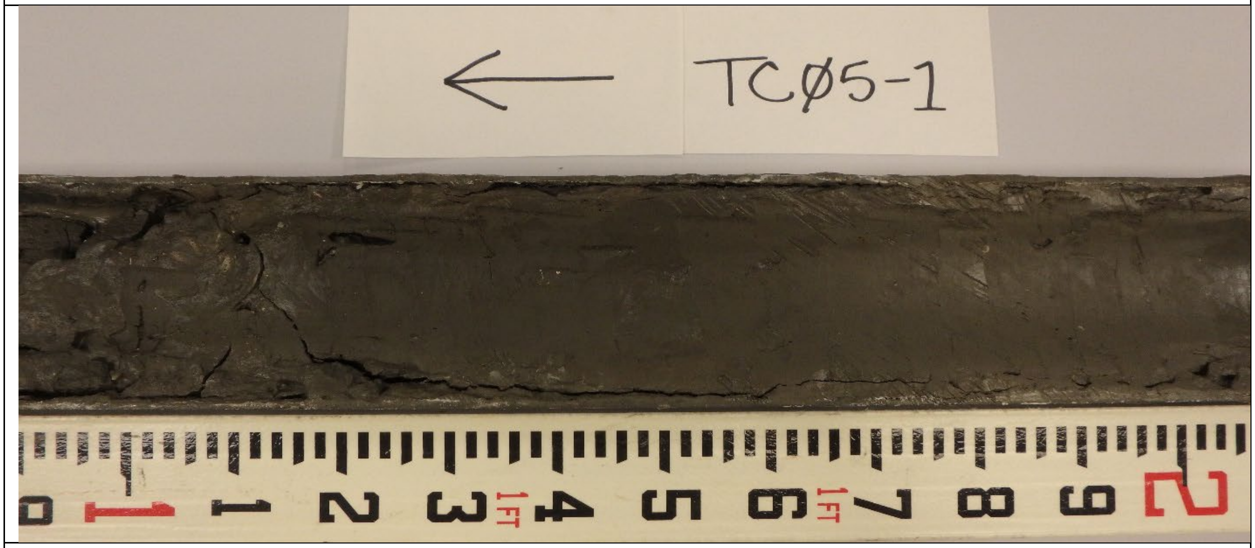
Timberneck Creek Core 4 Section 2 7.9 ft – 9 ft



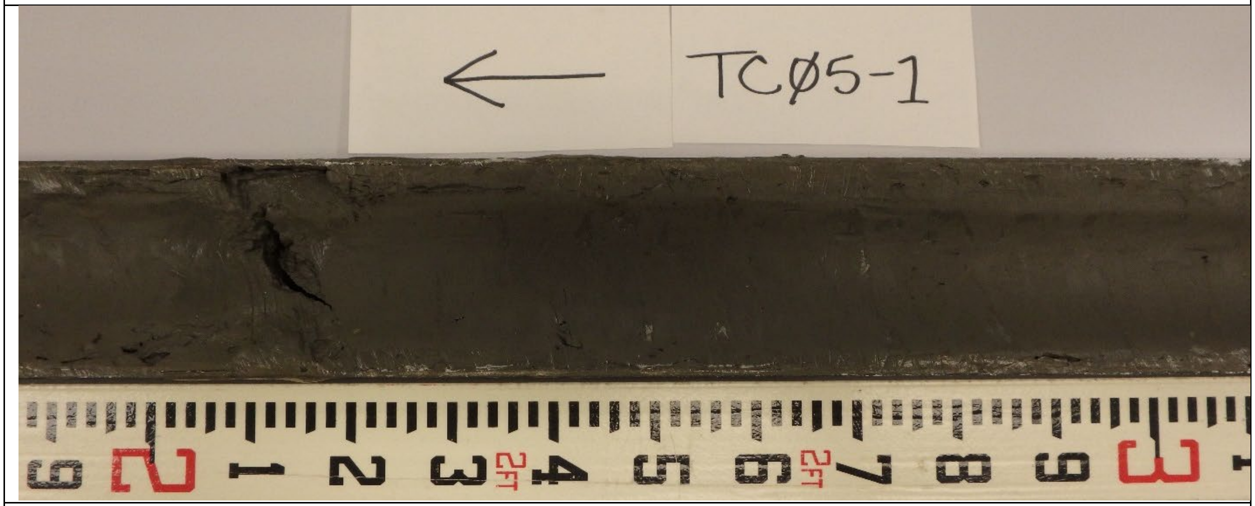
Timberneck Creek Core 4 Section 2 8.5 ft – 9.4 ft



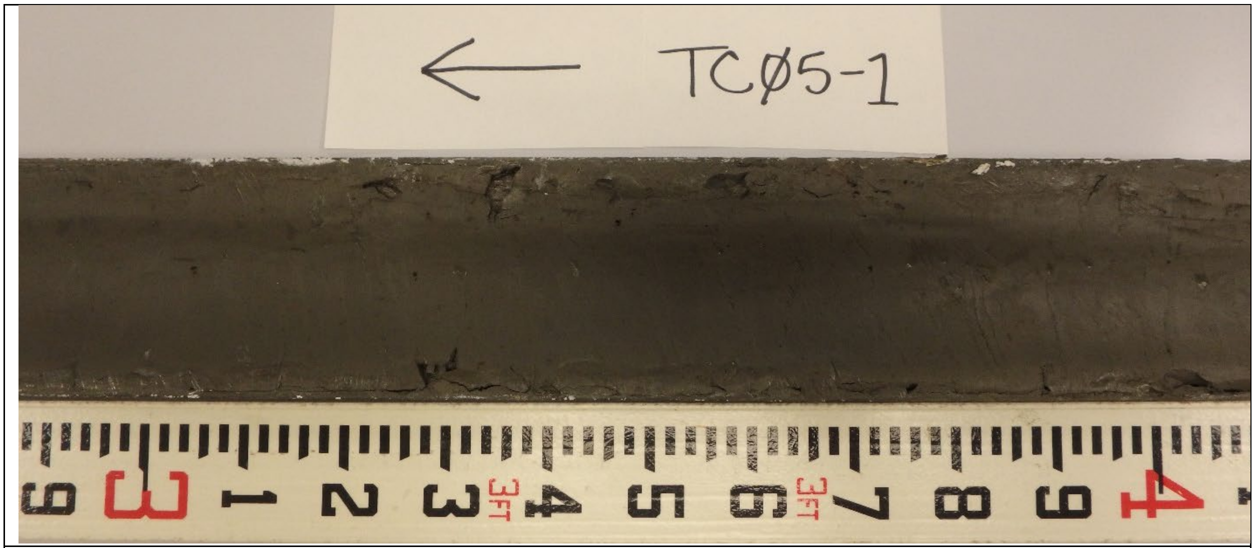
Timberneck Creek Core 5 Section 1 0 ft – 1.1 ft



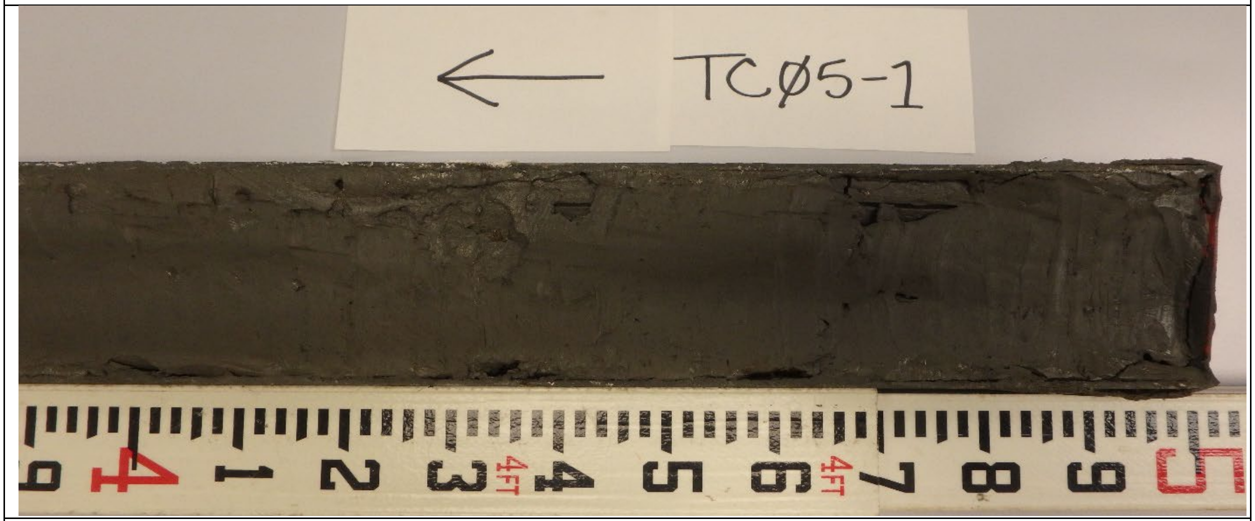
Timberneck Creek Core 5 Section 1 1 ft – 2 ft



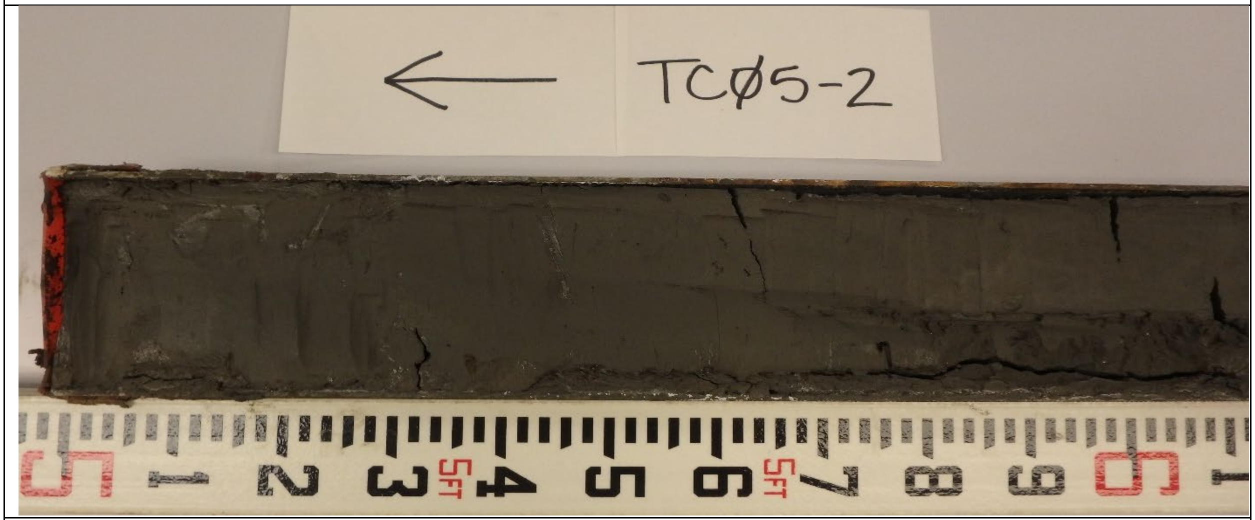
Timberneck Creek Core 5 Section 1.9 ft – 3 ft



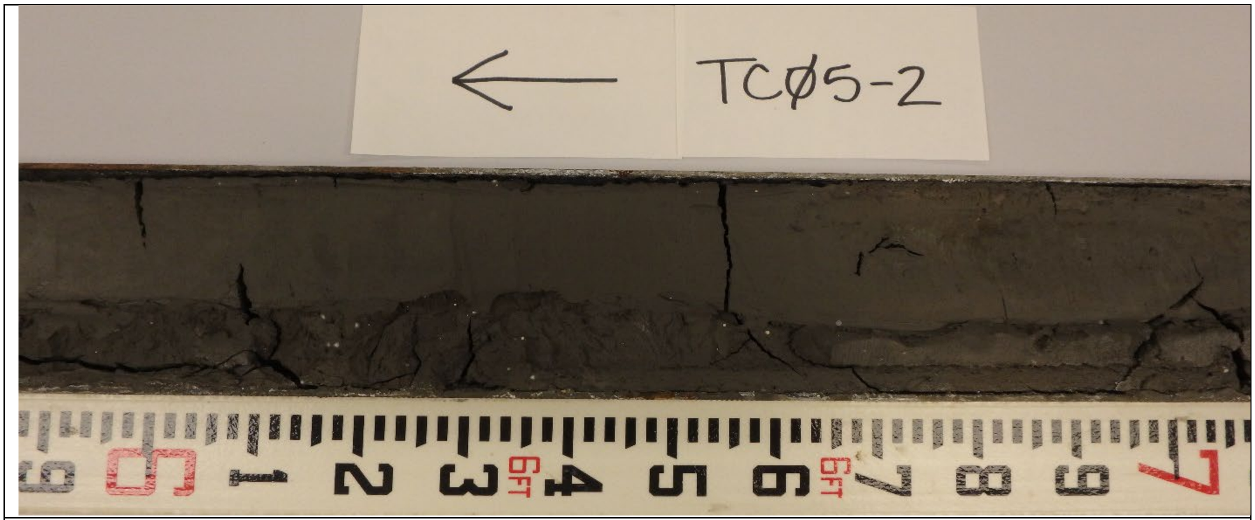
Timberneck Creek Core 5 Section 1 2.9 ft – 4 ft



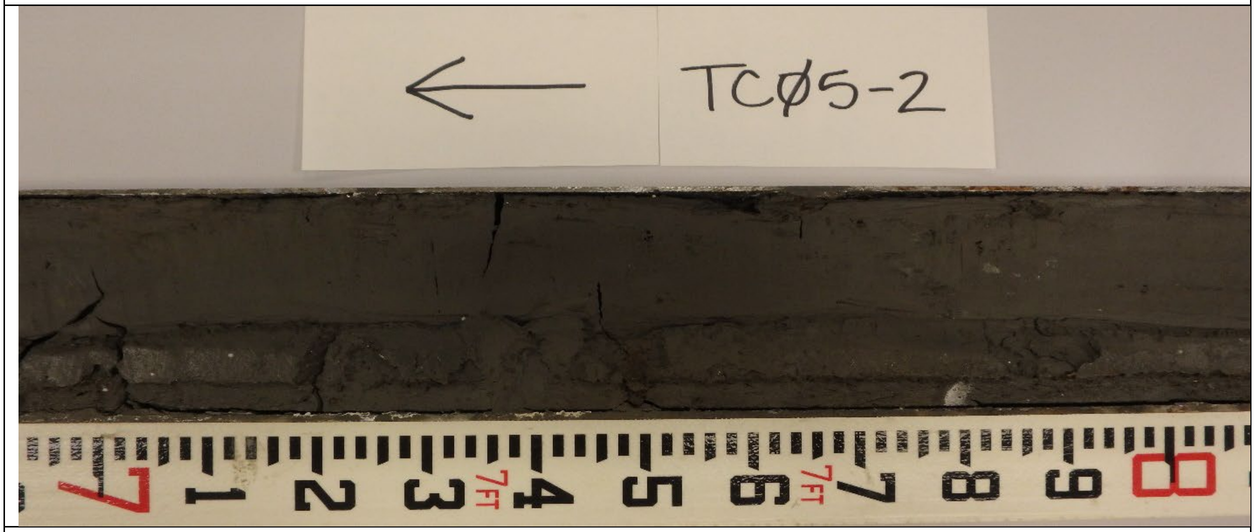
Timberneck Creek Core 5 Section 1 3.9 ft – 5 ft



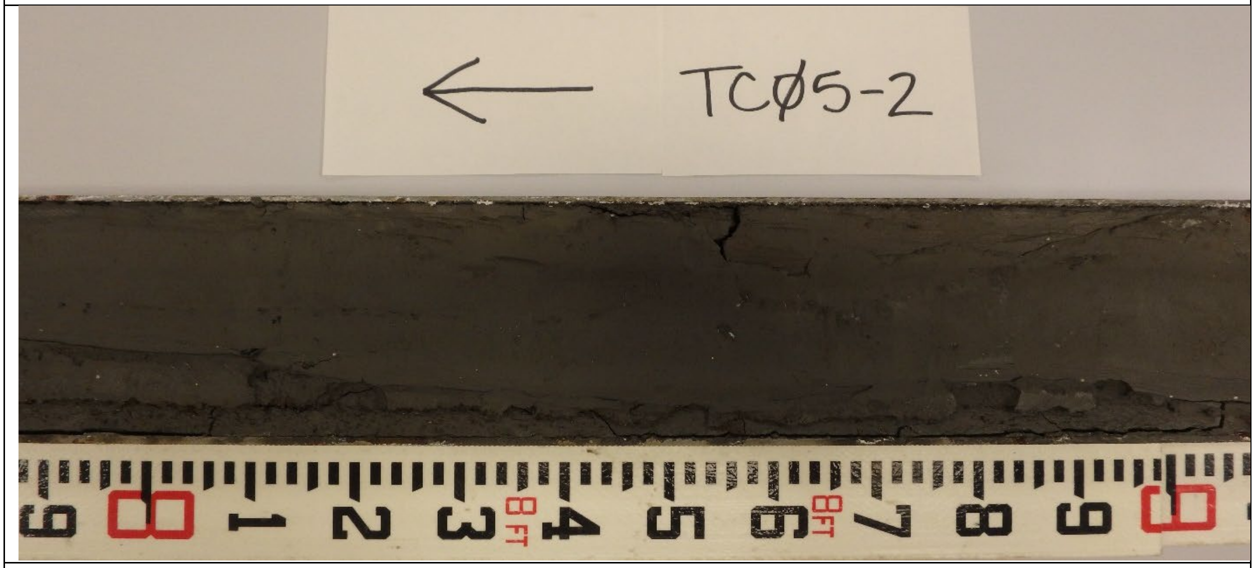
Timberneck Creek Core 5 Section 2 5 ft – 6.1 ft



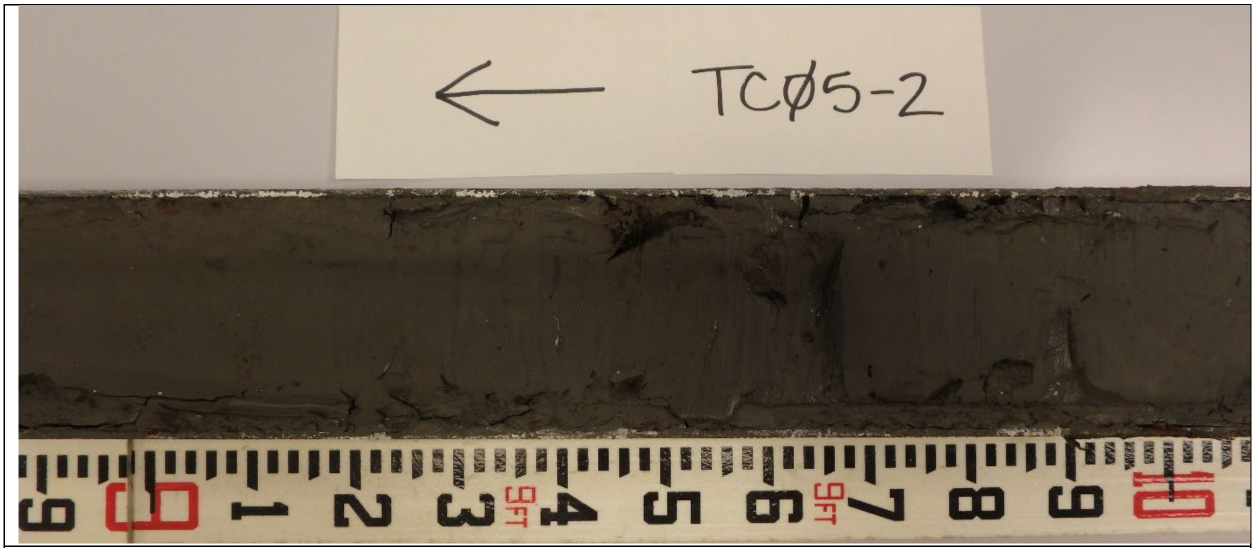
Timberneck Creek Core 5 Section 2 5.9 ft – 7 ft



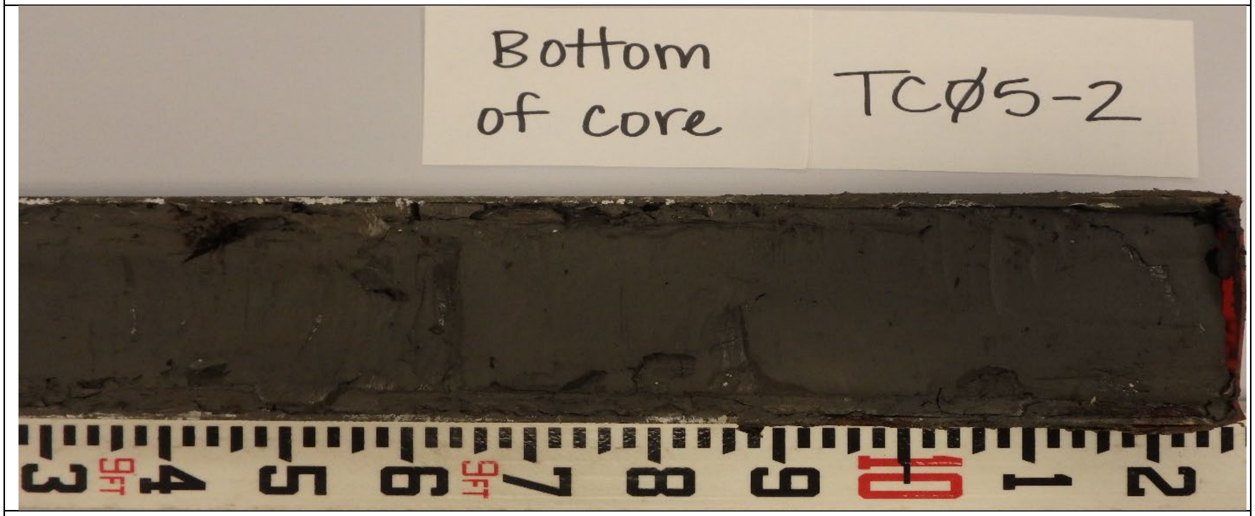
Timberneck Creek Core 5 Section 2 7 ft – 8 ft



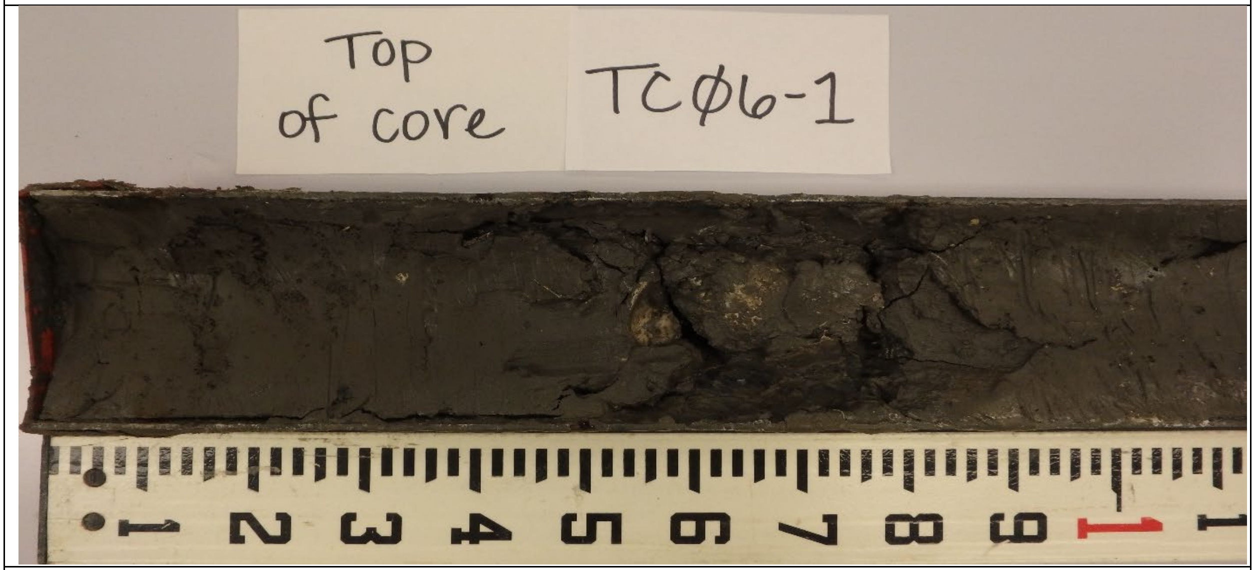
Timberneck Creek Core 5 Section 2 7.9 ft – 9 ft



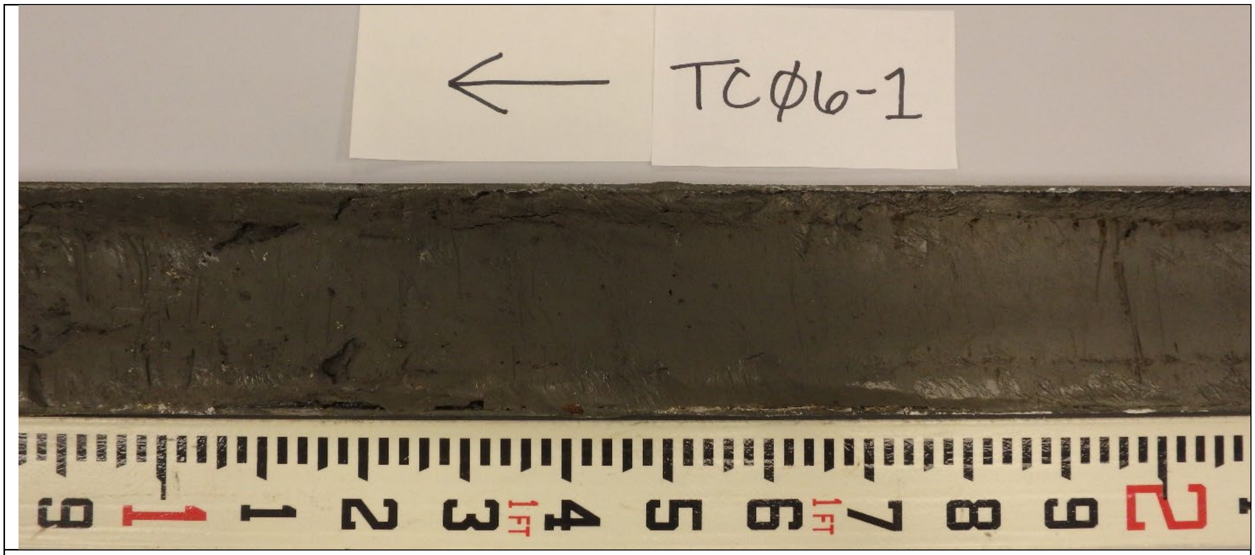
Timberneck Creek Core 5 Section 2 8.9 ft – 10.1 ft



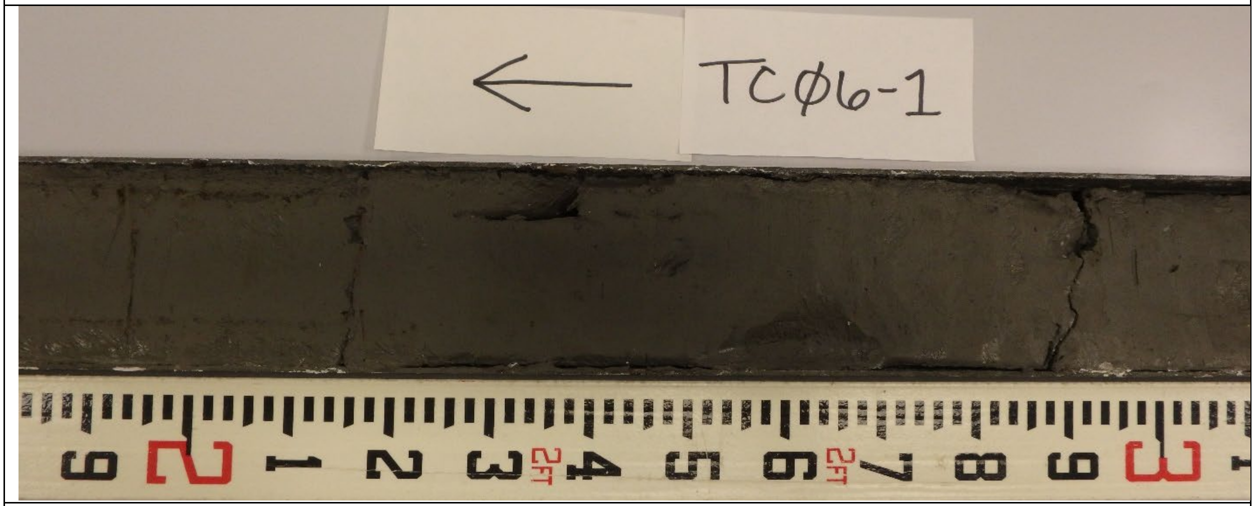
Timberneck Creek Core 5 Section 2 9.3 ft – 10.25 ft



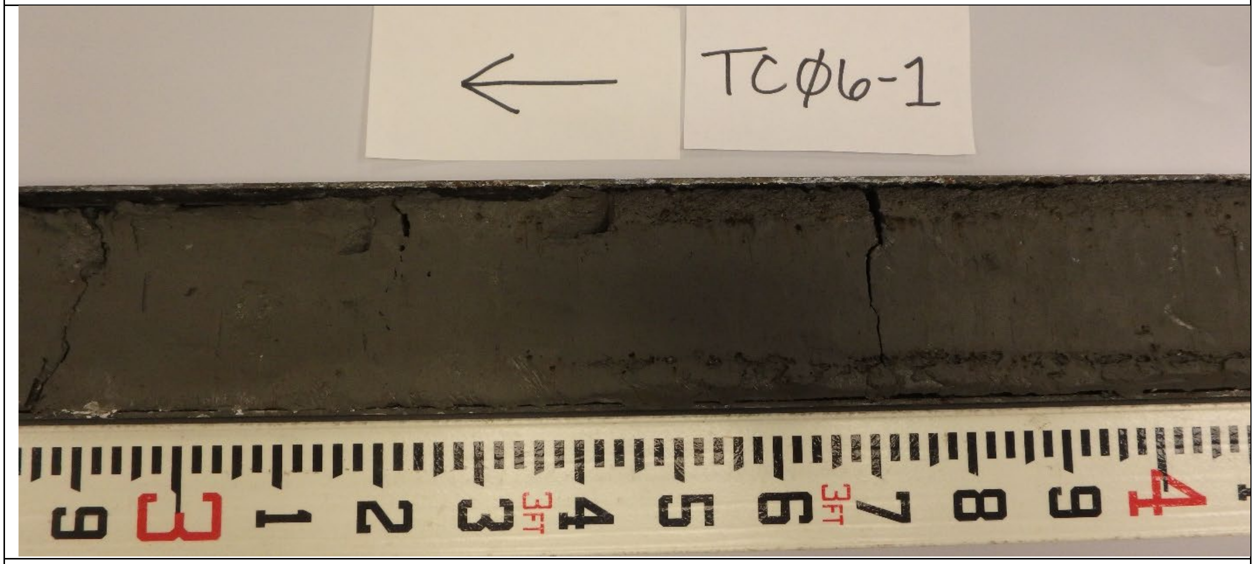
Timberneck Creek Core 6 Section 1 0 ft – 1.1 ft



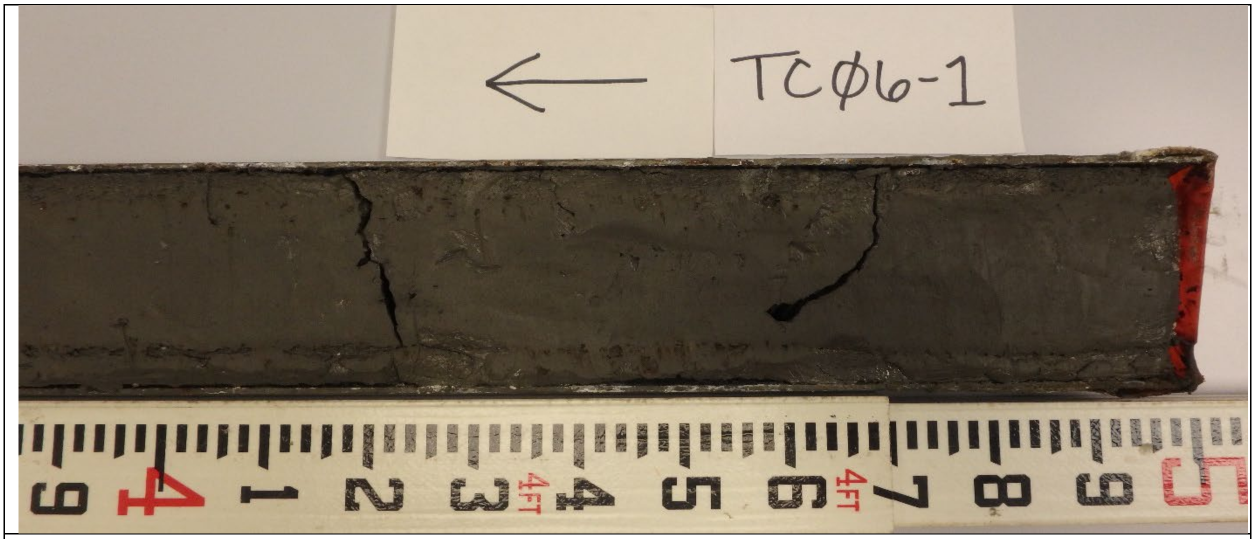
Timberneck Creek Core 6 Section 1 0.9 ft – 2 ft



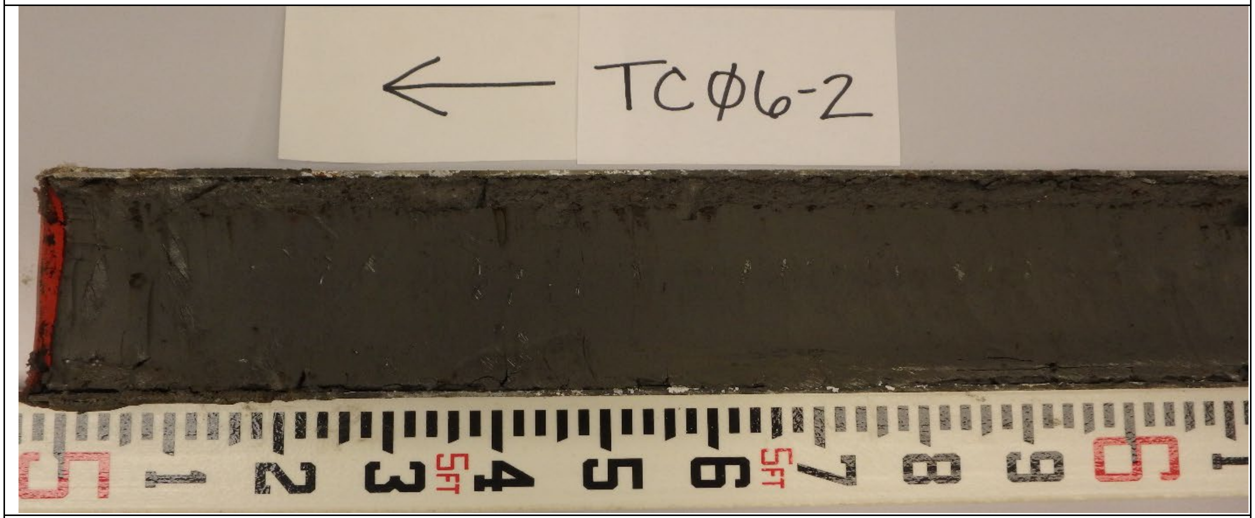
Timberneck Creek Core 6 Section 1 1.9 ft – 3 ft



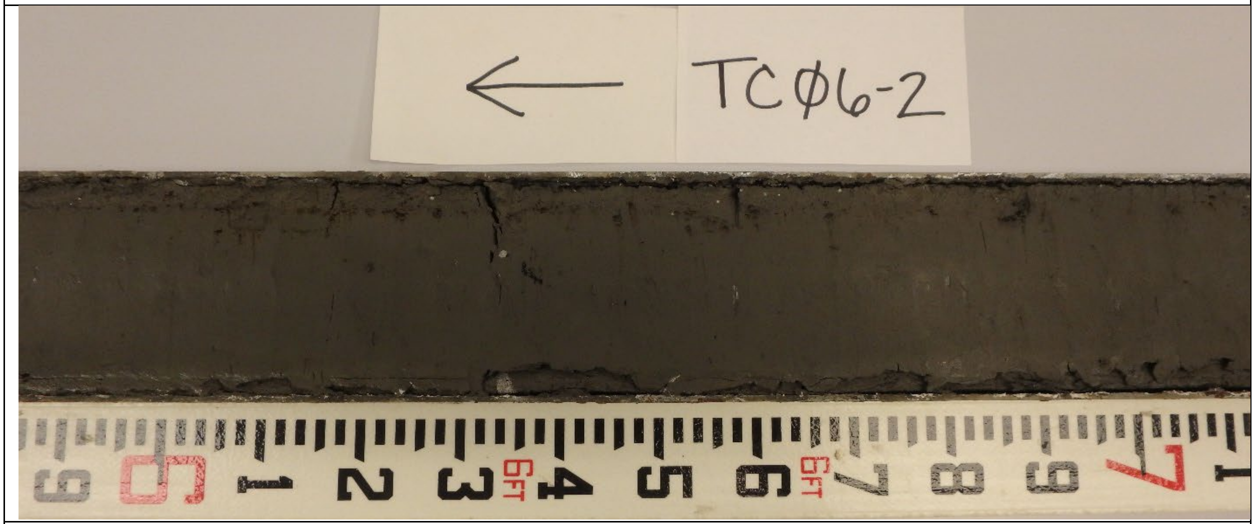
Timberneck Creek Core 6 Section 1 2.9 ft – 4 ft



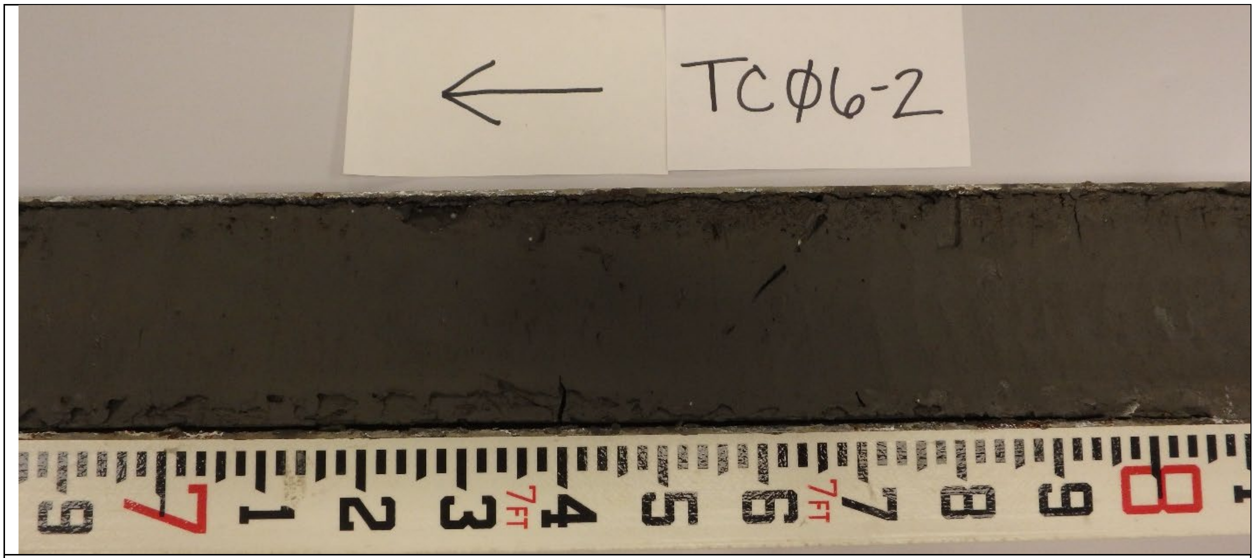
Timberneck Creek Core 6 Section 1 3.9 ft – 5 ft



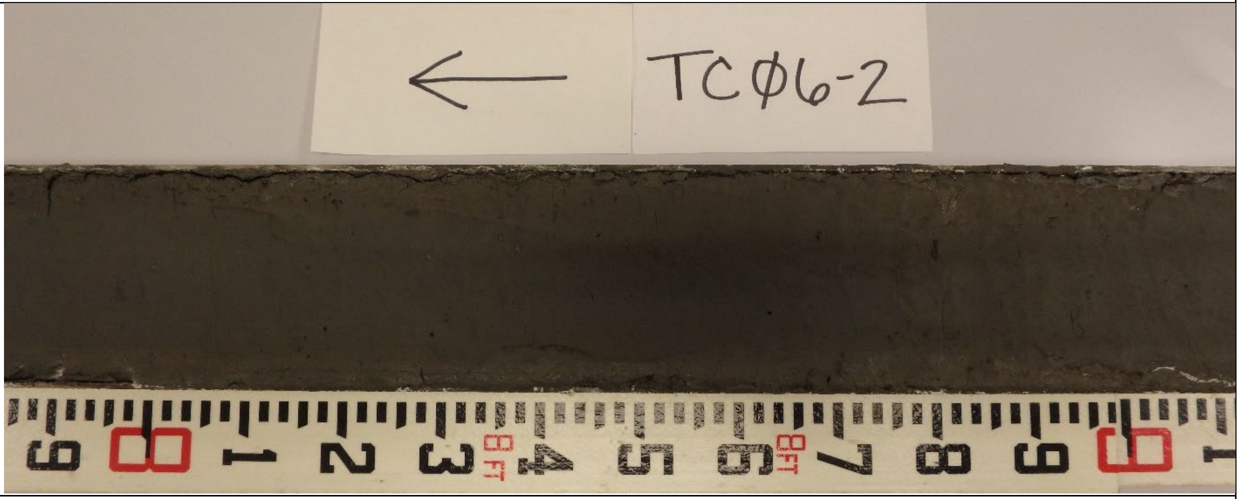
Timberneck Creek Core 6 Section 2 5 ft – 6.1 ft



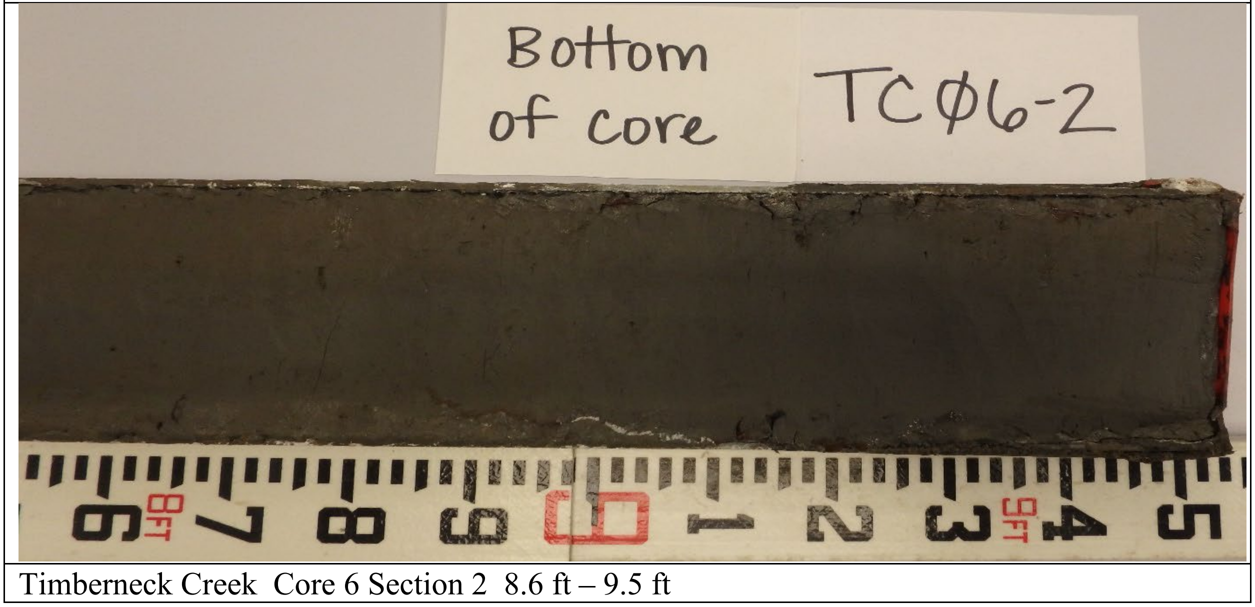
Timberneck Creek Core 6 Section 2 5.9 ft – 7.1 ft



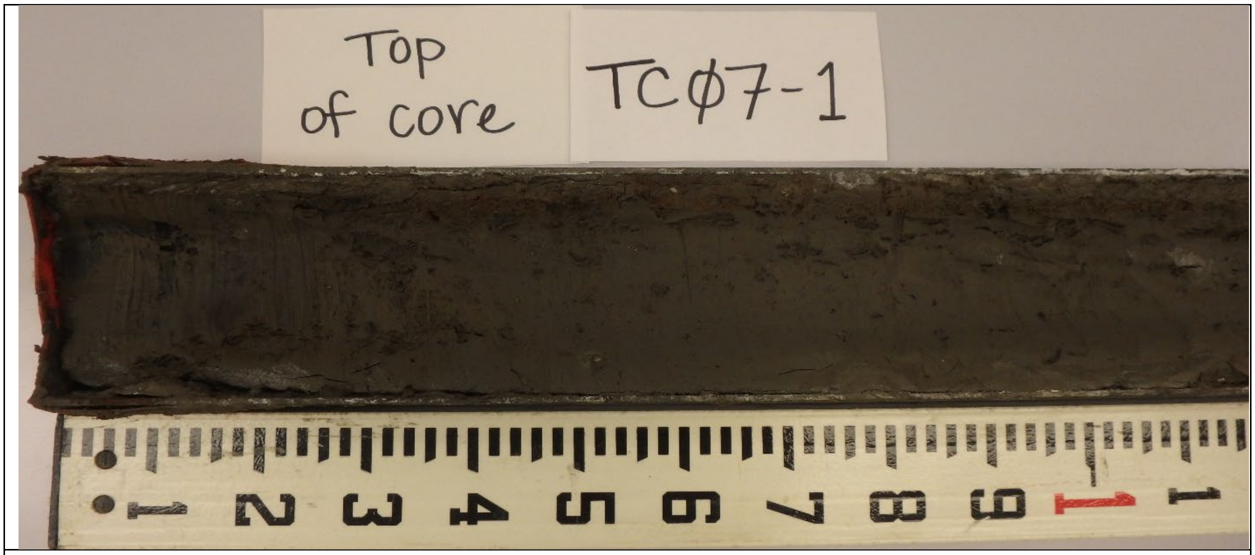
Timberneck Creek Core 6 Section 2 6.9 ft – 8 ft



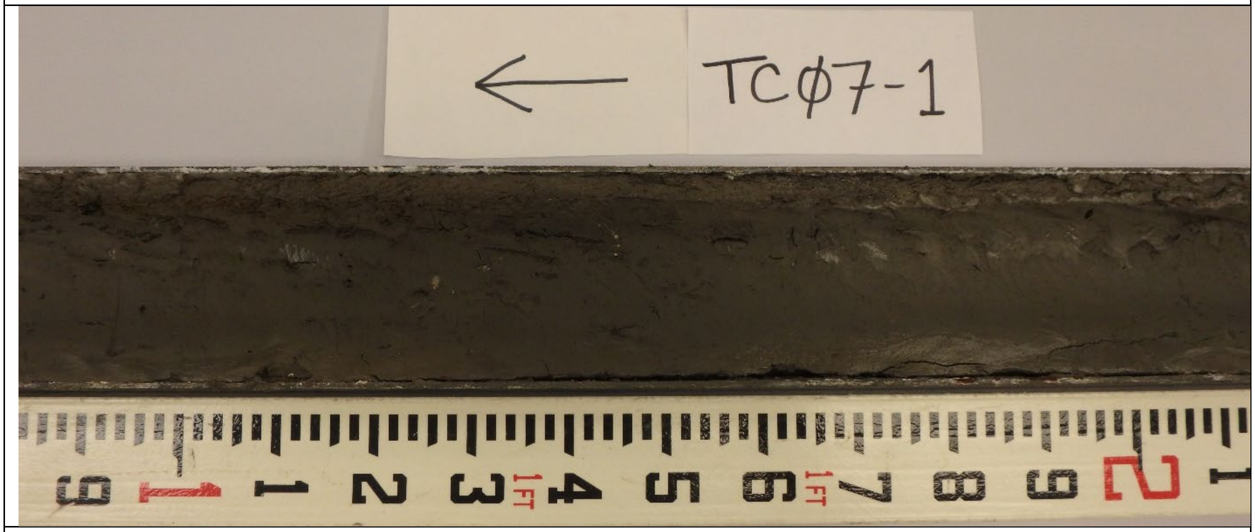
Timberneck Creek Core 6 Section 2 7.9 ft – 9.1 ft



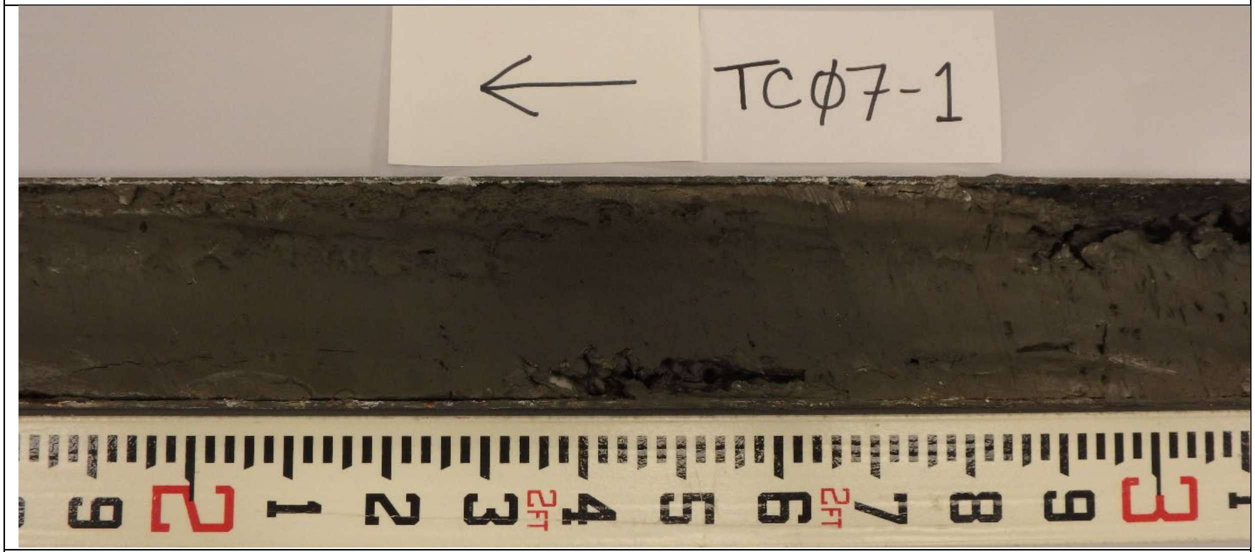
Timberneck Creek Core 6 Section 2 8.6 ft – 9.5 ft



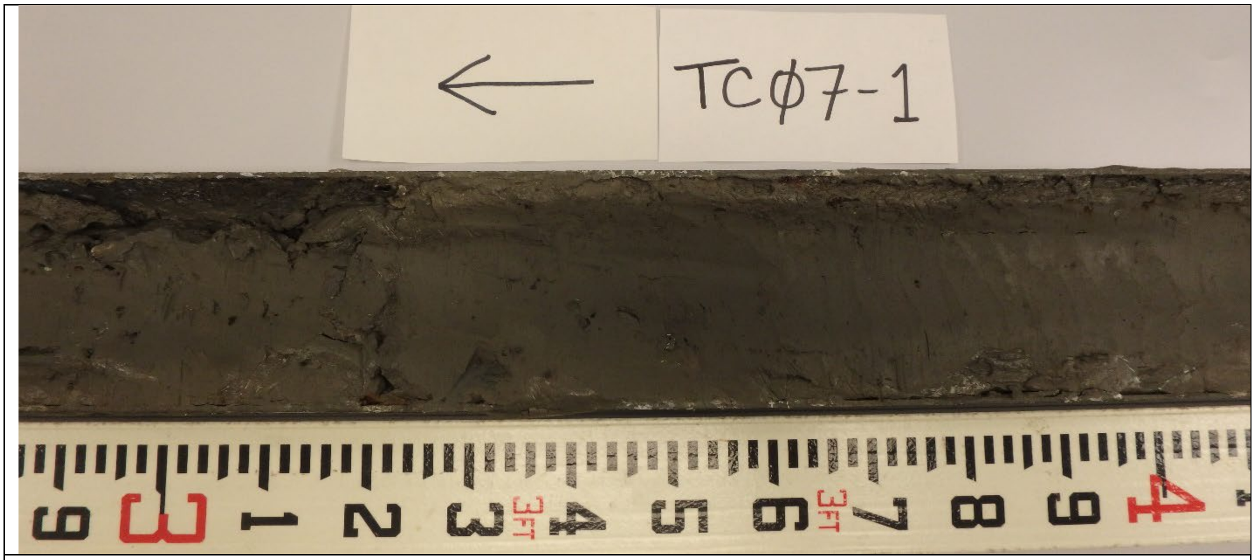
Timberneck Creek Core 7 Section 1 0 ft – 1.1 ft



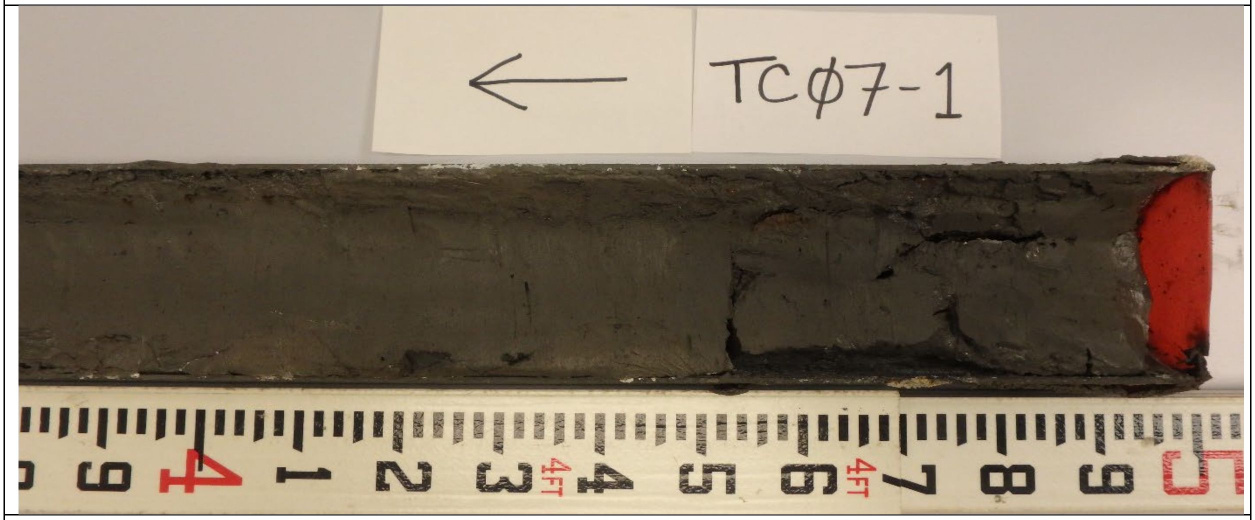
Timberneck Creek Core 7 Section 1 0.9 ft – 2.1 ft



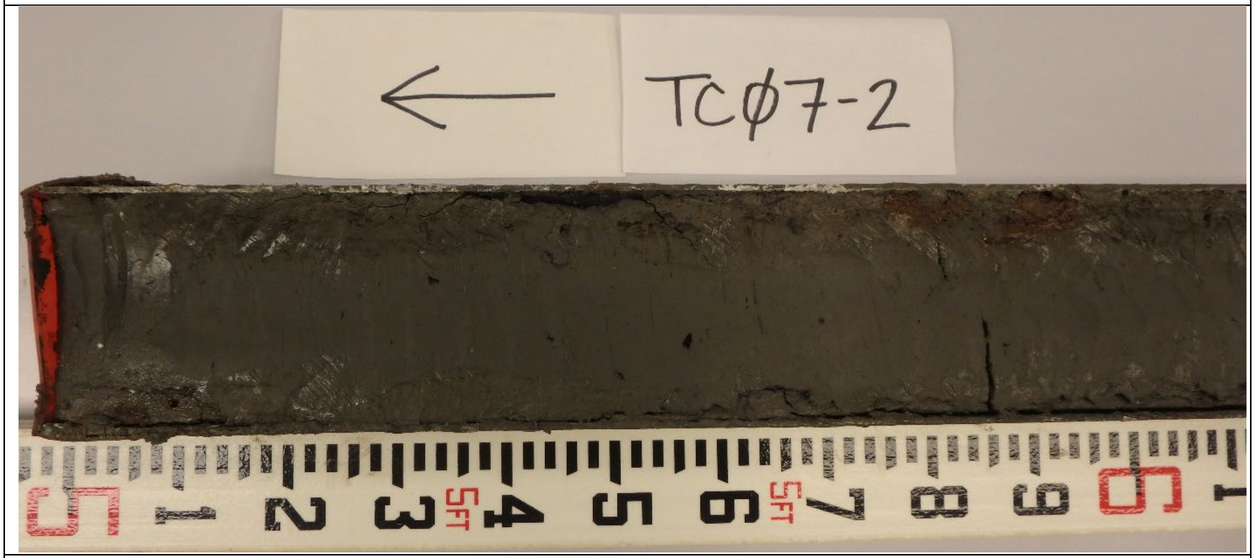
Timberneck Creek Core 7 Section 1 1.9 ft – 3.1 ft



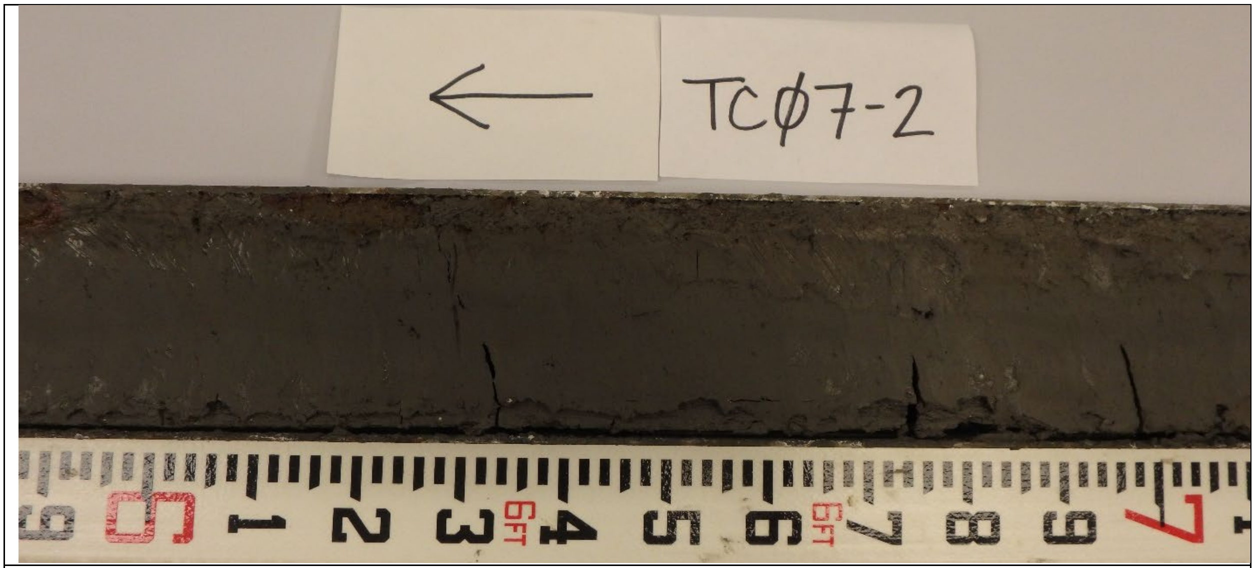
Timberneck Creek Core 7 Section 1 2.9 ft – 4 ft



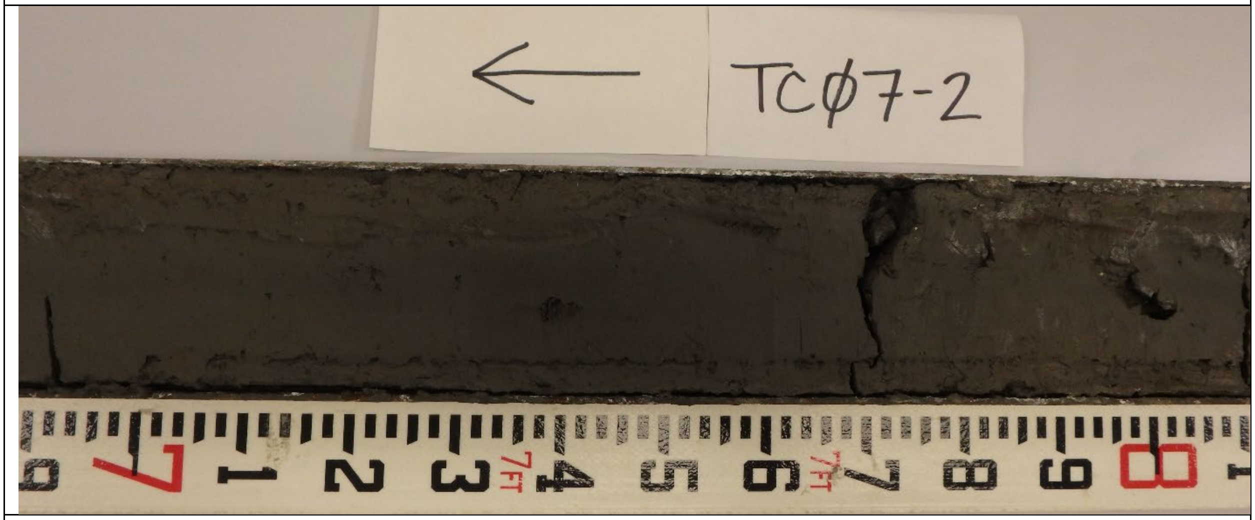
Timberneck Creek Core 7 Section 1 3.9 ft – 5 ft



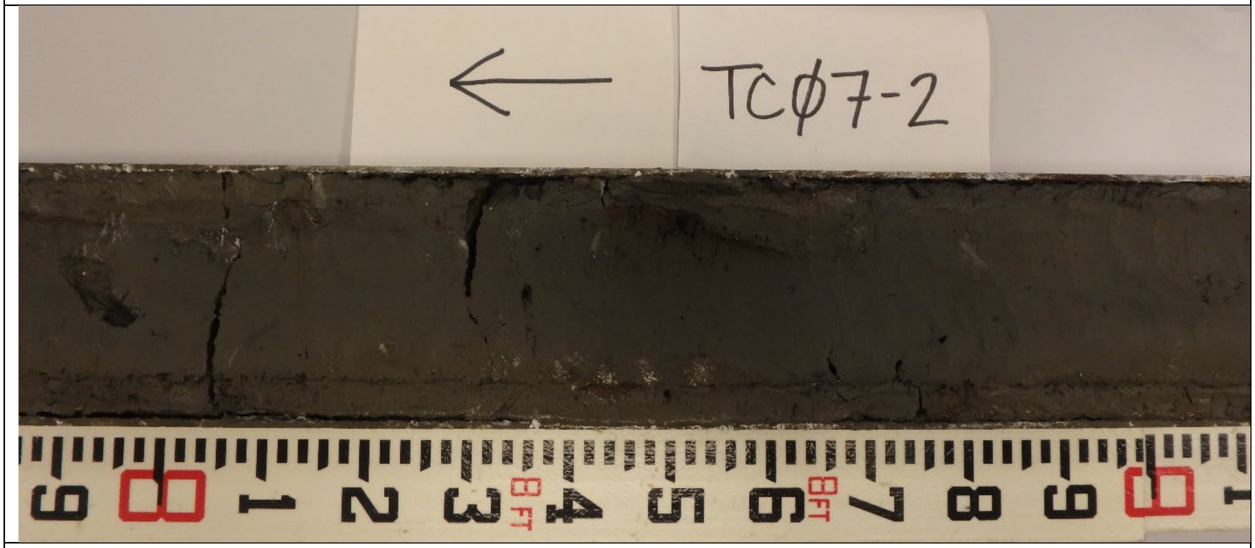
Timberneck Creek Core 7 Section 2 5 ft – 6.1 ft



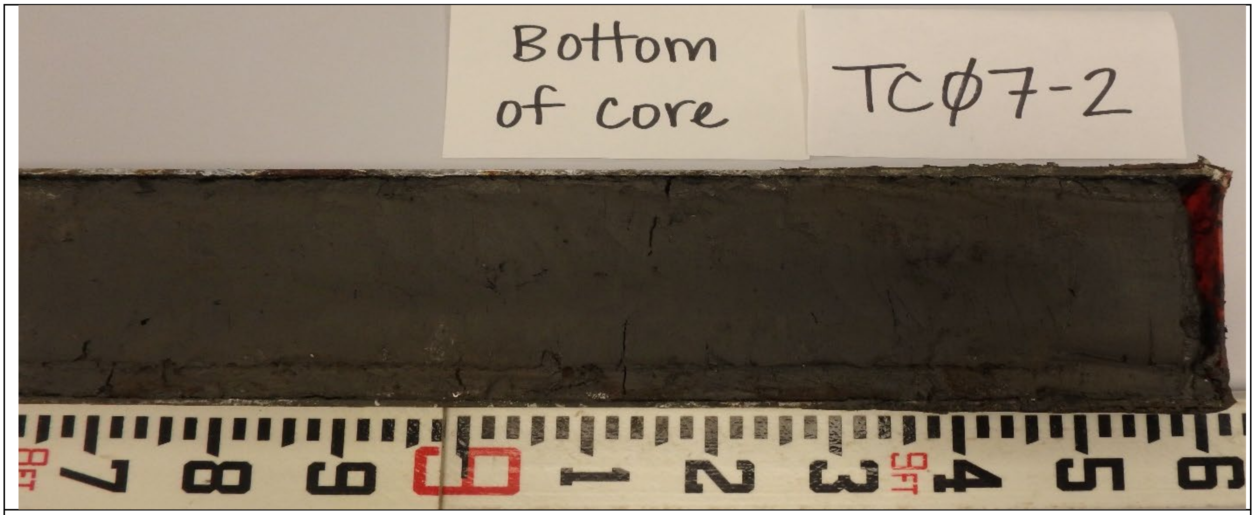
Timberneck Creek Core 7 Section 2 5.9 ft – 7 ft



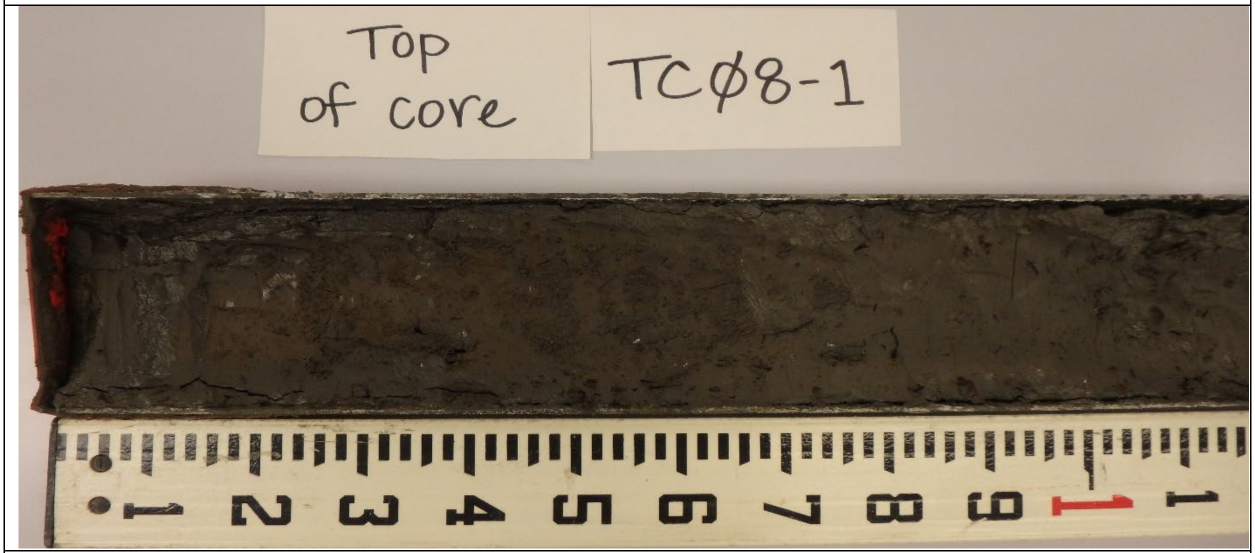
Timberneck Creek Core 7 Section 2 6.9 ft – 8 ft



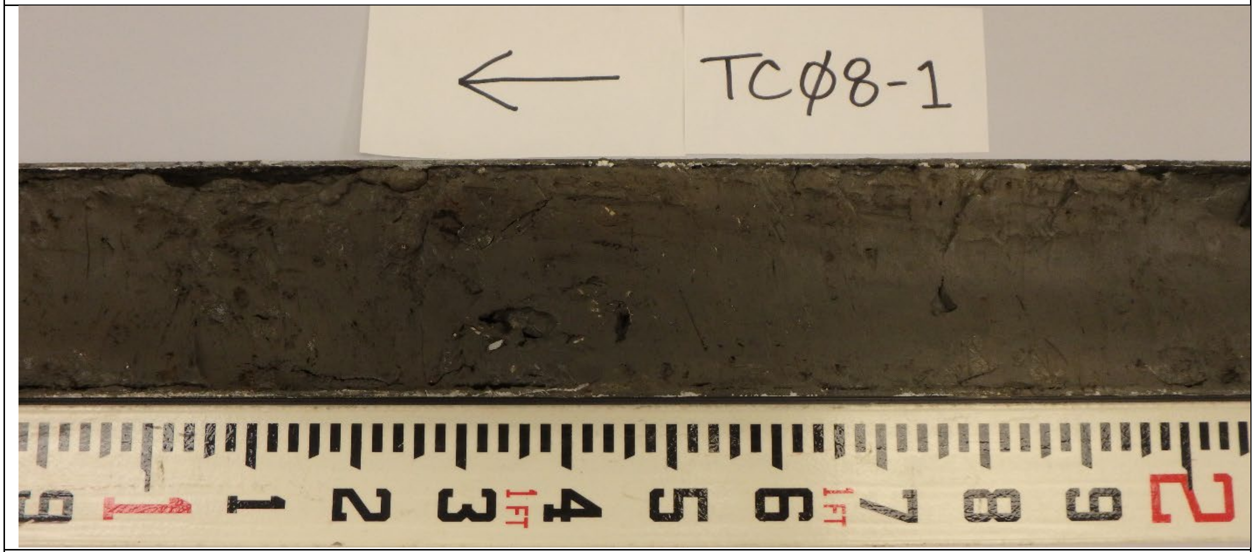
Timberneck Creek Core 7 Section 2 7.9 ft – 9.1 ft



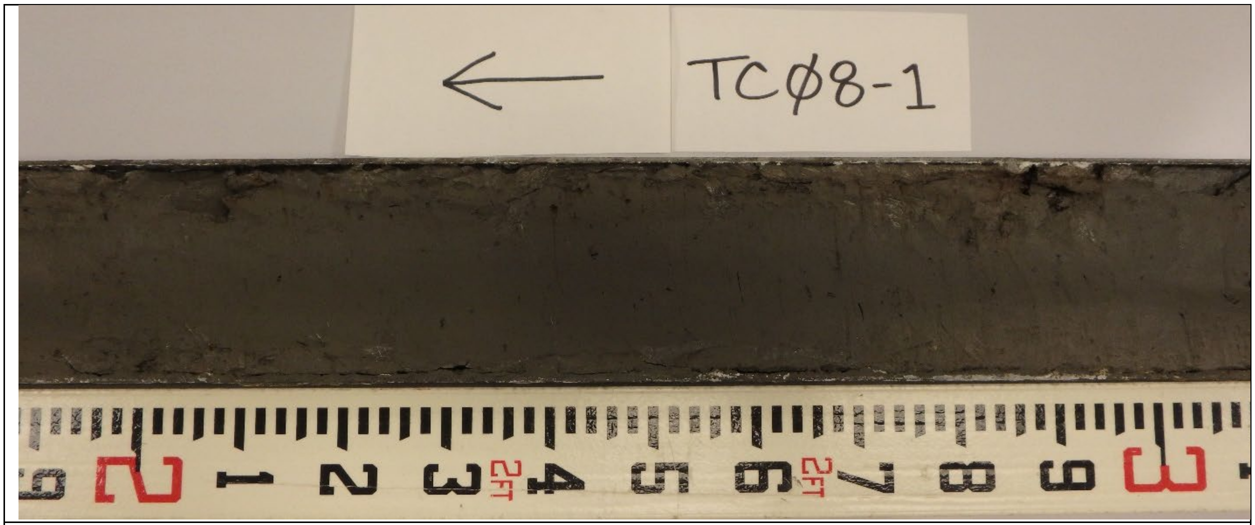
Timberneck Creek Core 7 Section 2 8.7 ft – 9.6 ft



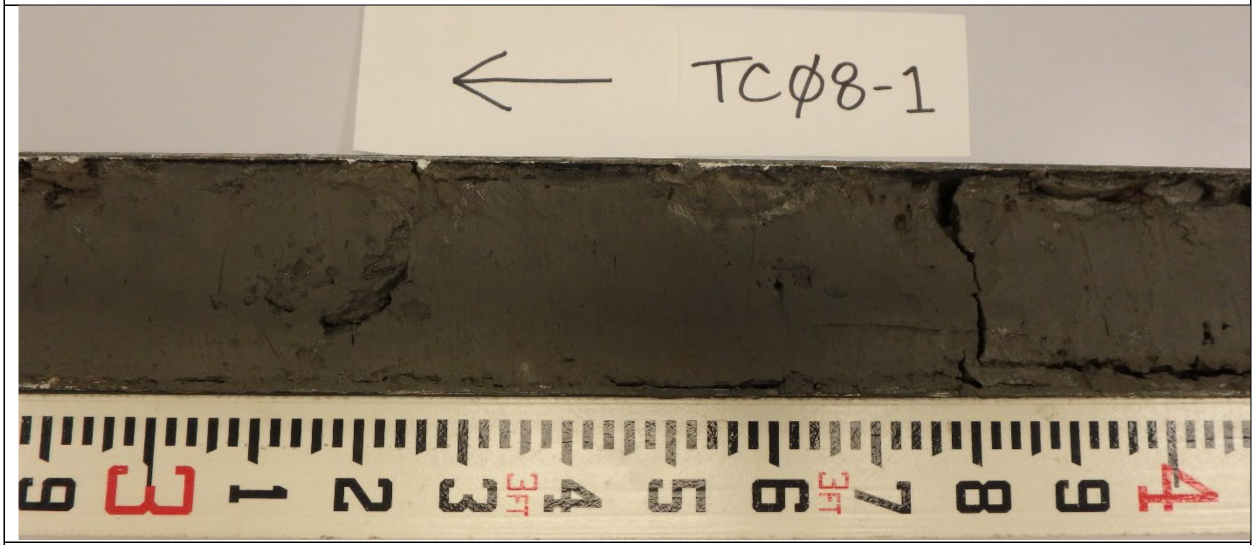
Timberneck Creek Core 8 Section 1 0 ft – 1.15 ft



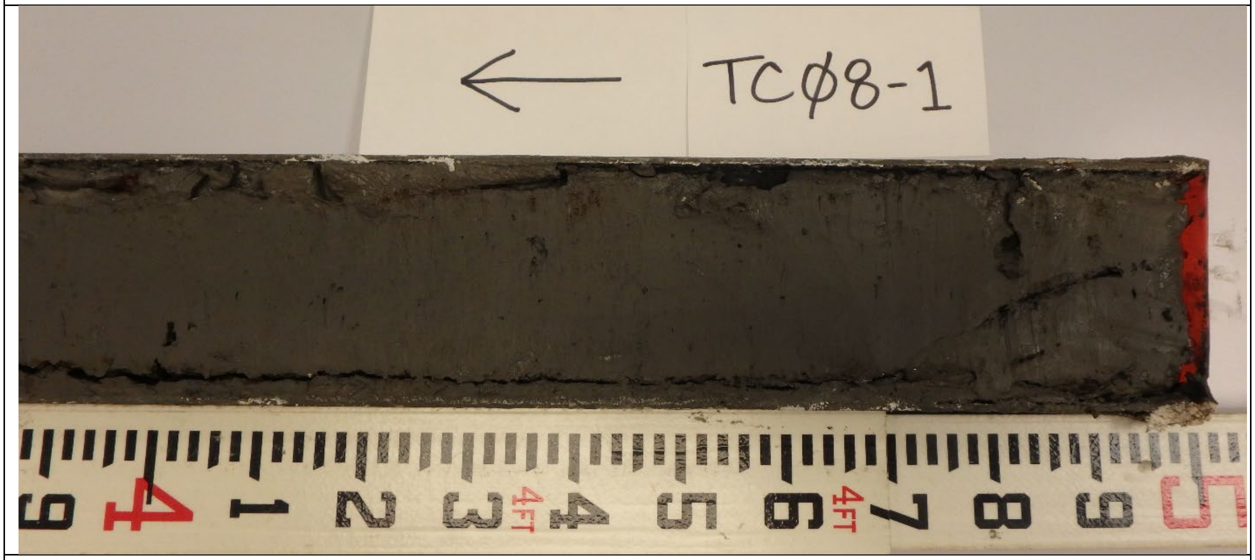
Timberneck Creek Core 8 Section 1 0.9 ft – 2 ft



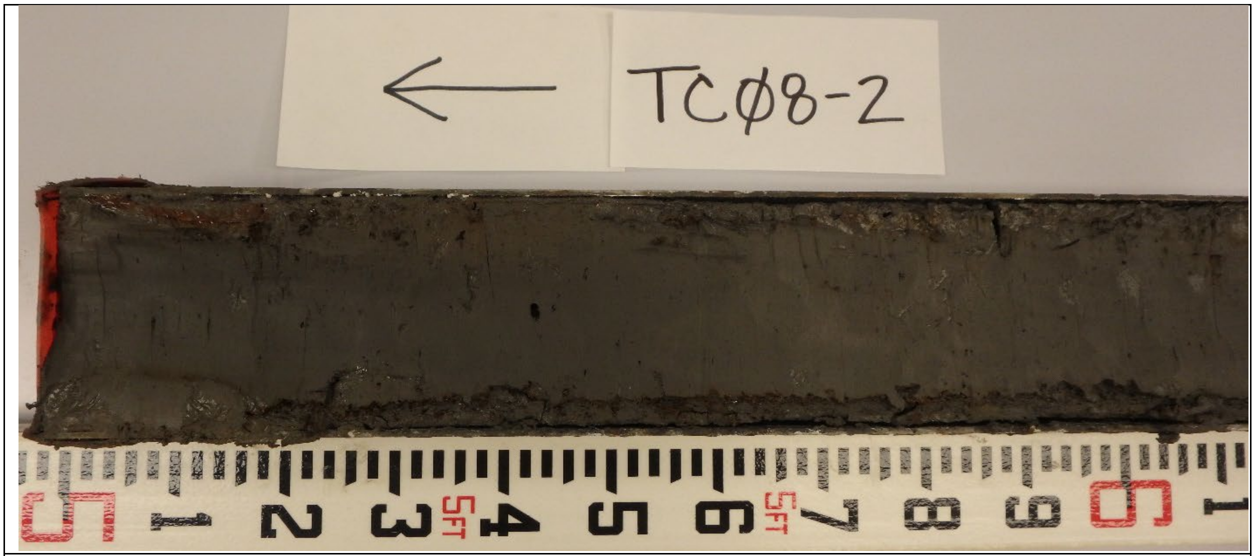
Timberneck Creek Core 8 Section 1 1.9 ft – 3 ft



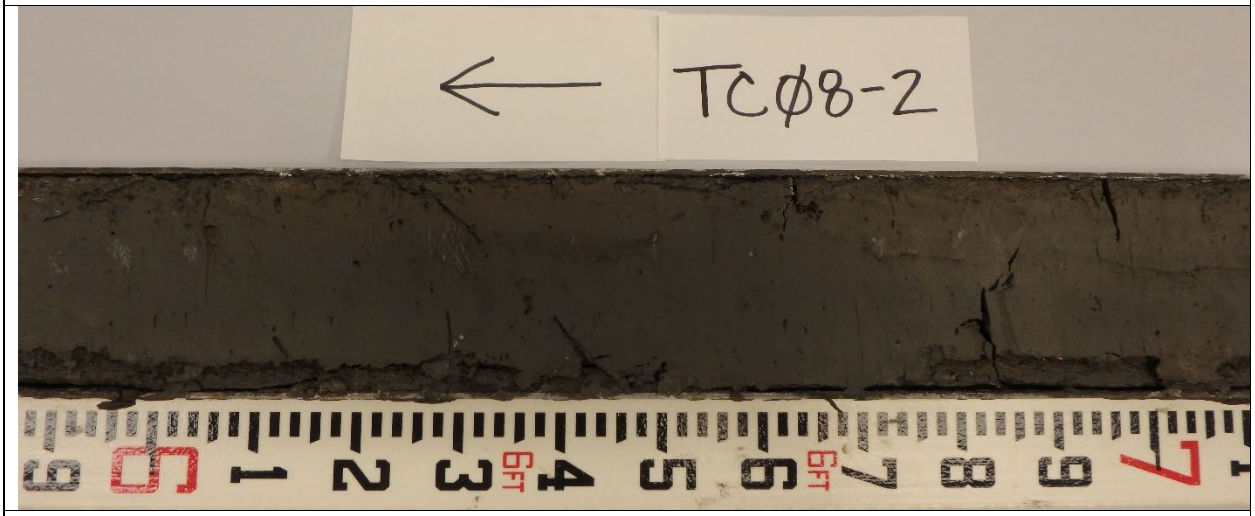
Timberneck Creek Core 8 Section 1 2.9 ft – 4 ft



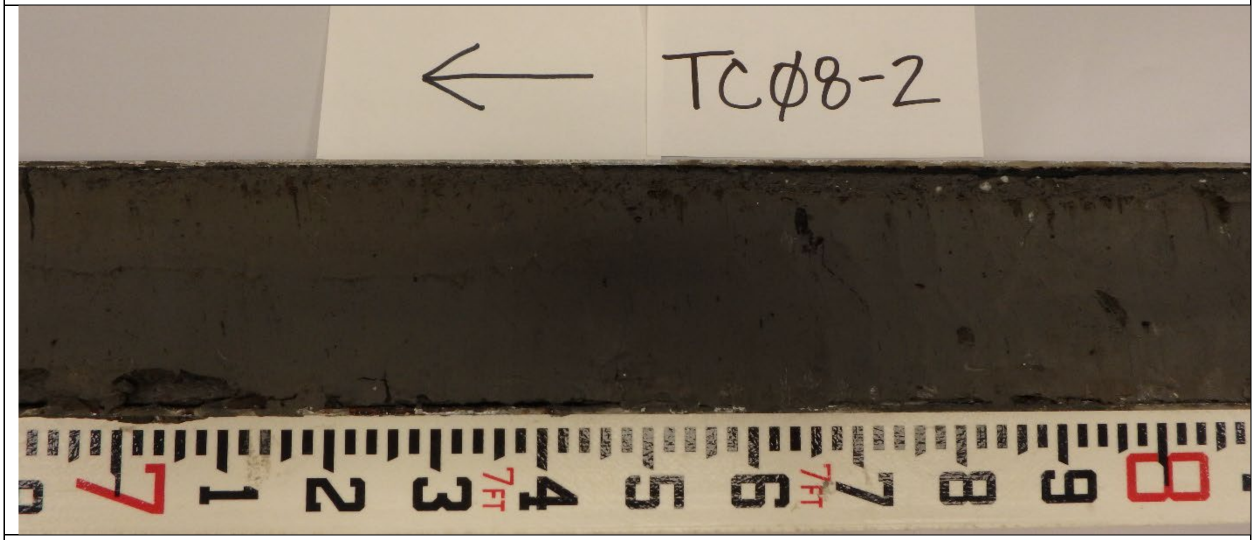
Timberneck Creek Core 8 Section 1 3.9 ft – 5 ft



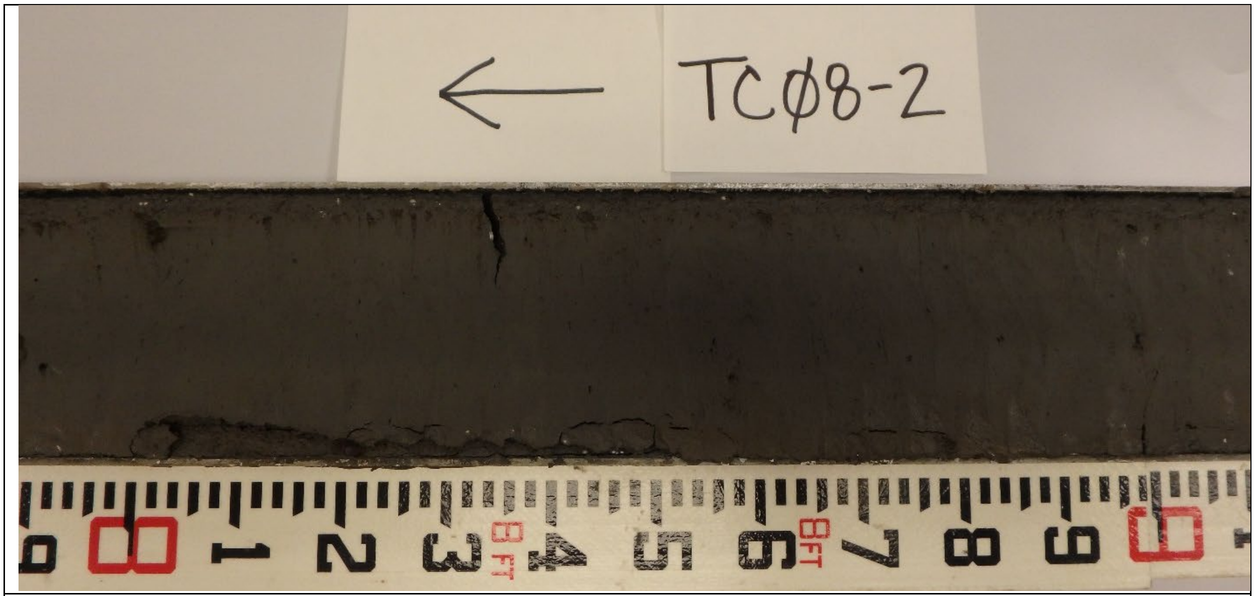
Timberneck Creek Core 8 Section 2 5 ft – 6.1 ft



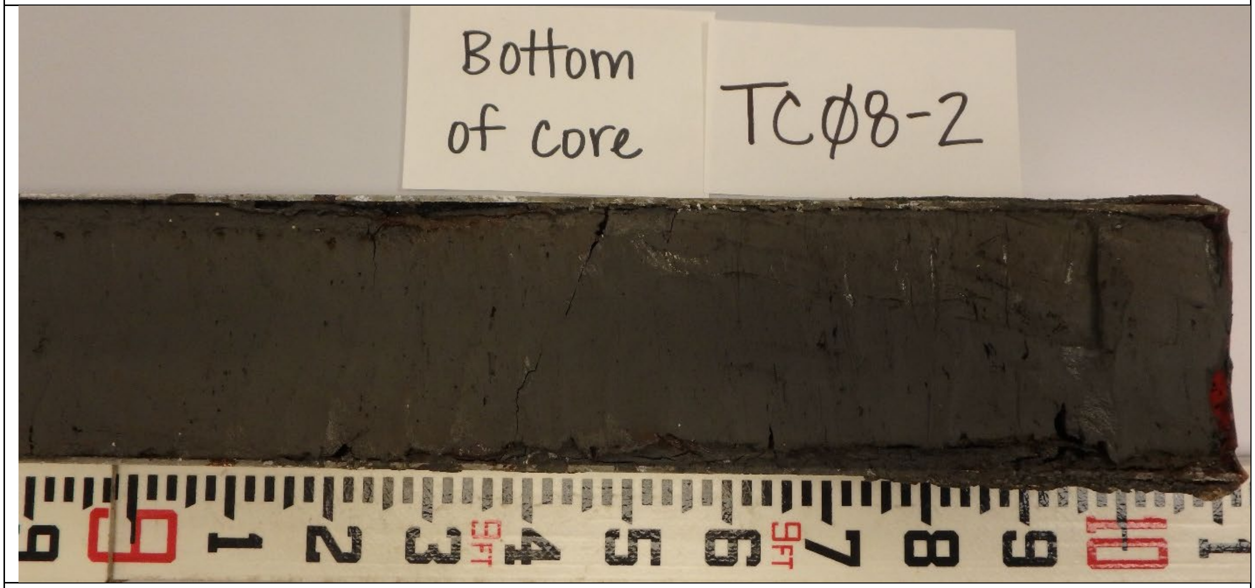
Timberneck Creek Core 8 Section 2 5.9 ft – 7.1 ft



Timberneck Creek Core 8 Section 2 7 ft – 8 ft



Timberneck Creek Core 8 Section 2 8 ft – 9.1 ft



Timberneck Creek Core 8 Section 2 8.9 ft – 10.1 ft

Appendix B

Core Logs

Timberneck Creek Core 1 Latitude: 37.2880 Longitude: -76.5415 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-5.3 to -10.3	▥	**ML**	clayey silt and very fine sand, sand content ranges from 20-50%, sediment is very mixed, no distinct units or layers, micaceous, abundant shells and shell fragments at 1-1.5 ft, clay content increases down core	olive gray	0/65.5/15.8/18.7 34.5 23.8	
1	5				**End of Section 1**			
2	5-10	-10.3 to -15.3	▥	**ML**	silty clay and very fine to fine sand, sand content ranges from 20-50%, no distinct units or layers, micaceous, some shells/shell fragments and plant/wood fragments throughout	olive gray	0/56.4/21.9/21.7 43.6 26.8	
2	10				**End of Section 2**			
Core	10				**End of Core**			

Timberneck Creek Core 2 Latitude: 37.2896 Longitude: -76.5402 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4.9 to -9.9	▥	**ML**	clayey silt and very fine to fine sand, sand content ranges from 20-50%, no distinct units or layers, micaceous, abundant shells and shell fragments at 0.8-1.6 ft	olive gray	0/70.6/11.2/18.2 29.4 28.6	
1	5				**End of Section 1**			
2	5-8.5	-9.9 to -13.4	▥	**ML**	clayey silt with some very fine to fine sand, micaceous, plant/wood fragments throughout	olive gray	0/42.4/27.0/30.6 57.6 34.5	
2	8.5				**End of Section 2**			
Core	8.5				**End of Core**			

Timberneck Creek Core 3 Latitude: 37.2905 Longitude: -76.5375 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4.7 to -9.7	▥	**ML**	clayey silt with trace fine sand, micaceous, some plant/wood fragments, some shell fragments	olive gray	0/8.5/37.5/54.0 91.5 48.1	
1	5				**End of Section 1**			
2	5-10.1	-9.7 to -14.8	▥	**ML**	clayey silt with trace fine sand, clay content increases down core, micaceous	olive gray	0/22.7/36.4/40.9 77.3 41.4	
2	10.1				**End of Section 2**			
Core	10.1				**End of Core**			

Timberneck Creek Core 4 Latitude: 37.2912 Longitude: -76.5351 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4.4 to -9.4	▥	**ML**	clayey silt with trace very fine sand, some shell hash	olive gray	0/5.3/40.9/53.8 94.7 49.1	core sampled for Pb-210 analysis (short-term accretion rates)
1	5				**End of Section 1**			
2	5-9.4	-9.4 to -13.8	┆│┆│	**OL**	silty clay, clay content increases down core, micaceous	olive gray	0/5.9/48.1/46.0 94.1 41.7	
2	9.4				**End of Section 2**			
Core	9.4				**End of Core**			

Timberneck Creek Core 5 Latitude: 37.2938 Longitude: -76.5340 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4.2 to -9.2	▥	**OL**	clayey silt	olive gray	0/3.7/38.6/57.7 96.3 48.9	
1	5				**End of Section 1**			
2	5-10.2	-9.2 to -14.4	▥	**OL**	silty clay, rare plant/wood fragments, micaceous	olive gray	0/3.9/43.9/52.2 96.1 41.6	
2	10.2				**End of Section 2**			
Core	10.2				**End of Core**			

Timberneck Creek Core 6 Latitude: 37.2956 Longitude: -76.5339 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4 to -9	▥	**ML**	clayey silt with trace very fine sand, abundant shells at 0.5-0.8 ft, some shell hash	olive gray	0/4.4/38.4/57.2 95.6 49.9	
1	5				**End of Section 1**			
2	5-9.5	-9 to -13.5	┊	**OL**	silty clay, micaceous, clay content increases down core	olive gray	0/2.3/44.2/53.5 97.7 43.2	
2	9.5				**End of Section 2**			
Core	9.5				**End of Core**			

Timberneck Creek Core 7 Latitude: 37.2983 Longitude: -76.5325 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-3.1 to -8.1	▥	**ML**	clayey silt with trace very fine sand, abundant shells at 2.9-3.2 ft, some shells/shell fragments throughout	olive gray	0/4.7/39.6/55.7 95.3 49.0	
1	5				**End of Section 1**			
2	5-9.6	-8.1 to -12.7	┆	**OL**	silty clay, clay content increases down core, some plant/wood fragments throughout	olive gray	0/5.2/41.4/53.4 94.8 41.9	
2	9.6				**End of Section 2**			
Core	9.6				**End of Core**			

Timberneck Creek Core 8 Latitude: 37.2998 Longitude: -76.5317 Date: 08/06/2020

Section	**Depth (ft)**	**Depth Below Sediment Surface MLLW (ft)**	**Graphic**	**USCS Soil Type**	**Description**	**Color**	**Grain Size %G/SD/S/C %Fines %Moisture**	**Comments**
1	0-5	-4 to -9	▥	**ML**	clayey silt with trace very fine sand, some shell fragments, occasional plant/wood fragments	olive gray	0/4.6/40.5/54.9 95.4 49.5	
1	5				**End of Section 1**			
2	5-10.1	-9 to -14.1	▥	**OL**	silty clay, clay content increases down core, plant/wood fragments throughout	olive gray	0/9.3/40.1/50.6 90.7 41.4	
2	10.1				**End of Section 2**			
Core	10.1				**End of Core**			

Appendix C

Sediment Data

Name	Location	Core-Section	SampleID	% Moisture Units: % MDL: 0.1
TC01	Timberneck Creek	1-1	1-1 (0-5 ft)	21.5
TC02	Timberneck Creek	1-2	1-2 (5-10 ft)	27.0
TC03	Timberneck Creek	2-1	2-1 (0-5 ft)	28.5
TC04	Timberneck Creek	2-2	2-2 (5-10 ft)	32.8
TC05	Timberneck Creek	3-1	3-1 (0-5 ft)	48.1
TC06	Timberneck Creek	3-2	3-2 (5-10.1 ft)	33.3
TC07	Timberneck Creek	4-1	4-1 (0-5 ft)	49.1
TC08	Timberneck Creek	4-2	4-2 (5-9.4 ft)	41.7
TC09	Timberneck Creek	5-1	5-1 (0-5 ft)	48.9
TC10	Timberneck Creek	5-5	5-2 (5-10.24 ft)	41.6
TC11	Timberneck Creek	6-1	6-1 (0-5 ft)	49.9
TC12	Timberneck Creek	6-2	6-2 (5-9.52 ft)	43.2
TC13	Timberneck Creek	7-1	7-1 (0-5 ft)	49.0
TC14	Timberneck Creek	7-2	7-2 (5-9.6 ft)	41.9
TC15	Timberneck Creek	8-1	8-1 (0-5 ft)	49.5
TC16	Timberneck Creek	8-2	8-2 (5-10.08 ft)	41.4

Name	SampleID	% Gravel Units: % MDL: 0.1	% Sand Units: % MDL: 0.1	% Silt Units: % MDL: 0.1	% Clay Units: % MDL: 0.1	% Fines Units: %
TC01	1-1 (0-5 ft)	0.0	63.9	17.3	18.8	36.1
TC02	1-2 (5-10 ft)	0.0	52.7	24.2	23.2	47.4
TC03	2-1 (0-5 ft)	0.0	60.1	16.7	23.1	39.8
TC04	2-2 (5-10 ft)	0.0	45.7	27.4	27	54.4
TC05	3-1 (0-5 ft)	0.0	8.5	37.5	54	91.5
TC06	3-2 (5-10.1 ft)	0.0	25.0	35.3	39.7	75
TC07	4-1 (0-5 ft)	0.0	5.3	40.9	53.8	94.7
TC08	4-2 (5-9.4 ft)	0.0	5.9	48.1	46	94.1
TC09	5-1 (0-5 ft)	0.0	3.7	38.6	57.7	96.3
TC10	5-2 (5-10.24 ft)	0.0	3.9	43.9	52.2	96.1
TC11	6-1 (0-5 ft)	0.0	4.4	38.4	57.2	95.6
TC12	6-2 (5-9.52 ft)	0.0	2.3	44.2	53.5	97.7
TC13	7-1 (0-5 ft)	0.0	4.7	39.6	55.7	95.3
TC14	7-2 (5-9.6 ft)	0.0	5.2	41.4	53.4	94.8
TC15	8-1 (0-5 ft)	0.0	4.6	40.5	54.9	95.4
TC16	8-2 (5-10.08 ft)	0.0	9.3	40.1	50.6	90.7

Name	SampleID	Total Sample Mean (mm)	Total Sample Median-D50 (mm)	Total Sample Stnd Dev (mm)	Total Sample Skewness (mm)	Total Sample Kurtosis (mm)
TC01	1-1 (0-5 ft)					
TC02	1-2 (5-10 ft)					
TC03	2-1 (0-5 ft)					
TC04	2-2 (5-10 ft)					
TC05	3-1 (0-5 ft)	0.03	0.00	0.04	4.84	46.61
TC06	3-2 (5-10.1 ft)					
TC07	4-1 (0-5 ft)					
TC08	4-2 (5-9.4 ft)					
TC09	5-1 (0-5 ft)					
TC10	5-2 (5-10.24 ft)	0.02	0.00	0.05	9.70	181.06
TC11	6-1 (0-5 ft)					
TC12	6-2 (5-9.52 ft)					
TC13	7-1 (0-5 ft)	0.02	0.00	0.05	26.87	943.95
TC14	7-2 (5-9.6 ft)					
TC15	8-1 (0-5 ft)					
TC16	8-2 (5-10.08 ft)	0.03	0.00	0.09	14.74	291.90

Samples from cores 4, 5, 6, 7, and 8 did not have enough sand to run the RSA.
Therefore total sample statistics are not calculated.

RSA analysis was not complete on cores 1, 2 and 3 at time of report

Appendix D

Chemical Sediment Analysis Results

ENTHALPY
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1941 Reymet Road ● Richmond, Virginia 23237 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Laboratory Order ID 21A0319

Client Name: Virginia Institute of Marine Science
1370 Greate Road

Gloucester, VA 23062-1346
Submitted To: Donna Milligan

Client Site I.D.: Shallow Water Dredging

Date Received: January 8, 2021 12:00
Date Issued: January 15, 2021 16:14
Project Number: [none]
Purchase Order: PCO2632666

Enclosed are the results of analyses for samples received by the laboratory on 01/08/2021 12:00. If you have any questions concerning this report, please feel free to contact the laboratory.

Sincerely,

Ted Soyars

Ted Soyars
Technical Director

End Notes:

The test results listed in this report relate only to the samples submitted to the laboratory and as received by the Laboratory.

Unless otherwise noted, the test results for solid materials are calculated on a wet weight basis. Analyses for pH, dissolved oxygen, temperature, residual chlorine and sulfite that are performed in the laboratory do not meet NELAC requirements due to extremely short holding times. These analyses should be performed in the field. The results of field analyses performed by the Sampler included in the Certificate of Analysis are done so at the client's request and are not included in the laboratory's fields of certification nor have they been audited for adherence to a reference method or procedure.

The signature on the final report certifies that these results conform to all applicable NELAC standards unless otherwise specified. For a complete list of the Laboratory's NELAC certified parameters please contact customer service.

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1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name: Virginia Institute of Marine Science
1370 Greate Road

Gloucester VA, 23062-1346

Date Issued: January 15, 2021 16:14
Project Number: [none]
Purchase Order: PCO2632666

Submitted To: Donna Milligan
Client Site I.D.: Shallow Water Dredging

ANALYTICAL REPORT FOR SAMPLES

Laboratory Order ID 21A0319

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Timberneck up creek	21A0319-01	Solids	01/07/2021 13:35	01/08/2021 12:00
Timberneck down creek	21A0319-02	Solids	01/07/2021 13:18	01/08/2021 12:00
Cedarbush up creek	21A0319-03	Solids	01/07/2021 13:01	01/08/2021 12:00
Cedarbush down creek	21A0319-04	Solids	01/07/2021 12:51	01/08/2021 12:00
Aberdeen up creek	21A0319-05	Solids	01/07/2021 12:27	01/08/2021 12:00
Aberdeen down creek	21A0319-06	Solids	01/07/2021 12:11	01/08/2021 12:00

PCB results have been calculated based on dry weight.

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck up creek

Laboratory Sample ID: 21A0319-01

Grab Date/Time: 01/07/2021 13:35

Field Residual Cl:

Field pH:

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Metals by 6000/7000 Series Methods									
TCLP Silver	01	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Arsenic	01	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Barium	01	SW6010D	<5.00 mg/L		5.00	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Cadmium	01	SW6010D	<0.0400 mg/L		0.0400	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Chromium	01	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Mercury	01	SW7470A	<0.008 mg/L		0.008	1	01/12/21 13:59	01/13/21 12:42	MWL
TCLP Lead	01	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Selenium	01	SW6010D	<0.250 mg/L		0.250	1	01/12/21 10:15	01/13/21 10:27	SNL
TCLP Extraction Fluid, Metals	01	SW1311	**1 #**		--	1	01/11/21 16:15	01/11/21 16:15	ESW
Volatile Organic Compounds by GC									
Methyl-t-butyl ether (MTBE)	01	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 00:30	01/12/21 00:30	MAK
Benzene	01	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 00:30	01/12/21 00:30	MAK
Toluene	01	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 00:30	01/12/21 00:30	MAK
Ethylbenzene	01	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 00:30	01/12/21 00:30	MAK
m+p-Xylenes	01	SW8021B	<10.0 ug/kg		10.0	1	01/12/21 00:30	01/12/21 00:30	MAK
o-Xylene	01	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 00:30	01/12/21 00:30	MAK
Xylenes, Total	01	SW8021B	<15.0 ug/kg		15.0	1	01/12/21 00:30	01/12/21 00:30	MAK
Surr: 2,5-Dibromotoluene (Surr PID)	*01*	*SW8021B*	*76.7 %*	*S*	*80-120*		*01/12/21 00:30*	*01/12/21 00:30*	*MAK*
Semivolatile Hydrocarbons by GC									
TPH-Semi-Volatiles (DRO)	01	SW8015C	<10.0 mg/kg		10.0	1	01/12/21 16:00	01/13/21 21:50	LBH2
Surr: Pentacosane (Surr)	*01*	*SW8015C*	*104 %*		*45-160*		*01/12/21 16:00*	*01/13/21 21:50*	*LBH2*
TCLP Semivolatile Organic Compounds									

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1941 Reymet Road ● Richmond, Virginia 23230 ● Tel: (804)-358-8295 Fax: (804)-358-8297

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck up creek **Laboratory Sample ID:** 21A0319-01

Grab Date/Time: 01/07/2021 13:35

Field Residual Cl: **Field pH:**

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Semivolatile Organic Compounds									
TCLP Extraction Fluid, SV Organics	01	SW1311	**1 #**		--	1	01/11/21 16:15	01/11/21 16:15	SMM
Organochlorine Pesticides and PCBs by GC/ECD									
PCB as Aroclor 1016	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1221	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1232	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1242	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1248	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1254	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
PCB as Aroclor 1260	01	SW8082A	<0.371 mg/kg dry		0.371	1	01/11/21 10:50	01/12/21 12:26	LBH2
Surr: DCB	*01*	*SW8082A*	*87.4 %*		*30-105*		*01/11/21 10:50*	*01/12/21 12:26*	*LBH2*
Surr: TCMX	*01*	*SW8082A*	*88.4 %*		*30-105*		*01/11/21 10:50*	*01/12/21 12:26*	*LBH2*
TCLP Organochlorine Herbicides by GC/ECD									
TCLP 2,4,5-TP (Silvex)	01	SW8151A	<0.0005 mg/L		0.0005	1	01/12/21 14:30	01/14/21 17:34	LBH2
TCLP 2,4-D	01	SW8151A	<0.001 mg/L		0.001	1	01/12/21 14:30	01/14/21 17:34	LBH2
Surr: DCAA (Surr)	*01*	*SW8151A*	*77.3 %*		*60-112*		*01/12/21 14:30*	*01/14/21 17:34*	*LBH2*
TCLP Organochlorine Pesticides and PCBs by GC/ECD									
TCLP Chlordane	01	SW8081B	<0.030 mg/L		0.030	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP Endrin	01	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP gamma-BHC (Lindane)	01	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP Heptachlor	01	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP Heptachlor Epoxide	01	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP Methoxychlor	01	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:39	lbh2
TCLP Toxaphene	01	SW8081B	<0.500 mg/L		0.500	1	01/13/21 13:45	01/14/21 16:39	lbh2
Surr: TCMX	*01*	*SW8081B*	*80.9 %*		*18-112*		*01/13/21 13:45*	*01/14/21 16:39*	*lbh2*

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck up creek

Laboratory Sample ID: 21A0319-01

Grab Date/Time: 01/07/2021 13:35

Field Residual Cl:

Field pH:

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Organochlorine Pesticides and PCBs by GC/ECD									
Surr: DCB	*01*	*SW8081B*	*80.9 %*		*27-131*		*01/13/21 13:45*	*01/14/21 16:39*	*lbh2*
Wet Chemistry Analysis									
Percent Solids	01	SM22 2540G-2011	**26.9 %**		0.10	1	01/09/21 13:30	01/09/21 13:30	TLF

Certificate of Analysis

Final Report

Client Name: Virginia Institute of Marine Science
1370 Greate Road

Gloucester VA, 23062-1346
Submitted To: Donna Milligan
Client Site I.D.: Shallow Water Dredging

Date Issued: January 15, 2021 16:14
Project Number: [none]
Purchase Order: PCO2632666

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck down creek

Laboratory Sample ID: 21A0319-02

Grab Date/Time: 01/07/2021 13:18

Field Residual Cl:

Field pH:

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Metals by 6000/7000 Series Methods									
TCLP Silver	02	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Arsenic	02	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Barium	02	SW6010D	<5.00 mg/L		5.00	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Cadmium	02	SW6010D	<0.0400 mg/L		0.0400	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Chromium	02	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Mercury	02	SW7470A	<0.008 mg/L		0.008	1	01/12/21 13:59	01/13/21 12:50	MWL
TCLP Lead	02	SW6010D	<0.100 mg/L		0.100	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Selenium	02	SW6010D	<0.250 mg/L		0.250	1	01/12/21 10:15	01/13/21 10:36	SNL
TCLP Extraction Fluid, Metals	02	SW1311	**1 #**		--	1	01/11/21 16:15	01/11/21 16:15	ESW
Volatile Organic Compounds by GC									
Methyl-t-butyl ether (MTBE)	02	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 01:10	01/12/21 01:10	MAK
Benzene	02	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 01:10	01/12/21 01:10	MAK
Toluene	02	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 01:10	01/12/21 01:10	MAK
Ethylbenzene	02	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 01:10	01/12/21 01:10	MAK
m+p-Xylenes	02	SW8021B	<10.0 ug/kg		10.0	1	01/12/21 01:10	01/12/21 01:10	MAK
o-Xylene	02	SW8021B	<5.00 ug/kg		5.00	1	01/12/21 01:10	01/12/21 01:10	MAK
Xylenes, Total	02	SW8021B	<15.0 ug/kg		15.0	1	01/12/21 01:10	01/12/21 01:10	MAK
Surr: 2,5-Dibromotoluene (Surr PID)	*02*	*SW8021B*	*75.5 %*	*S*	*80-120*		*01/12/21 01:10*	*01/12/21 01:10*	*MAK*
Semivolatile Hydrocarbons by GC									
TPH-Semi-Volatiles (DRO)	02	SW8015C	**10.0 mg/kg**		10.0	1	01/12/21 16:00	01/13/21 22:16	LBH2
Surr: Pentacosane (Surr)	*02*	*SW8015C*	*87.4 %*		*45-160*		*01/12/21 16:00*	*01/13/21 22:16*	*LBH2*
TCLP Semivolatile Organic Compounds									

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck down creek

Laboratory Sample ID: 21A0319-02

Grab Date/Time: 01/07/2021 13:18

Field Residual Cl:

Field pH:

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Semivolatile Organic Compounds									
TCLP Extraction Fluid, SV Organics	02	SW1311	**1 #**		--	1	01/11/21 16:15	01/11/21 16:15	SMM
Organochlorine Pesticides and PCBs by GC/ECD									
PCB as Aroclor 1016	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1221	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1232	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1242	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1248	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1254	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
PCB as Aroclor 1260	02	SW8082A	<0.247 mg/kg dry		0.247	1	01/11/21 10:50	01/12/21 12:47	LBH2
Surr: DCB	*02*	*SW8082A*	*89.4 %*		*30-105*		*01/11/21 10:50*	*01/12/21 12:47*	*LBH2*
Surr: TCMX	*02*	*SW8082A*	*94.6 %*		*30-105*		*01/11/21 10:50*	*01/12/21 12:47*	*LBH2*
TCLP Organochlorine Herbicides by GC/ECD									
TCLP 2,4,5-TP (Silvex)	02	SW8151A	<0.0005 mg/L		0.0005	1	01/12/21 14:30	01/14/21 18:00	LBH2
TCLP 2,4-D	02	SW8151A	<0.001 mg/L		0.001	1	01/12/21 14:30	01/14/21 18:00	LBH2
Surr: DCAA (Surr)	*02*	*SW8151A*	*76.5 %*		*60-112*		*01/12/21 14:30*	*01/14/21 18:00*	*LBH2*
TCLP Organochlorine Pesticides and PCBs by GC/ECD									
TCLP Chlordane	02	SW8081B	<0.030 mg/L		0.030	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP Endrin	02	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP gamma-BHC (Lindane)	02	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP Heptachlor	02	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP Heptachlor Epoxide	02	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP Methoxychlor	02	SW8081B	<0.005 mg/L		0.005	1	01/13/21 13:45	01/14/21 16:56	lbh2
TCLP Toxaphene	02	SW8081B	<0.500 mg/L		0.500	1	01/13/21 13:45	01/14/21 16:56	lbh2
Surr: TCMX	*02*	*SW8081B*	*35.1 %*		*18-112*		*01/13/21 13:45*	*01/14/21 16:56*	*lbh2*

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Laboratory Order ID: 21A0319

Analytical Results

Sample I.D. Timberneck down creek

Laboratory Sample ID: 21A0319-02

Grab Date/Time: 01/07/2021 13:18

Field Residual Cl:

Field pH:

Parameter	Samp ID	Method	Result	Qual	Reporting Limit	D.F.	Sample Prep Date/Time	Analysis Date/Time	Analyst
TCLP Organochlorine Pesticides and PCBs by GC/ECD									
Surr: DCB	*02*	*SW8081B*	*35.3 %*		*27-131*		*01/13/21 13:45*	*01/14/21 16:56*	*lbh2*
Wet Chemistry Analysis									
Percent Solids	02	SM22 2540G-2011	**40.5 %**		0.10	1	01/09/21 13:30	01/09/21 13:30	TLF

Certificate of Analysis

Final Report

Client Name: Virginia Institute of Marine Science
1370 Greate Road

Gloucester VA, 23062-1346
Submitted To: Donna Milligan
Client Site I.D.: Shallow Water Dredging

Date Issued: January 15, 2021 16:14
Project Number: [none]
Purchase Order: PCO2632666

Analytical Summary

Preparation Method:

Wet Chemistry Analysis — **Preparation Method:** **No Prep Wet Chem**

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
21A0319-01	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	
21A0319-02	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	
21A0319-03	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	
21A0319-04	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	
21A0319-05	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	
21A0319-06	10.0 g / 10.0 mL	SM22 2540G-2011	BEA0198	SEA0179	

TCLP Metals by 6000/7000 Series Methods — **Preparation Method:** **SW1311 Metals**

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
21A0319-01	100 g / 2000 mL	SW1311	BEA0240	SEA0218	
21A0319-02	100 g / 2000 mL	SW1311	BEA0240	SEA0218	
21A0319-03	100 g / 2000 mL	SW1311	BEA0240	SEA0218	
21A0319-04	100 g / 2000 mL	SW1311	BEA0240	SEA0218	
21A0319-05	100 g / 2000 mL	SW1311	BEA0240	SEA0218	
21A0319-06	100 g / 2000 mL	SW1311	BEA0240	SEA0218	

TCLP Metals by 6000/7000 Series Methods — **Preparation Method:** **SW3010A**

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
21A0319-01	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133
21A0319-02	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133
21A0319-03	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133
21A0319-04	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133
21A0319-05	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133
21A0319-06	10.0 mL / 50.0 mL	SW6010D	BEA0247	SEA0269	AE00133

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID

TCLP Semivolatile Organic Compounds — **Preparation Method:** **SW3510C**

Certificate of Analysis

Final Report

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Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
21A0319-01	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
21A0319-02	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
21A0319-03	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
21A0319-04	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
21A0319-05	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
21A0319-06	100 g / 2000 mL	SW1311	BEA0257	SEA0233	AL00074
TCLP Organochlorine Herbicides by GC/ECD		**Preparation Method:**	**SW3510C**		
21A0319-01	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
21A0319-02	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
21A0319-03	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
21A0319-04	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
21A0319-05	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
21A0319-06	100 mL / 5.00 mL	SW8151A	BEA0266	SEA0330	AK00094
Semivolatile Hydrocarbons by GC		**Preparation Method:**	**SW3510C**		
21A0319-01	50.3 g / 1.00 mL	SW8015C	BEA0297	SEA0276	AA10005
21A0319-02	52.0 g / 1.00 mL	SW8015C	BEA0297	SEA0276	AA10005
21A0319-03	51.1 g / 1.00 mL	SW8015C	BEA0297	SEA0276	AA10005
21A0319-04	51.1 g / 2.00 mL	SW8015C	BEA0297	SEA0276	AA10005
21A0319-05	50.8 g / 1.00 mL	SW8015C	BEA0297	SEA0276	AA10005
21A0319-06	50.3 g / 2.00 mL	SW8015C	BEA0297	SEA0276	AA10005
TCLP Organochlorine Pesticides and PCBs by GC/ECD		**Preparation Method:**	**SW3510C**		
21A0319-01	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033
21A0319-02	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033
21A0319-03	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033
21A0319-04	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033
21A0319-05	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033
21A0319-06	100 mL / 1.00 mL	SW8081B	BEA0313	SEA0326	AA10033

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Organochlorine Pesticides and PCBs by GC/ECD		**Preparation Method:**	**SW3550B**		
21A0319-01	30.0 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088
21A0319-02	30.0 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088
21A0319-03	30.6 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088
21A0319-04	30.1 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088

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Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
21A0319-05	30.3 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088
21A0319-06	31.9 g / 5.00 mL	SW8082A	BEA0209	SEA0256	AJ00088

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
Volatile Organic Compounds by GC		**Preparation Method:**	**SW5030B**		
21A0319-01	5.33 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001
21A0319-02	5.32 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001
21A0319-03	5.11 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001
21A0319-04	5.03 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001
21A0319-05	5.14 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001
21A0319-06	5.22 g / 5.00 mL	SW8021B	BEA0220	SEA0209	AA10001

Sample ID	Preparation Factors Initial / Final	Method	Batch ID	Sequence ID	Calibration ID
TCLP Metals by 6000/7000 Series Methods		**Preparation Method:**	**SW7470A**		
21A0319-01	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039
21A0319-02	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039
21A0319-03	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039
21A0319-04	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039
21A0319-05	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039
21A0319-06	1.00 mL / 20.0 mL	SW7470A	BEA0264	SEA0263	AA10039

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TCLP Metals by 6000/7000 Series Methods - Quality Control

Air Water & Soil Laboratories, Inc.

Batch BEA0240 - SW1311 Metals

Blank (BEA0240-BLK1) Prepared & Analyzed: 01/11/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Extraction Fluid, Metals	1 #	0	#							

Blank (BEA0240-BLK2) Prepared & Analyzed: 01/11/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Extraction Fluid, Metals	2 #	0	#							

Batch BEA0247 - SW3010A

Blank (BEA0247-BLK1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Arsenic	<0.100 mg/L	0.100	mg/L							
Barium	<5.00 mg/L	5.00	mg/L							
Cadmium	<0.0400 mg/L	0.0400	mg/L							
Chromium	<0.100 mg/L	0.100	mg/L							
Lead	<0.100 mg/L	0.100	mg/L							
Selenium	<0.250 mg/L	0.250	mg/L							
Silver	<0.100 mg/L	0.100	mg/L							

LCS (BEA0247-BS1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Arsenic	2.36 mg/L	0.100	mg/L	2.50 mg/L		94.3	80-120			
Barium	<5.00 mg/L	5.00	mg/L	2.50 mg/L		97.8	80-120			
Cadmium	2.30 mg/L	0.0400	mg/L	2.50 mg/L		92.1	80-120			
Chromium	2.31 mg/L	0.100	mg/L	2.50 mg/L		92.4	80-120			
Lead	2.28 mg/L	0.100	mg/L	2.50 mg/L		91.3	80-120			
Selenium	2.23 mg/L	0.250	mg/L	2.50 mg/L		89.3	80-120			
Silver	0.445 mg/L	0.100	mg/L	0.500 mg/L		88.9	80-120			

LCS Dup (BEA0247-BSD1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Arsenic	2.30 mg/L	0.100	mg/L	2.50 mg/L		92.0	80-120	2.53	20	
Barium	<5.00 mg/L	5.00	mg/L	2.50 mg/L		95.9	80-120	2.00	20	
Cadmium	2.24 mg/L	0.0400	mg/L	2.50 mg/L		89.6	80-120	2.74	20	
Chromium	2.22 mg/L	0.100	mg/L	2.50 mg/L		88.9	80-120	3.82	20	
Lead	2.24 mg/L	0.100	mg/L	2.50 mg/L		89.6	80-120	1.91	20	
Selenium	2.20 mg/L	0.250	mg/L	2.50 mg/L		88.0	80-120	1.47	20	
Silver	0.442 mg/L	0.100	mg/L	0.500 mg/L		88.4	80-120	0.582	20	

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TCLP Metals by 6000/7000 Series Methods - Quality Control

Air Water & Soil Laboratories, Inc.

Batch BEA0247 - SW3010A

Matrix Spike (BEA0247-MS1) **Source: 21A0319-01** Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Arsenic	2.32 mg/L	0.100	mg/L	2.50	<0.100 mg/L	92.6	75-125			
Barium	<5.00 mg/L	5.00	mg/L	2.50	<5.00 mg/L	85.2	75-125			
Cadmium	2.25 mg/L	0.0400	mg/L	2.50	<0.0400 mg/L	90.1	75-125			
Chromium	2.25 mg/L	0.100	mg/L	2.50	<0.100 mg/L	90.2	75-125			
Lead	2.25 mg/L	0.100	mg/L	2.50	<0.100 mg/L	89.9	75-125			
Selenium	2.21 mg/L	0.250	mg/L	2.50	<0.250 mg/L	88.4	75-125			
Silver	0.372 mg/L	0.100	mg/L	0.500	<0.100 mg/L	74.3	75-125			M

Matrix Spike Dup (BEA0247-MSD1) **Source: 21A0319-01** Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Arsenic	2.35 mg/L	0.100	mg/L	2.50	<0.100 mg/L	93.9	75-125	1.29	20	
Barium	<5.00 mg/L	5.00	mg/L	2.50	<5.00 mg/L	101	75-125	17.1	20	
Cadmium	2.27 mg/L	0.0400	mg/L	2.50	<0.0400 mg/L	90.8	75-125	0.758	20	
Chromium	2.30 mg/L	0.100	mg/L	2.50	<0.100 mg/L	91.8	75-125	1.82	20	
Lead	2.27 mg/L	0.100	mg/L	2.50	<0.100 mg/L	90.9	75-125	1.19	20	
Selenium	2.24 mg/L	0.250	mg/L	2.50	<0.250 mg/L	89.7	75-125	1.44	20	
Silver	0.452 mg/L	0.100	mg/L	0.500	<0.100 mg/L	90.5	75-125	19.6	20	

Batch BEA0264 - SW7470A

Blank (BEA0264-BLK1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Mercury	<0.008 mg/L	0.008	mg/L							

LCS (BEA0264-BS1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Mercury	0.048 mg/L	0.008	mg/L	0.0500 mg/L		96.1	80-120			

LCS Dup (BEA0264-BSD1) Prepared: 01/12/2021 Analyzed: 01/13/2021

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Mercury	0.048 mg/L	0.008	mg/L	0.0500 mg/L		95.9	80-120	0.265	20	

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TCLP Metals by 6000/7000 Series Methods - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0264 - SW7470A										
Matrix Spike (BEA0264-MS1)		**Source: 21A0319-01**		Prepared: 01/12/2021 Analyzed: 01/13/2021						
Mercury	0.050 mg/L	0.008	mg/L	0.0500	<0.008 mg/L	99.8	80-120			
Matrix Spike Dup (BEA0264-MSD1)		**Source: 21A0319-01**		Prepared: 01/12/2021 Analyzed: 01/13/2021						
Mercury	0.051 mg/L	0.008	mg/L	0.0500	<0.008 mg/L	102	80-120	2.12	20	

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Volatile Organic Compounds by GC - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0220 - SW5030B										
Blank (BEA0220-BLK1)				Prepared & Analyzed: 01/11/2021						
Methyl-t-butyl ether (MTBE)	<5.00 ug/kg	5.00	ug/kg							
Benzene	<5.00 ug/kg	5.00	ug/kg							
Toluene	<5.00 ug/kg	5.00	ug/kg							
Ethylbenzene	<5.00 ug/kg	5.00	ug/kg							
m+p-Xylenes	<10.0 ug/kg	10.0	ug/kg							
o-Xylene	<5.00 ug/kg	5.00	ug/kg							
Xylenes, Total	<15.0 ug/kg	15.0	ug/kg							
Surr: 2,5-Dibromotoluene (Surr PID)	82.3		ug/L	100		82.3	80-120			
LCS (BEA0220-BS1)				Prepared & Analyzed: 01/11/2021						
Methyl-t-butyl ether (MTBE)	81.3 ug/kg	5.00	ug/kg	100	ug/kg	81.3	70-130			
Benzene	78.6 ug/kg	5.00	ug/kg	100	ug/kg	78.6	70-130			
Toluene	79.5 ug/kg	5.00	ug/kg	100	ug/kg	79.5	70-130			
Ethylbenzene	86.8 ug/kg	5.00	ug/kg	100	ug/kg	86.8	70-130			
m+p-Xylenes	174 ug/kg	10.0	ug/kg	200	ug/kg	87.0	70-130			
o-Xylene	83.6 ug/kg	5.00	ug/kg	100	ug/kg	83.6	70-130			
Surr: 2,5-Dibromotoluene (Surr PID)	85.7		ug/L	100	ug/L	85.7	80-120			
Matrix Spike (BEA0220-MS1)	**Source: 21A0319-04**			Prepared & Analyzed: 01/12/2021						
Methyl-t-butyl ether (MTBE)	60.0 ug/kg	5.00	ug/kg	94.9	<5.00 ug/kg	63.2	70-130			M
Benzene	51.6 ug/kg	5.00	ug/kg	94.9	<5.00 ug/kg	54.4	70-130			M
Toluene	52.3 ug/kg	5.00	ug/kg	94.9	<5.00 ug/kg	55.1	70-130			M
Ethylbenzene	56.9 ug/kg	5.00	ug/kg	94.9	<5.00 ug/kg	59.9	70-130			M
m+p-Xylenes	111 ug/kg	10.0	ug/kg	190	<10.0 ug/kg	58.7	70-130			M
o-Xylene	53.7 ug/kg	5.00	ug/kg	94.9	<5.00 ug/kg	56.6	70-130			M
Surr: 2,5-Dibromotoluene (Surr PID)	81.0		ug/L	100	ug/L	81.0	80-120			
Matrix Spike Dup (BEA0220-MSD1)	**Source: 21A0319-04**			Prepared & Analyzed: 01/12/2021						
Methyl-t-butyl ether (MTBE)	59.9 ug/kg	5.00	ug/kg	94.5	<5.00 ug/kg	63.4	70-130	0.0471	20	M
Benzene	50.8 ug/kg	5.00	ug/kg	94.5	<5.00 ug/kg	53.7	70-130	1.67	20	M
Toluene	51.3 ug/kg	5.00	ug/kg	94.5	<5.00 ug/kg	54.3	70-130	1.84	20	M
Ethylbenzene	56.2 ug/kg	5.00	ug/kg	94.5	<5.00 ug/kg	59.4	70-130	1.22	20	M

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Volatile Organic Compounds by GC - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0220 - SW5030B										
Matrix Spike Dup (BEA0220-MSD1)		**Source: 21A0319-04**		Prepared & Analyzed: 01/12/2021						
m+p-Xylenes	110 ug/kg	10.0	ug/kg	189	<10.0 ug/kg	58.3	70-130	1.06	20	M
o-Xylene	53.2 ug/kg	5.00	ug/kg	94.5	<5.00 ug/kg	56.3	70-130	0.892	20	M
Surr: 2,5-Dibromotoluene (Surr PID)	86.7		ug/L	100	ug/L	86.7	80-120			

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Semivolatile Hydrocarbons by GC - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0297 - SW3510C										
Blank (BEA0297-BLK1)				Prepared: 01/12/2021 Analyzed: 01/13/2021						
TPH-Semi-Volatiles (DRO)	<10.0 mg/kg	10.0	mg/kg							
Surr: Pentacosane (Surr)	3.54		mg/kg	5.00		70.8	45-160			
LCS (BEA0297-BS1)				Prepared: 01/12/2021 Analyzed: 01/13/2021						
TPH-Semi-Volatiles (DRO)	82.1 mg/kg	10.0	mg/kg	100	mg/kg	82.1	40-160			
Surr: Pentacosane (Surr)	4.34		mg/kg	5.00	mg/kg	86.9	45-160			
Matrix Spike (BEA0297-MS1)		**Source: 21A0351-03**		Prepared: 01/12/2021 Analyzed: 01/13/2021						
TPH-Semi-Volatiles (DRO)	886 mg/kg	50.0	mg/kg	100	1080 mg/kg	-192	40-160			M2
Surr: Pentacosane (Surr)	4.58		mg/kg	5.00	mg/kg	91.6	45-160			
Matrix Spike Dup (BEA0297-MSD1)		**Source: 21A0351-03**		Prepared: 01/12/2021 Analyzed: 01/13/2021						
TPH-Semi-Volatiles (DRO)	572 mg/kg	49.7	mg/kg	99.4	1080 mg/kg	-509	40-160	43.1	20	M2, P
Surr: Pentacosane (Surr)	4.14		mg/kg	4.97	mg/kg	83.3	45-160			

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Organochlorine Pesticides and PCBs by GC/ECD - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0209 - SW3550B										
Blank (BEA0209-BLK1)				Prepared: 01/11/2021 Analyzed: 01/12/2021						
PCB as Aroclor 1016	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1221	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1232	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1242	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1248	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1254	<0.100 mg/kg wet	0.100	mg/kg wet							
PCB as Aroclor 1260	<0.100 mg/kg wet	0.100	mg/kg wet							
Surr: DCB	0.0333		mg/kg wet	0.0333		99.9	30-105			
Surr: TCMX	0.0274		mg/kg wet	0.0333		82.2	30-105			
LCS (BEA0209-BS1)				Prepared: 01/11/2021 Analyzed: 01/12/2021						
PCB as Aroclor 1016	0.173 mg/kg wet	0.100	mg/kg wet	0.167	mg/kg wet	104	60-140			
PCB as Aroclor 1260	0.168 mg/kg wet	0.100	mg/kg wet	0.167	mg/kg wet	101	60-140			
Surr: DCB	0.0353		mg/kg wet	0.0333	mg/kg wet	106	30-105			S
Surr: TCMX	0.0330		mg/kg wet	0.0333	mg/kg wet	99.1	30-105			
Matrix Spike (BEA0209-MS1)		**Source: 21A0235-01**		Prepared: 01/11/2021 Analyzed: 01/12/2021						
PCB as Aroclor 1016	0.200 mg/kg dry	0.106	mg/kg dry	0.177	<0.106 mg/kg dry	113	60-140			
PCB as Aroclor 1260	0.191 mg/kg dry	0.106	mg/kg dry	0.177	<0.106 mg/kg dry	108	60-140			
Surr: DCB	0.0393		mg/kg dry	0.0354	mg/kg dry	111	30-105			S
Surr: TCMX	0.0349		mg/kg dry	0.0354	mg/kg dry	98.5	30-105			
Matrix Spike Dup (BEA0209-MSD1)		**Source: 21A0235-01**		Prepared: 01/11/2021 Analyzed: 01/12/2021						
PCB as Aroclor 1016	0.210 mg/kg dry	0.111	mg/kg dry	0.185	<0.111 mg/kg dry	113	60-140	4.70	20	
PCB as Aroclor 1260	0.218 mg/kg dry	0.111	mg/kg dry	0.185	<0.111 mg/kg dry	118	60-140	13.1	20	
Surr: DCB	0.0429		mg/kg dry	0.0370	mg/kg dry	116	30-105			S
Surr: TCMX	0.0382		mg/kg dry	0.0370	mg/kg dry	103	30-105			

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

TCLP Organochlorine Herbicides by GC/ECD - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0266 - SW3510C										
Blank (BEA0266-BLK1)				Prepared: 01/12/2021 Analyzed: 01/14/2021						
2,4,5-TP (Silvex)	<0.0005 mg/L	0.0005	mg/L							
2,4-D	<0.001 mg/L	0.001	mg/L							
Surr: DCAA (Surr)	0.00790		mg/L	0.0100		79.0	60-112			
LCS (BEA0266-BS1)				Prepared: 01/12/2021 Analyzed: 01/14/2021						
2,4,5-TP (Silvex)	0.004 mg/L	0.0005	mg/L	0.00500	mg/L	75.8	62-132			
2,4-D	0.004 mg/L	0.001	mg/L	0.00500	mg/L	82.9	74-139			
Surr: DCAA (Surr)	0.00553		mg/L	0.0100	mg/L	55.3	60-112			S
Matrix Spike (BEA0266-MS1)		**Source: 21A0319-06**		Prepared: 01/12/2021 Analyzed: 01/14/2021						
2,4,5-TP (Silvex)	0.004 mg/L	0.0005	mg/L	0.00500	<0.0005 mg/L	87.5	52-129			
2,4-D	0.005 mg/L	0.001	mg/L	0.00500	<0.001 mg/L	98.4	53-126			
Surr: DCAA (Surr)	0.00903		mg/L	0.0100	mg/L	90.3	60-112			
Matrix Spike Dup (BEA0266-MSD1)		**Source: 21A0319-06**		Prepared: 01/12/2021 Analyzed: 01/14/2021						
2,4,5-TP (Silvex)	0.004 mg/L	0.0005	mg/L	0.00500	<0.0005 mg/L	80.1	52-129	8.85	20	
2,4-D	0.004 mg/L	0.001	mg/L	0.00500	<0.001 mg/L	88.4	53-126	10.7	20	
Surr: DCAA (Surr)	0.00759		mg/L	0.0100	mg/L	75.9	60-112			

Certificate of Analysis

Final Report

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		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

TCLP Organochlorine Pesticides and PCBs by GC/ECD - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0313 - SW3510C										
Blank (BEA0313-BLK1)				Prepared: 01/13/2021 Analyzed: 01/14/2021						
Chlordane	<0.030 mg/L	0.030	mg/L							
Endrin	<0.005 mg/L	0.005	mg/L							
gamma-BHC (Lindane)	<0.005 mg/L	0.005	mg/L							
Heptachlor	<0.005 mg/L	0.005	mg/L							
Heptachlor Epoxide	<0.005 mg/L	0.005	mg/L							
Methoxychlor	<0.005 mg/L	0.005	mg/L							
Toxaphene	<0.500 mg/L	0.500	mg/L							
Surr: TCMX	0.00148		mg/L	0.00200		74.2	18-112			
Surr: DCB	0.000928		mg/L	0.00200		46.4	27-131			
LCS (BEA0313-BS1)				Prepared: 01/13/2021 Analyzed: 01/14/2021						
Endrin	<0.005 mg/L	0.005	mg/L	0.00100 mg/L		84.3	23-134			
Heptachlor	<0.005 mg/L	0.005	mg/L	0.00100 mg/L		80.5	23-134			
Heptachlor Epoxide	<0.005 mg/L	0.005	mg/L	0.00100 mg/L		83.9	23-134			
Methoxychlor	<0.005 mg/L	0.005	mg/L	0.00100 mg/L		102	23-134			
Surr: TCMX	0.00149		mg/L	0.00200 mg/L		74.3	18-112			
Surr: DCB	0.000920		mg/L	0.00200 mg/L		46.0	27-131			
LCS (BEA0313-BS2)				Prepared: 01/13/2021 Analyzed: 01/14/2021						
Toxaphene	<0.500 mg/L	0.500	mg/L	0.0250 mg/L		74.3	23-134			
Surr: TCMX	0.00123		mg/L	0.00200 mg/L		61.5	18-112			
Surr: DCB	0.000853		mg/L	0.00200 mg/L		42.7	27-131			
LCS (BEA0313-BS3)				Prepared: 01/13/2021 Analyzed: 01/14/2021						
Chlordane	<0.030 mg/L	0.030	mg/L	0.0250 mg/L		72.6	23-134			
Surr: TCMX	0.00139		mg/L	0.00200 mg/L		69.6	18-112			
Surr: DCB	0.000818		mg/L	0.00200 mg/L		40.9	27-131			

Certificate of Analysis

Final Report

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		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

TCLP Organochlorine Pesticides and PCBs by GC/ECD - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0313 - SW3510C										
Matrix Spike (BEA0313-MS1)		**Source: 21A0319-01**		Prepared: 01/13/2021 Analyzed: 01/14/2021						
Endrin	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	73.8	23-134			
Heptachlor	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	75.2	23-134			
Heptachlor Epoxide	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	72.9	23-134			
Methoxychlor	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	90.9	23-134			
Surr: TCMX	0.00137		mg/L	0.00200 mg/L		68.6	18-112			
Surr: DCB	0.00138		mg/L	0.00200 mg/L		68.8	27-131			
Matrix Spike Dup (BEA0313-MSD1)		**Source: 21A0319-01**		Prepared: 01/13/2021 Analyzed: 01/14/2021						
Endrin	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	84.5	23-134	13.5	20	
Heptachlor	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	89.5	23-134	17.4	20	
Heptachlor Epoxide	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	88.0	23-134	18.7	20	
Methoxychlor	<0.005 mg/L	0.005	mg/L	0.00100	<0.005 mg/L	103	23-134	12.5	20	
Surr: TCMX	0.00154		mg/L	0.00200 mg/L		77.0	18-112			
Surr: DCB	0.00173		mg/L	0.00200 mg/L		86.4	27-131			

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Wet Chemistry Analysis - Quality Control

Air Water & Soil Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qual
Batch BEA0198 - No Prep Wet Chem										
Blank (BEA0198-BLK1)				Prepared & Analyzed: 01/09/2021						
Percent Solids	100 %	0.10	%							
Duplicate (BEA0198-DUP1)		**Source: 21A0295-01**		Prepared & Analyzed: 01/09/2021						
Percent Solids	83.9 %	0.10	%		83.4 %			0.533	20	

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Certified Analyses included in this Report

Analyte	Certifications
SW1311 in Solids	
Extraction Fluid, Metals	VELAP
Extraction Fluid, SV Organics	VELAP
SW6010D in Non-Potable Water	
Arsenic	VELAP,WVDEP
Barium	VELAP,WVDEP
Cadmium	VELAP,WVDEP
Chromium	VELAP,WVDEP
Lead	VELAP,WVDEP
Selenium	VELAP,WVDEP
Silver	VELAP,WVDEP
SW7470A in Non-Potable Water	
Mercury	VELAP,WVDEP
SW8015C in Solids	
TPH-Semi-Volatiles (DRO)	VELAP,NC,WVDEP
SW8021B in Solids	
Methyl-t-butyl ether (MTBE)	VELAP,WVDEP
Benzene	VELAP,WVDEP
Toluene	VELAP,WVDEP
Ethylbenzene	VELAP,WVDEP
m+p-Xylenes	VELAP,WVDEP
o-Xylene	VELAP,WVDEP
Xylenes, Total	VELAP,WVDEP
SW8081B in Non-Potable Water	
Chlordane	VELAP,WVDEP
Endrin	VELAP,WVDEP
gamma-BHC (Lindane)	VELAP,WVDEP
Heptachlor	VELAP,WVDEP
Heptachlor Epoxide	VELAP,WVDEP
Methoxychlor	VELAP,WVDEP
Toxaphene	VELAP,WVDEP
SW8082A in Solids	
PCB as Aroclor 1016	VELAP,NC
PCB as Aroclor 1221	VELAP,NC
PCB as Aroclor 1232	VELAP,NC
PCB as Aroclor 1242	VELAP,NC

Certificate of Analysis

Final Report

Client Name: Virginia Institute of Marine Science
1370 Greate Road

Gloucester VA, 23062-1346
Submitted To: Donna Milligan
Client Site I.D.: Shallow Water Dredging

Date Issued: January 15, 2021 16:14
Project Number: [none]
Purchase Order: PCO2632666

Certified Analyses included in this Report

Analyte	**Certifications**
PCB as Aroclor 1248	VELAP,NC
PCB as Aroclor 1254	VELAP,NC
PCB as Aroclor 1260	VELAP,NC
SW8151A in Non-Potable Water	
2,4,5-TP (Silvex)	VELAP,WVDEP
2,4-D	VELAP,WVDEP

Code	Description	Laboratory ID	Expires
MdDOE	Maryland DE Drinking Water	341	12/31/2021
NC	North Carolina DENR	495	12/31/2021
NCDOH	North Carolina Department of Health	51714	07/31/2021
NJDEP	NELAC-New Jersey DEP	VA015	06/30/2021
NYDOH	New York DOH Drinking Water	12096	04/01/2021
PADEP	NELAC-Pennsylvania Certificate #006	68-03503	10/31/2021
VELAP	NELAC-Virginia Certificate #11064	460021	06/14/2021
WVDEP	West Virginia DEP	350	02/28/2021

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Summary of Data Qualifiers

M	Matrix spike recovery is outside established acceptance limits
M2	Sample was diluted due to matrix interference.
P	Duplicate analysis does not meet the acceptance criteria for precision
S	Surrogate recovery was outside acceptance criteria
RPD	Relative Percent Difference
Qual	Qualifers
-RE	Denotes sample was re-analyzed
D.F.	Dilution Factor. Please also see the Preparation Factor in the Analysis Summary section.
TIC	Tentatively Identified Compounds are compounds that are identified by comparing the analyte mass spectral pattern with the NIST spectral library. A TIC spectral match is reported when the pattern is at least 75% consistent with the published pattern. Compound concentrations are estimated and are calculated using an internal standard response factor of 1.
PCBs, Total	Total PCBs are defined as the sum of detected Aroclors 1016, 1221, 1232, 1248, 1254, 1260, 1262, and 1268.

ENTHALPY ANALYTICAL
formerly *Air, Water & Soil Laboratories*

1941 REYMET ROAD
RICHMOND, VIRGINIA 23237
(804) 358-8295 PHONE
(804)358-8297 FAX

Chain of Custody
Form #: F1331
Rev. 2.0
Effective: Jun 28, 2016

CHAIN OF CUSTODY

PAGE ____ OF ____

COMPANY NAME: Virginia Institute of Marine Science
CONTACT: Donna Milligan
ADDRESS: 1370 Greate Road, Gloucester, VA 23062
PHONE #: 804-684-7596
FAX #:
EMAIL: milligan@vims.edu
Is sample for compliance reporting? YES NO
SAMPLER NAME (PRINT):

INVOICE TO: Virginia Institute of Marine Science
INVOICE CONTACT: Donna Milligan
INVOICE ADDRESS:
INVOICE PHONE #:
Is sample from a chlorinated supply? YES NO
SAMPLER SIGNATURE:

PROJECT NAME:
SITE NAME:
PROJECT NUMBER: Shallow Water Dredging
P.O. #:
Pretreatment Program:
PWS I.D. #:
Turn Around Time: Circle: 10 [✓ 5 Days] or __ Day(s)

Matrix Codes: WW=Waste Water/Storm Water GW=Ground Water DW=Drinking Water S=Soil/Solids OR=Organic A=Air WP=Wipe OT=Other____________

CLIENT SAMPLE I.D.	Grab	Composite	Field Filtered (Dissolved Metals)	Composite Start Date	Composite Start Time	Grab Date or Composite Stop Date	Grab Time or Composite Stop Time	Time Preserved	Matrix (See Codes)	Number of Containers	ANALYSIS / (PRESERVATIVE)								COMMENTS Preservative Codes: N=Nitric Acid C=Hydrochloric Acid S=Sulfuric Acid H=Sodium Hydroxide A=Ascorbic Acid Z=Zinc Acetate T=Sodium Thiosulfate M=Methanol PLEASE NOTE PRESERVATIVE(S), INTERFERENCE CHECKS or PUMP RATE (L/min)
											Full TCLP	TPH-DRO SW 8015	MBTEX SW 8021	PCB SW 8082	Percent Solids				
1) Timberneck up creek	X			01/07	13:35				S		X	X	X	X	X				
2) Timberneck down creek	X			01/07	13:18				S		X	X	X	X	X				
3) Cedarbush up creek	X			01/07	13:01				S		X	X	X	X	X				
4) Cedarbush down creek	X			01/07	12:51				S		X	X	X	X	X				
5) Aberdeen up creek	X			01/07	12:27				S		X	X	X	X	X				
6) Aberdeen down creek	X			01/07	12:41				S		X	X	X	X	X				
7)																			
8)																			
9)																			on ice
10)																			#277 no seals

R NQUISHED:	DATE / TIME 01/08/21 12:00	RECEIVED:	DATE / TIME 1-8-21 12:00	QC Data Package Level III ☐ Level IV ☐
R NQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME	
R NQUISHED:	DATE / TIME	RECEIVED:	DATE / TIME	

LAB USE ONLY
COOLER TEMP 3.8 °C

21A0319

Virginia Institute o: 21A0319
Shallow Water Dredging
Recd: 01/08/2021 Due: 01/15/2021

v130325002

Certificate of Analysis

Final Report

Client Name:	Virginia Institute of Marine Science 1370 Greate Road Gloucester VA, 23062-1346	Date Issued:	January 15, 2021 16:14
		Project Number:	[none]
		Purchase Order:	PCO2632666
Submitted To:	Donna Milligan		
Client Site I.D.:	Shallow Water Dredging		

Sample Conditions Checklist

Samples Received at:	**3.80°C**
How were samples received?	Walk In
Were Custody Seals used? If so, were they received intact?	No
Are the custody papers filled out completely and correctly?	No
Do all bottle labels agree with custody papers?	No
Is the temperature blank or representative sample within acceptable limits or received on ice, and recently taken?	Yes
Are all samples within holding time for requested laboratory tests?	Yes
Is a sufficient amount of sample provided to perform the tests included?	Yes
Are all samples in appropriate containers for the analyses requested?	Yes
Were volatile organic containers received?	No
Are all volatile organic and TOX containers free of headspace?	NA
Is a trip blank provided for each VOC sample set? VOC sample sets include EPA8011, EPA504, EPA8260, EPA624, EPA8015 GRO, EPA8021, EPA524, and RSK-175.	NA
Are all samples received appropriately preserved? Note that metals containers do not require field preservation but lab preservation may delay analysis.	Yes

Work Order Comments

Sample 'Aberdeen down creek' logged with sample time of 12:41 per the COC instead of 12:11 per the bottle labels. Donna Milligan notified via email. RMF 1-8-21 14:38

Per email from Donna Milligan, sample 'Aberdeen down creek' logged with sample time of 12:11. RMF 1-8-21 15:48

Per Donna Milligan, only TCLP Pest, Herb, and Metals are to be analyzed (not full TCLP). KLC 1-11-2021.

Appendix E

Draft Joint Permit Application

FOR AGENCY USE ONLY

	Notes:
JPA#	

APPLICANTS

PLEASE PRINT OR TYPE ALL ANSWERS. If a question does not apply to your project, please print N/A (not applicable) in the space provided. ***If additional space is needed, attach extra 8 ½ x 11 inch sheets of paper.***

Check all that apply

☐ Pre-Construction Notification (PCN) ☐ NWP # ________ ☐ RP # 05 (*For NWPs & RP 05 ONLY - No DEQ-VWP permit writer will be assigned*)	☐ SPGP	☐ DEQ Reapplication Existing permit number: ____________________	☐ Receiving federal funds Agency providing funding: ________________________
☐ Regional Permit 17 Checklist (RP-17)			

PREVIOUS ACTIONS RELATED TO THE PROPOSED WORK (Include all federal, state, and local pre application coordination, site visits, previous permits, or applications whether issued, withdrawn, or denied)

Historical information for past permit submittals can be found online with VMRC - https://webapps.mrc.virginia.gov/public/habitat/ - or VIMS - http://ccrm.vims.edu/perms/newpermits.html

Agency	Action / Activity	Permit/Project number, including any non-reporting Nationwide permits previously used (e.g., NWP 13)	Date of Action	If denied, give reason for denial

1. APPLICANT, AGENT, PROPERTY OWNER, AND CONTRACTOR INFORMATION

The applicant(s) is/are the legal entity to which the permit may be issued (see How to Apply at beginning of form). The applicant(s) can either be the property owner(s) or the person/people/company(ies) that intend(s) to undertake the activity. The agent is the person or company that is representing the applicant(s). If a company, please also provide the company name that is registered with the State Corporation Commission (SCC), or indicate no registration with the SCC.

Legal Name(s) of Applicant(s)			Agent (if applicable)		
Mailing address			Mailing address		
City	State	ZIP Code	City	State	ZIP Code
Phone number w/area code	Fax		Phone number w/area code	Fax	
Mobile	E-mail		Mobile	E-mail	
State Corporation Commission Name and ID number (if applicable)			State Corporation Commission Name and ID number (if applicable)		

Certain permits or permit authorizations may be provided via electronic mail. If the applicant wishes to receive their permit via electronic mail, please provide an e-mail address here: ____

1. APPLICANT, AGENT, PROPERTY OWNER, AND CONTRACTOR INFORMATION (Continued)

Property owner(s) legal name, if different from applicant			Contractor, if known		
Mailing address			Mailing address		
City	State	ZIP code	City	State	ZIP code
Phone number w/area code	Fax		Phone number w/area code	Fax	
Mobile	E-mail		Mobile	E-mail	
State Corporation Commission Name and ID number (if applicable)			State Corporation Commission Name ID number (if applicable)		

2. PROJECT LOCATION INFORMATION

(Attach a copy of a detailed map, such as a USGS topographic map or street map showing the site location and project boundary, so that it may be located for inspection. Include an arrow indicating the north direction. Include the drainage area if the SPGP box is checked on Page 7.)

Street Address (911 address if available)	City/County/ZIP Code Gloucester County
Subdivision	Lot/Block/Parcel #

Name of water body(ies) within project boundaries and drainage area (acres or square miles).
Timberneck Creek and York River

Tributary(ies) to: Timberneck Creek/York River/Chesapeake Bay
Basin: York River Sub-basin: Lower York
(*Example:* *Basin:* *James River* *Sub-basin:* *Middle James River*)

Special Standards (based on DEQ Water Quality Standards 9VAC25-260 et seq.): ______

Project type (check one)
______ Single user (private, non-commercial, residential)
X Multi-user (community, commercial, industrial, government)
______ Surface water withdrawal

Latitude and longitude at center of project site (decimal degrees): 37.29342° / -76.53494°
(Example: 37.33164/-77.68200)

USGS topographic map name: Claybank

8-digit USGS Hydrologic Unit Code (HUC) for your project site (See http://cfpub.epa.gov/surf/locate/index.cfm): 02080107
If known, indicate the 10-digit and 12-digit USGS HUCs (see http://consapps.dcr.virginia.gov/htdocs/maps/HUExplorer.htm) :
______ 020801070203

Name of your project (*Example: Water Creek driveway crossing*) Timberneck Creek Channel

Is there an access road to the project? ☑Yes ☐No. If yes, check all that apply: ☑public ☐private ☐improved ☐unimproved

Total size of the project area (in acres): 31.8 acres (13.8 acre channel and 18 acre disposal site)

2. PROJECT LOCATION INFORMATION (Continued)

Provide driving directions to your site, giving distances from the best and nearest visible landmarks or major intersections:

Take Rt 17 North from the Coleman Bridge to Rt. 636, Providence Rd. Turn left on Rt 636. Travel 1.5 miles to Rt. 635. Turn left onto Rt. 635, Borden Rd. Travel about 0.6 miles and turn left onto Country Lane. You have arrived at Machicomoco State Park where the dredged material will be placed.

Does your project site cross boundaries of two or more localities (i.e., cities/counties/towns)? ☐ Yes ☑ No

If so, name those localities:

3. DESCRIPTION OF THE PROJECT, PROJECT PRIMARY AND SECONDARY *PURPOSES*, PROJECT *NEED*, INTENDED USE(S), AND ALTERNATIVES CONSIDERED (Attach additional sheets if necessary)

- The purpose and need must include any new development or expansion of an existing land use and/or proposed future use of residual land.
- Describe the physical alteration of surface waters, including the use of pilings (#, materials), vibratory hammers, explosives, and hydraulic dredging, when applicable, and *whether or not tree clearing will occur* (include the area in square feet and time of year).
- Include a description of alternatives considered and measures taken to avoid or minimize impacts to surface waters, including wetlands, to the maximum extent practicable. Include factors such as, but not limited to, alternative construction technologies, alternative project layout and design, alternative locations, local land use regulations, and existing infrastructure
- For utility crossings, include both alternative routes and alternative construction methodologies considered
- For surface water withdrawals, public surface water supply withdrawals, or projects that will alter in stream flows, include the water supply issues that form the basis of the proposed project.

This project consists of new dredging at Timberneck Creek with dredged material placement upland at Dept of Conservation and Recreation property 4.5 miles upriver adjacent to Aberdeen Creek. Dredging of Timberneck Creek is necessary to allow safe navigation for vessels utilizing boat slips at Machicomoco State Park and the working waterfront located on the creek. The channel design used the federally-authorized channel at Aberdeen Creek as guidance to determine the parameters that best fit this section of the York River. The channel will be dredged to a maximum depth of -7 ft MLLW including allowable overdepth and non-pay depth. The Timberneck channel is 7,200 ft long and 80 ft wide with a 160 ft wide turning basin at the working waterfront. Approximately 46,300 cy of material will be dredged. Dredged material placement will occur at an upland disposal site using Geotubes for containment.

Date of proposed commencement of work (MM/DD/YYYY) ____________________	Date of proposed completion of work (MM/DD/YYYY) ____________________
Are you submitting this application at the direction of any state, local, or federal agency? _____Yes _____No	Has any work commenced or has any portion of the project for which you are seeking a permit been completed? _____ Yes __X__ No

If you answered "yes" to either question above, give details stating when the work was completed and/or when it commenced, who performed the work, and which agency (if any) directed you to submit this application. In addition, you will need to clearly differentiate between completed work and proposed work on your project drawings.

Are you aware of any unresolved violations of environmental law or litigation involving the property? _____Yes __X__No

(If yes, please explain)

4. PROJECT COSTS

Approximate cost of the entire project, including materials and labor: $XX
Approximate cost of only the portion of the project affecting state waters (channelward of mean low water in tidal areas and below ordinary high water mark in nontidal areas): $ xx

5. PUBLIC NOTIFICATION (Attach additional sheets if necessary)

Complete information for all property owners adjacent to the project site and across the waterway, if the waterway is less than 500 feet in width. If your project is located within a cove, you will need to provide names and mailing addresses for all property owners within the cove. If you own the adjacent lot, provide the requested information for the first adjacent parcel beyond your property line. Per Army Regulation (AR 25-51) outgoing correspondence must be addressed to a person or business.

Failure to provide this information may result in a delay in the processing of your application by VMRC.

Property owner's name	Mailing address	City	State	ZIP code

Name of newspaper having general circulation in the area of the project: Gloucester-Mathews Gazette-Journal
Address and phone number (including area code) of newspaper P.O. Box 2060 Gloucester, Va. 23061 Phone: 804-693-3101

Have adjacent property owners been notified with forms in Appendix A? _____Yes [✓ No] (attach copies of distributed forms)

6. THREATENED AND ENDANGERED SPECIES INFORMATION

Please provide any information concerning the potential for your project to impact state and/or federally threatened and endangered species (listed or proposed). Attach correspondence from agencies and/or reference materials that address potential impacts, such as database search results or confirmed waters and wetlands delineation/jurisdictional determination. Include information when applicable regarding the location of the project in Endangered Species Act-designated or -critical habitats. Contact information for the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Virginia Dept. of Game and Inland Fisheries, and the Virginia Dept. of Conservation and Recreation-Division of Natural Heritage can be found on page 4 of this package.

7. HISTORIC RESOURCES INFORMATION

Note: Historic properties include but are not limited to archeological sites, battlefields, Civil War earthworks, graveyards, buildings, bridges, canals, etc. Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the USACE from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the USACE, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant.

Are any historic properties located within or adjacent to the project site? ____ Yes [✓ No] _____ Uncertain
If Yes, please provide a map showing the location of the historic property within or adjacent to the project site.

Are there any buildings or structures 50 years old or older located on the project site? ____ Yes [✓ No] _____ Uncertain
If Yes, please provide a map showing the location of these buildings or structures on the project site.

Is your project located within a historic district? ____ Yes [✓ No] ____ Uncertain

If Yes, please indicate which district: ______________________________

7. HISTORIC RESOURCES INFORMATION (Continued)

Has a survey to locate archeological sites and/or historic structures been carried out on the property?
___ Yes x___ No ___ Uncertain

If Yes, please provide the following information: Date of Survey: ____________________________________

Name of firm: ____

Is there a report on file with the Virginia Department of Historic Resources? ____ Yes X____ No ___Uncertain

Title of Cultural Resources Management (CRM) report: ____

Was any historic property located? ____ Yes ____ No __ Uncertain

8. WETLANDS, WATERS, AND DUNES/BEACHES IMPACT INFORMATION

Report each impact site in a separate column. If needed, attach additional sheets using a similar table format. Please ensure that the associated project drawings clearly depict the location and footprint of each numbered impact site. For dredging, mining, and excavating projects, use Section 17.

	Impact site number 1	Impact site number 2	Impact site number 3	Impact site number 4	Impact site number 5
Impact description (use all that apply): F=fill EX=excavation S=Structure T=tidal NT=non-tidal TE=temporary PE=permanent PR=perennial IN=intermittent SB=subaqueous bottom DB=dune/beach IS=hydrologically isolated V=vegetated NV=non-vegetated MC=Mechanized Clearing of PFO (*Example: F, NT, PE, V*)	Channel Dredging EX, T, PE, SB	Upland Disposal Site F			
Latitude / Longitude (in decimal degrees)	37.29342°,-76.53494°	37.297926, -76.537382			
Wetland/waters impact area (square feet / acres)	13.8 acres	18 acres			
Dune/beach impact area (square feet)					
Stream dimensions at impact site (length and average width in linear feet, and area in square feet)					
Volume of fill below Mean High Water or Ordinary High Water (cubic yards)					

8. WETLANDS/WATERS IMPACT INFORMATION (Continued)

Cowardin classification of impacted wetland/water or geomorphological classification of stream *Example wetland: PFO; Example stream: 'C' channel and if tidal, whether vegetated or non-vegetated wetlands per Section 28.2-1300 of the Code of Virginia*	E1UBL				
Average stream flow at site (flow rate under normal rainfall conditions in cubic feet per second) and method of deriving it (gage, estimate, etc.)					
Contributing drainage area in acres or square miles (*VMRC cannot complete review without this information*)	<5 sq miles				
DEQ classification of impacted resource(s): Estuarine Class II Non-tidal waters Class III Mountainous zone waters Class IV Stockable trout waters Class V Natural trout waters Class VI Wetlands Class VII https://law.lis.virginia.gov	Estuarine Class II				

For DEQ permitting purposes, also submit as part of this section a wetland and waters boundary delineation map – see (3) in the Footnotes section in the form instructions.

For DEQ permitting purposes, also submit as part of this section a written disclosure of all wetlands, open water, or streams that are located within the proposed project or compensation areas that are also under a deed restriction, conservation easement, restrictive covenant, or other land-use protective instrument.

9. APPLICANT, AGENT, PROPERTY OWNER, AND CONTRACTOR CERTIFICATIONS

READ ALL OF THE FOLLOWING CAREFULLY BEFORE SIGNING

PRIVACY ACT STATEMENT: The Department of the Army permit program is authorized by Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and Section 103 of the Marine Protection Research and Sanctuaries Act of 1972. These laws require that individuals obtain permits that authorize structures and work in or affecting navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters prior to undertaking the activity. Information provided in the Joint Permit Application will be used in the permit review process and is a matter of public record once the application is filed. Disclosure of the requested information is voluntary, but it may not be possible to evaluate the permit application or to issue a permit if the information requested is not provided.

CERTIFICATION: I am hereby applying for permits typically issued by the DEQ, VMRC, USACE, and/or Local Wetlands Boards for the activities I have described herein. I agree to allow the duly authorized representatives of any regulatory or advisory agency to enter upon the premises of the project site at reasonable times to inspect and photograph site conditions, both in reviewing a proposal to issue a permit and after permit issuance to determine compliance with the permit.

In addition, I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

9. APPLICANT, AGENT, PROPERTY OWNER, AND CONTRACTOR CERTIFICATIONS (Continued)

Is/Are the Applicant(s) and Owner(s) the same? ☐ *Yes* ☐ *No*

Legal name & title of Applicant	Second applicant's legal name & title, if applicable
Applicant's signature	Second applicant's signature
Date	Date
Property owner's legal name, if different from Applicant	Second property owner's legal name, if applicable
Property owner's signature, if different from Applicant	Second property owner's signature
Date	Date

CERTIFICATION OF AUTHORIZATION TO ALLOW AGENT(S) TO ACT ON APPLICANT'S(S') BEHALF (IF APPLICABLE)

I (we), ___________________________________ (and) ________________________________ ,
APPLICANT'S LEGAL NAME(S) – *complete the second blank if more than one Applicant*

hereby certify that I (we) have authorized ______________________________ (and) ________________________________
AGENT'S NAME(S) – *complete the second blank if more than one Agent*
to act on my (our) behalf and take all actions necessary to the processing, issuance, and acceptance of this permit and any and all standard and special conditions attached. I (we) hereby certify that the information submitted in this application is true and accurate to the best of my (our) knowledge.

Applicant's signature	Second applicant's signature, if applicable
Date	Date
Agent's signature and title	Second agent's signature and title, if applicable
Date	Date

CONTRACTOR ACKNOWLEDGEMENT (IF APPLICABLE)

I (we), ____ (and) ____ ,
APPLICANT'S LEGAL NAME(S) – *complete the second blank if more than one Applicant*

have contracted _______________________________________ (and) _______________________________________
CONTRACTOR'S NAME(S) – *complete the second blank if more than one Contractor*

to perform the work described in this Joint Permit Application, signed and dated ____________________________________.

I (we) will read and abide by all conditions as set forth in all federal, state, and local permits as required for this project. I (we) understand that failure to follow the conditions of the permits may constitute a violation of applicable federal, state, and local statutes and that we will be liable for any civil and/or criminal penalties imposed by these statutes.
In addition, I (we) agree to make available a copy of any permit to any regulatory representative visiting the project site to ensure permit compliance. If I (we) fail to provide the applicable permit upon request, I (we) understand that the representative will have the option of stopping our operation until it has been determined that we have a properly signed and executed permit and are in full compliance with all of the terms and conditions.

Contractor's name or name of firm (printed/typed)	Contractor's or firm's mailing address	
Contractor's signature and title	Contractor's license number	Date
Applicant's signature	Second applicant's signature, if applicable	
Date	Date	

16. BEACH NOURISHMENT (Continued)

Describe the type(s) of vegetation proposed for stabilization and the proposed planting plan, including schedule, spacing, monitoring, etc. Attach additional sheets if necessary.

17. DREDGING, MINING, AND EXCAVATING

FILL OUT THE FOLLOWING TABLE FOR DREDGING PROJECTS

	NEW dredging				**MAINTENANCE dredging**			
	Hydraulic		Mechanical (clamshell, dragline, etc.)		Hydraulic		Mechanical (clamshell, dragline, etc.)	
	Cubic yards	Square feet	Cubic yards	Square feet	Cubic yards	Square feet	Cubic yards	Square feet
Vegetated wetlands								
Non-vegetated wetlands								
Subaqueous land	46,300 cy							
Totals	46,300 cy							

Is this a one-time dredging event? ☒ Yes _____ No If "no", how many dredging cycles are anticipated: ____________________
(____ initial cycle in cu. yds.) (_____ subsequent cycles in cu. yds.)

Composition of material (percentage sand, silt, clay, rock):
Provide documentation (i.e., laboratory results or analytical reports) that *dredged* material from on-site areas is free of toxics. If not free of toxics, provide documentation of proper disposal (i.e., bill of lading from commercial supplier or disposal site).

Timberneck Creek is a small tributary to the York River in rural Gloucester County far removed from the sources of industrial contamination. Dredge material is relatively recently shoaled sediments migrating through the littoral system.

Please include a dredged material management plan that includes specifics on how the dredged material will be handled and retained to prevent its entry into surface waters or wetlands. If on-site dewatering is proposed, please include plan view and cross-sectional drawings of the dewatering area and associated outfall.

Dredged material will be placed in geo-tubes. In additions, silt fencing will be used to prevent dredged material entrance to surface waters while drying.

Will the dredged material be used for any commercial purpose or beneficial use? _____Yes _x____No
If yes, please explain:

If this is a maintenance dredging project, what was the date that the dredging was last performed? ________________________
Permit number of original permit: ______________________ *(It is important that you attach a copy of the original permit.)*

17. DREDGING, MINING, AND EXCAVATING (Continued)

For mining projects: On separate sheets of paper, explain the operation plans, including: 1) the frequency (e.g., every six weeks), duration (i.e., April through September), and volume (in cubic yards) to be removed per operation; 2) the temporary storage and handling methods of mined material, including the dimensions of the containment berm used for upland disposal of dredged material and the need (or no need) for a liner or impermeable material to prevent the leaching of any identified contaminants into ground water; 3) how equipment will access the mine site; and 4) verification that dredging: a) will not occur in water body segments that are currently on the effective Section 303(d) Total Maximum Daily Load (TMDL) priority list (available at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/TMDLProgramPriorities.aspx) or that have an approved TMDL; b) will not exacerbate any impairment; and c) will be consistent with any waste load allocation/limit/conditions imposed by an approved TMDL (see, "What's in my backyard" or subsequent spatial files at http://www.deq.virginia.gov/ConnectWithDEQ/VEGIS.aspx to determine the extent of TMDL watersheds and impairment segments).

Have you applied for a permit from the Virginia Department of Mines, Minerals and Energy? _____Yes _____No If Yes:
Existing permit number:______________________ Date permit issued: ________________

Contributing drainage area: __________square miles	Average stream flow at site (flow rate under normal rainfall conditions): _______________cfs

18. FILL (not associated with backfilled shoreline structures) AND OTHER STRUCTURES (other than piers and boathouses) IN WETLANDS OR WATERS, OR ON DUNES/BEACHES

Source and composition of fill material (percentage sand, silt, clay, rock):

____

Provide documentation (i.e., laboratory results or analytical reports) that *fill* material from *off-site* locations is free of toxics. If not free of toxics, provide documentation of proper disposal (i.e., bill of lading from commercial supplier or disposal site). Documentation is not necessary for fill material obtained from on-site areas.

Explain the purpose of the filling activity and the type of structure to be constructed over the filled area (if any):

Describe any structure that will be placed in wetlands/waters or on a beach dune and its purpose:

Will the structure be placed on pilings? ____ Yes ____ No	Total area occupied by any structure. ___________ Square Feet
How far will the structure be placed channelward from the back edge of the dune? ______feet	How far will the structure be placed channelward from the back edge of the beach? ________feet

19. NONTIDAL STREAM CHANNEL MODIFICATIONS FOR RESTORATION OR ENHANCMENT, or TEMPORARY OR PERMANENT RELOCATIONS

If proposed activities are being conducted for the purposes of compensatory mitigation, please attach separate sheets of paper providing all information required by the most recent version of the stream assessment methodology approved by the Norfolk District of the U.S. Army Corps of Engineers and the Virginia Department of Environmental Quality, in lieu of completing the questions below. Required information outlined by the methodology can be found at: http://www.nao.usace.army.mil/Missions/Regulatory/UnifiedStreamMethodology.aspx *or* http://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Mitigation.aspx.

For all projects proposing stream restoration provide a completed Natural Channel Design Review Checklist and Selected Morphological Characteristics form. These forms and the associated manual can be located at: https://www.fws.gov/chesapeakebay/StreamReports/NCD%20Review%20Checklist/Natural%20Channel%20Design%20Checklist%20Doc%20V2%20Final%2011-4-11.pdf

Has the stream restoration project been designed by a local, state, or federal agency? ____ Yes ____ No. If yes, please include the name of the agency here: ____.

Is the agency also providing funding for this project? _____ Yes _____ No

Stream dimensions at impact site (length and average width in linear feet, and area in square feet):
L: _________(feet) AW:_________ (feet) Area:___________ (square feet)

Contributing drainage area: __________acres *or* __________square miles

APPENDIX A

Adjacent Property Owner’s Acknowledgement Form

I, ____, own land next to/ across the water from/ in the same cove
(print adjacent property owner’s name)

as the land of ____.
(print applicant’s name)

I have reviewed the applicant’s project drawings dated ____ to be submitted for all
(date of drawings)

necessary federal, state, and local permits.

_____ I have no comment regarding the proposal

_____ I do not object to the proposal

_____ I object to the proposal

The applicant has agreed to contact me for additional comments if the proposal changes prior to construction of the project.

(Before signing this form, please be sure that you have checked the appropriate option above)

____
Adjacent property owner’s signature

____
Date

NOTE: IF YOU OBJECT TO THE PROPOSAL, THE REASON(S) YOU OPPOSE THE PROJECT MUST BE SUBMITTED TO VMRC IN WRITING. AN OBJECTION WILL NOT NECESSARILY RESULT IN A DENIAL OF A PERMIT FOR THE PROPOSED WORK. HOWEVER, VALID COMPLAINTS WILL BE GIVEN FULL CONSIDERATION DURING THE PERMIT REVIEW PROCESS.

APPENDIX A

Adjacent Property Owner's Acknowledgement Form

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The applicant has agreed to contact me for additional comments if the proposal changes prior to construction of the project.

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____
Date

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APPENDIX C

Chesapeake Bay Preservation Act Information

Please answer the following questions to determine if your project is subject to the requirements of the Bay Act Regulations:

1. Is your project located within Tidewater Virginia? _X__Yes ____No (See map on page 31) - If the answer is "no", the Bay Act requirements do not apply; if "yes", then please continue to question #2.

2. Please indicate if the project proposes to impact any of the following Resource Protection Area (RPA) features:

____ Tidal wetlands,

____ Nontidal wetlands connected by surface flow and contiguous to tidal wetlands or water bodies with perennial flow,

____ Tidal shores,

____ Other lands considered by the local government to meet the provisions of subsection A of 9VAC25-830-80 and to be necessary to protect the quality of state waters (contact the local government for specific information),

____ A buffer area not less than 100 feet in width located adjacent to and landward of the components listed above, and along both sides of any water body with perennial flow.

If the answer to question #1 was "yes" and any of the features listed under question #2 will be impacted, compliance with the Chesapeake Bay Preservation Area Designation and Management Regulations is required. **The Chesapeake Bay Preservation Area Designation and Management Regulations** are enforced through locally adopted ordinances based on the Chesapeake Bay Preservation Act (CBPA) program. Compliance with state and local CBPA requirements mandates the submission of a ***Water Quality Impact Assessment (WQIA)*** for the review and approval of the local government. Contact the appropriate local government office to determine if a WQIA is required for the proposed activity(ies).

The individual localities, not the DEQ, USACE, or the Local Wetlands Boards, are responsible for enforcing the CBPA requirements and, therefore, local permits for land disturbance are not issued through this JPA process. **Approval of this wetlands permit does not constitute compliance with the CBPA regulations nor does it guarantee that the local government will grant approval for encroachments into the RPA that may result from this project.**

Notes for all projects in RPAs

Development, redevelopment, construction, land disturbance, or placement of fill within the RPA features listed above requires the approval of the locality and may require an exception or variance from the local Bay Act ordinance. Please contact the appropriate local government to determine the types of development or land uses that are permitted within RPAs.

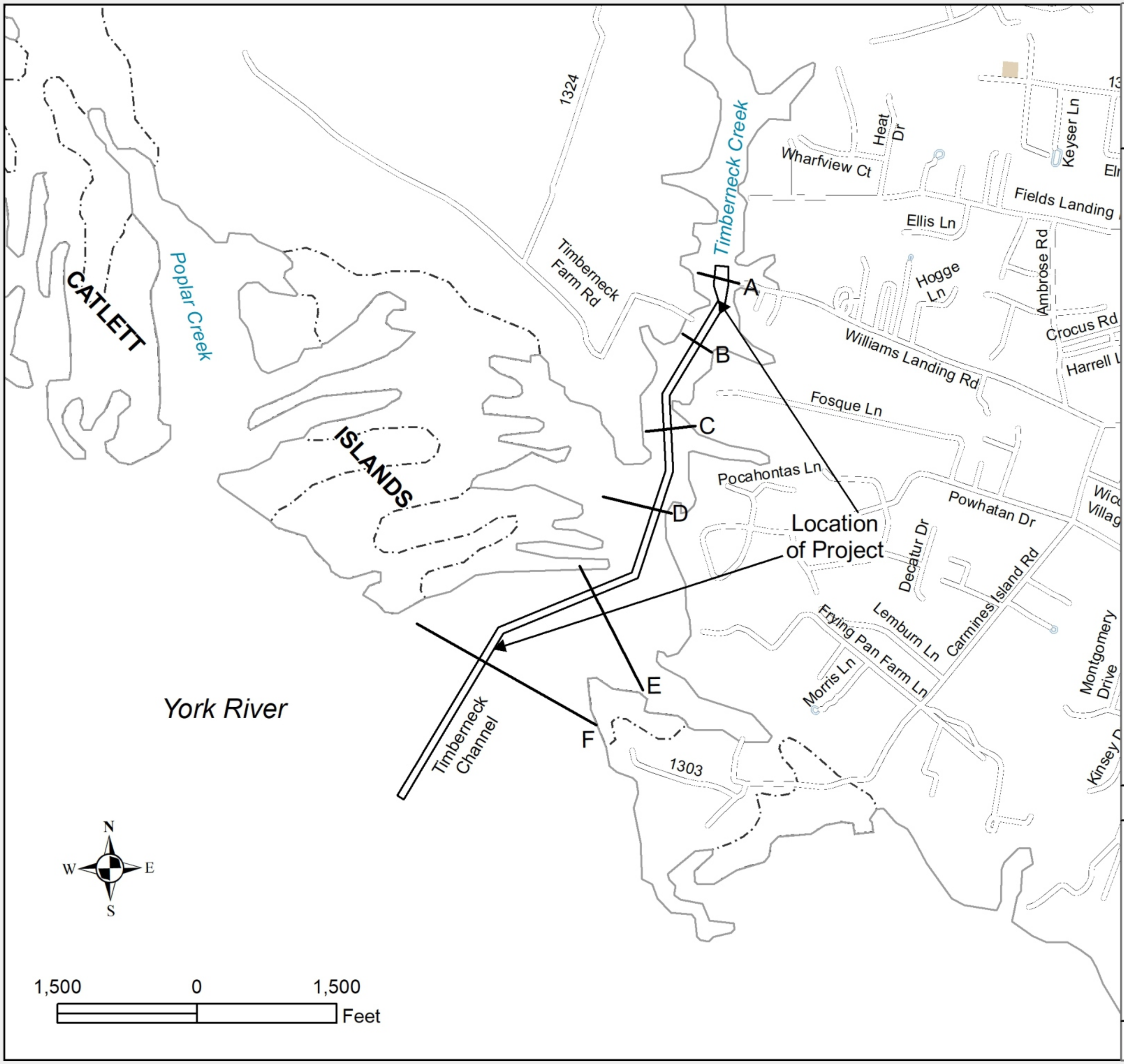
Pursuant to 9VAC25-830-110, *on-site delineation of the RPA is required for all projects in CBPAs*. Because USGS maps are not always indicative of actual "in-field" conditions, they may not be used to determine the site-specific boundaries of the RPA.

Notes for shoreline erosion control projects in RPAs

Re-establishment of woody vegetation in the buffer will be required by the locality to mitigate for the removal or disturbance of buffer vegetation associated with your proposed project. Please contact the local government to determine the mitigation requirements for impacts to the 100-foot RPA buffer.

Pursuant to 9VAC25-830-140 5 a (4) of the Virginia Administrative Code, shoreline erosion projects are a permitted modification to RPAs provided that the project is based on the "best technical advice" and complies with applicable permit conditions. In accordance with 9VAC25-830-140 1 of the Virginia Administrative Code, the locality will use the information provided in this Appendix, in the project drawings, in this permit application, and as required by the locality, to make a determination that:

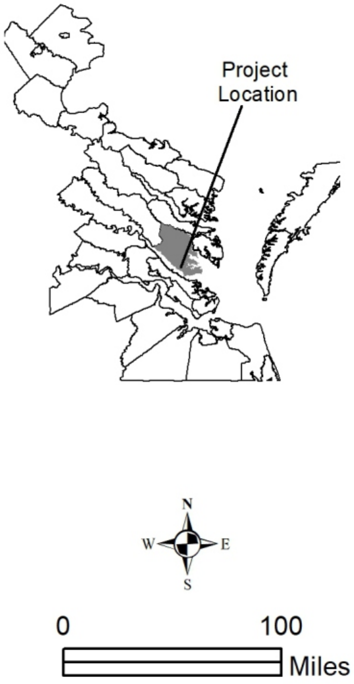
1. Any proposed shoreline erosion control measure is necessary and consistent with the nature of the erosion occurring on the site, and the measures have employed the "best available technical advice"
2. Indigenous vegetation will be preserved to the maximum extent practicable
3. Proposed land disturbance has been minimized
4. Appropriate mitigation plantings will provide the required water quality functions of the buffer (9VAC25-830-140 3)
5. The project is consistent with the locality's comprehensive plan
6. Access to the project will be provided with the minimum disturbance necessary.



VIMS | William & Mary

Virginia Institute of Marine Science

Shoreline Studies Program



Virginia Institute of Marine Science
Gloucester County, Virginia

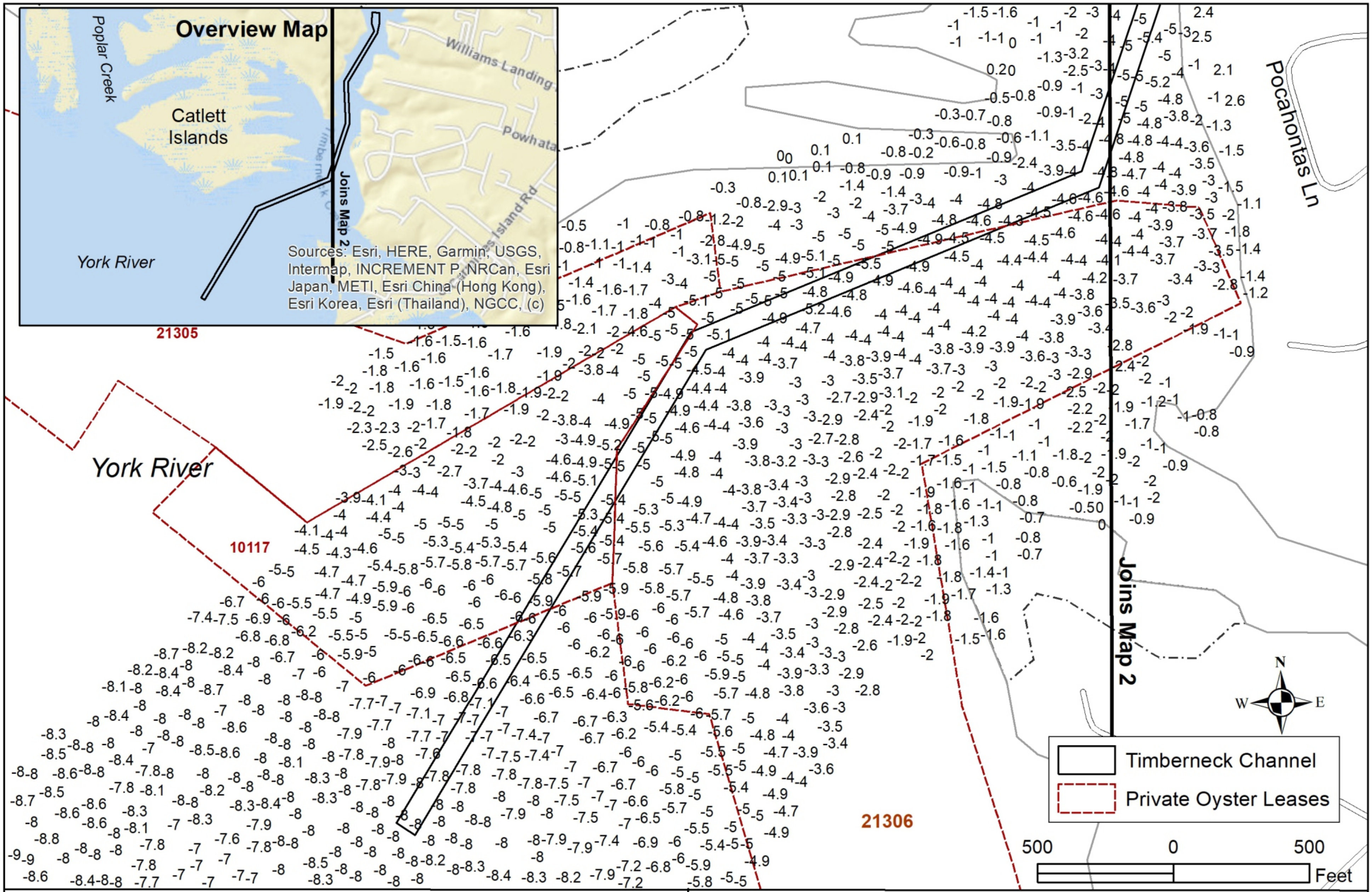
COVERSHEET

Timberneck Channel
Gloucester County
Virginia

SCALE: AS SHOWN ON SHEET

December 2020

Sheet: 1 of 8



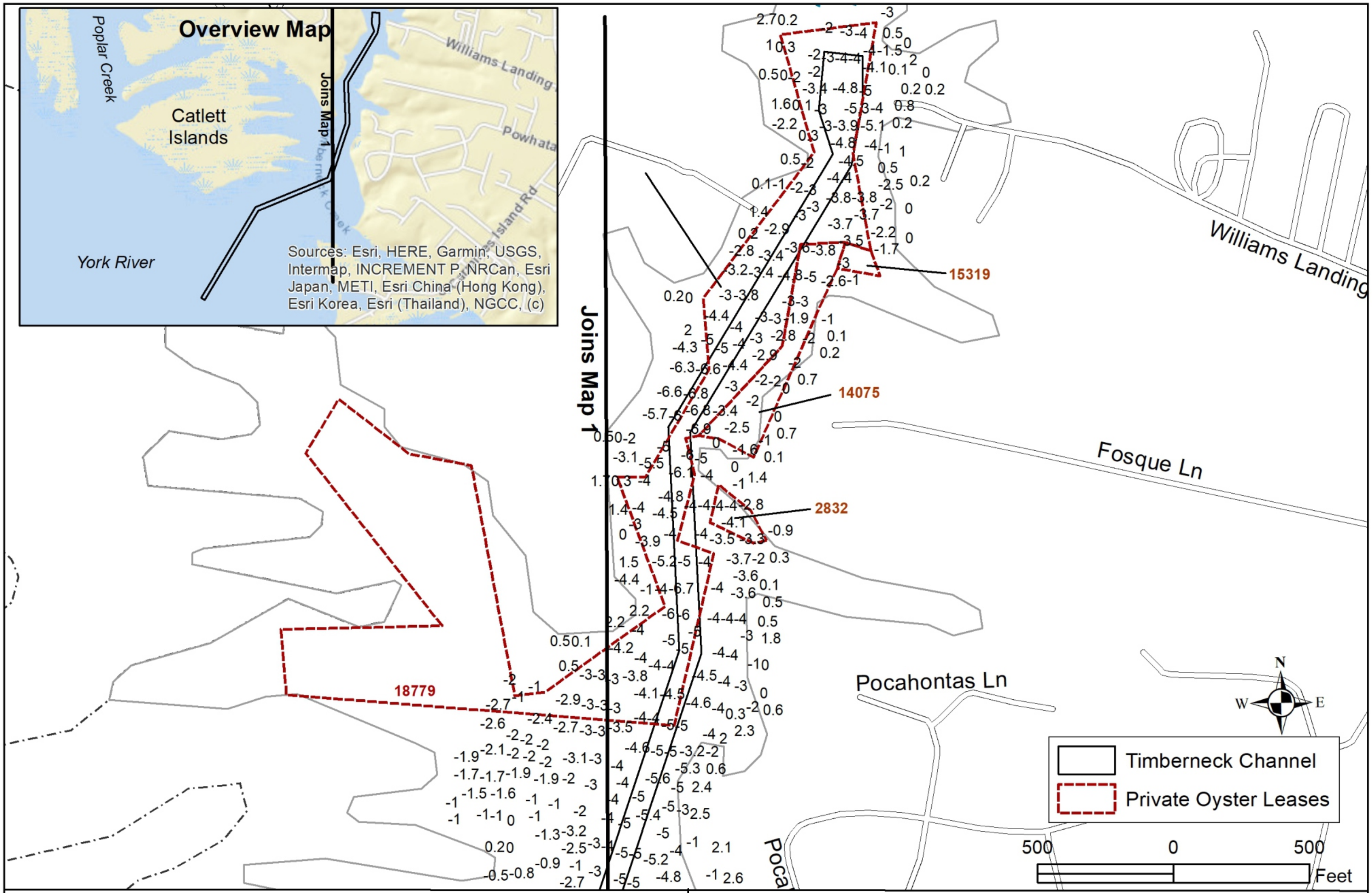
EXISTING CONDITIONS MAP 1

TIMBERNECK CHANNEL
GLOUCESTER COUNTY, VIRGINIA

SCALE: AS SHOWN

December 2020

Sheet: 2 of 8



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)

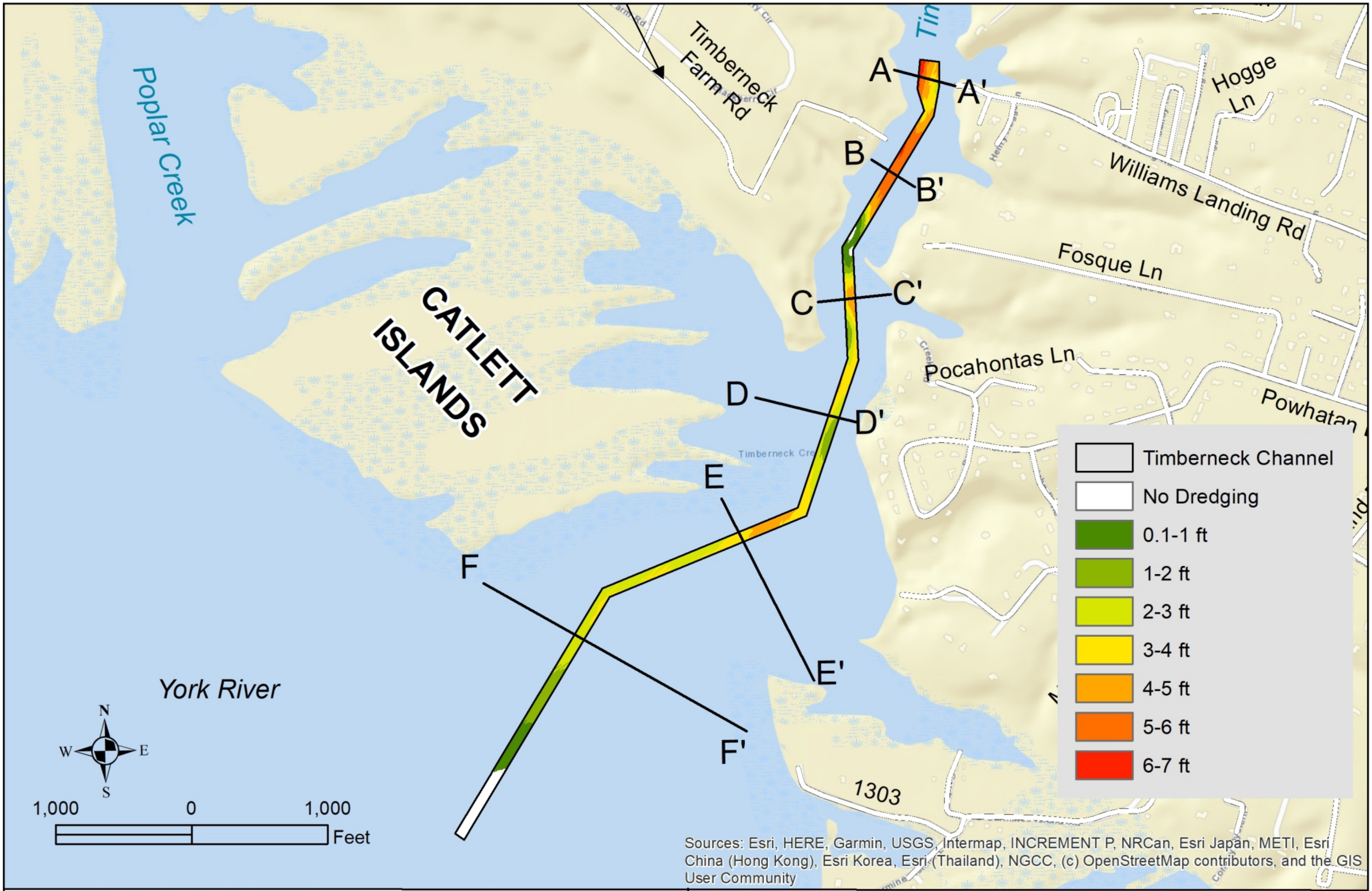
EXISTING CONDITIONS MAP 2

TIMBERNECK CHANNEL
GLOUCESTER COUNTY, VIRGINIA

SCALE: AS SHOWN

December 2020

Sheet: 3 of 8



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

DREDGE DEPTHS

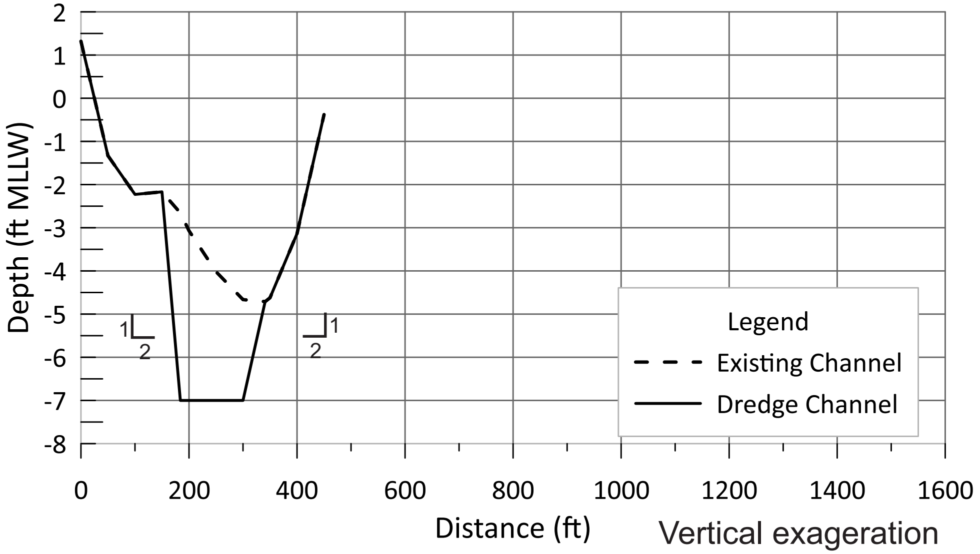
TIMBERNECK CHANNEL
GLOUCESTER COUNTY, VIRGINIA

SCALE: AS SHOWN

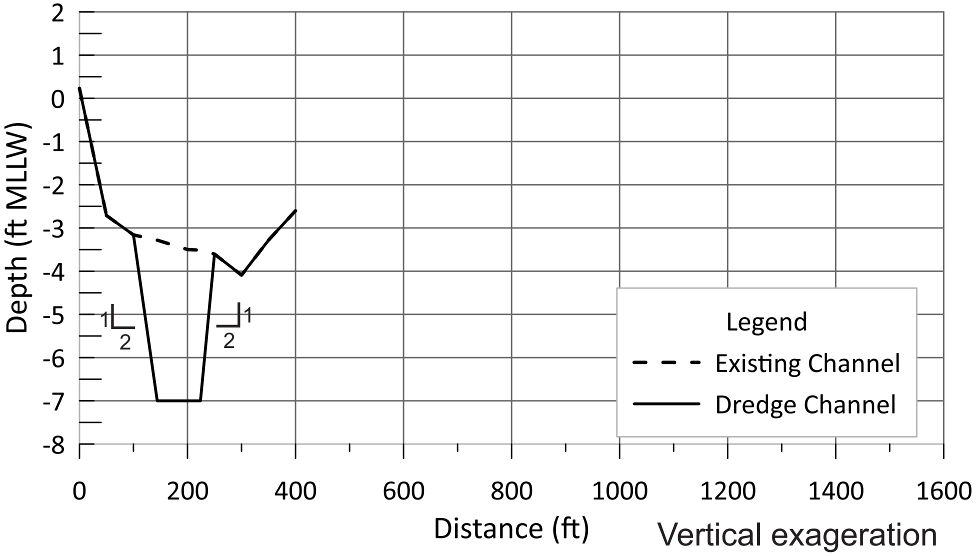
December 2020

Sheet: 4 of 8

Profile A



Profile B



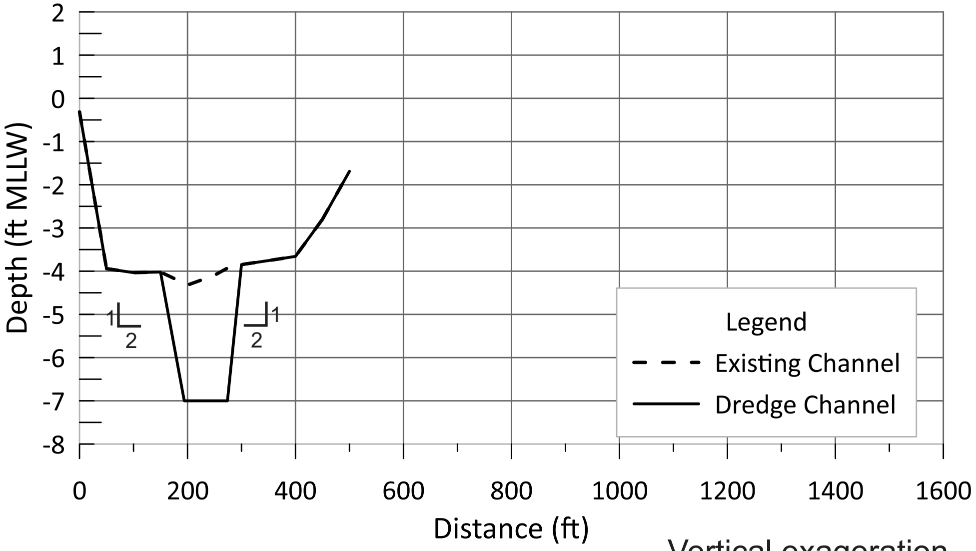
CROSS-SECTIONS
Timberneck Creek Channel
Gloucester County, Virginia

Scale: As Shown

December 2020

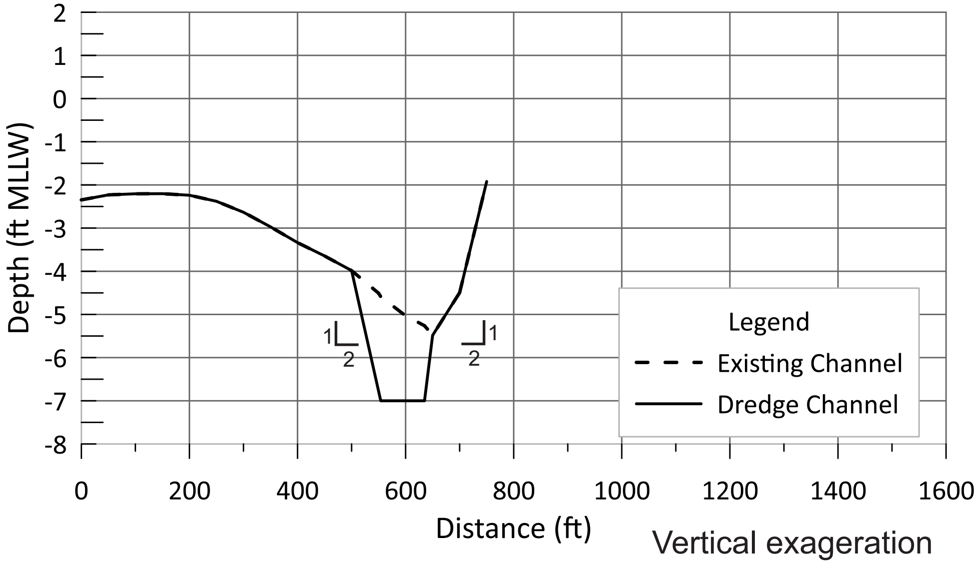
Sheet 5 of 8

Profile C



Vertical exageration

Profile D



Vertical exageration

CROSS-SECTIONS

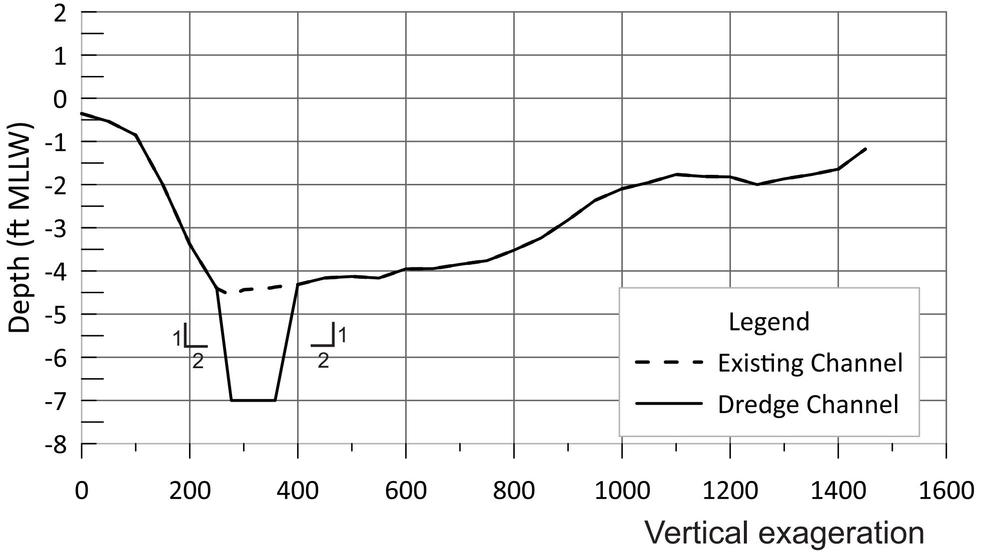
Timberneck Creek Channel
Gloucester County, Virginia

Scale: As Shown

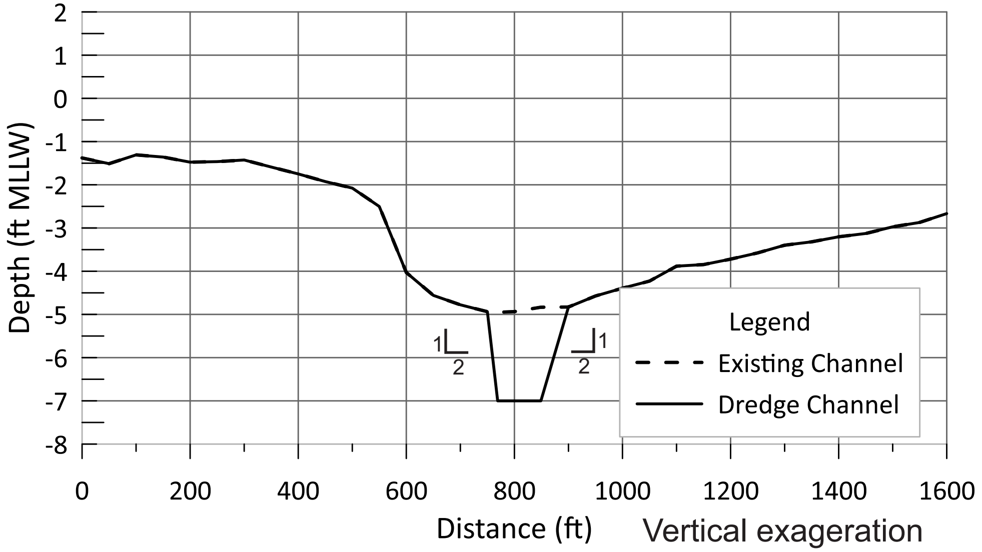
December 2020

Sheet 6 of 8

Profile E



Profile F



CROSS-SECTIONS

Timberneck Creek Channel
Gloucester County, Virginia

Scale: As Shown

December 2020

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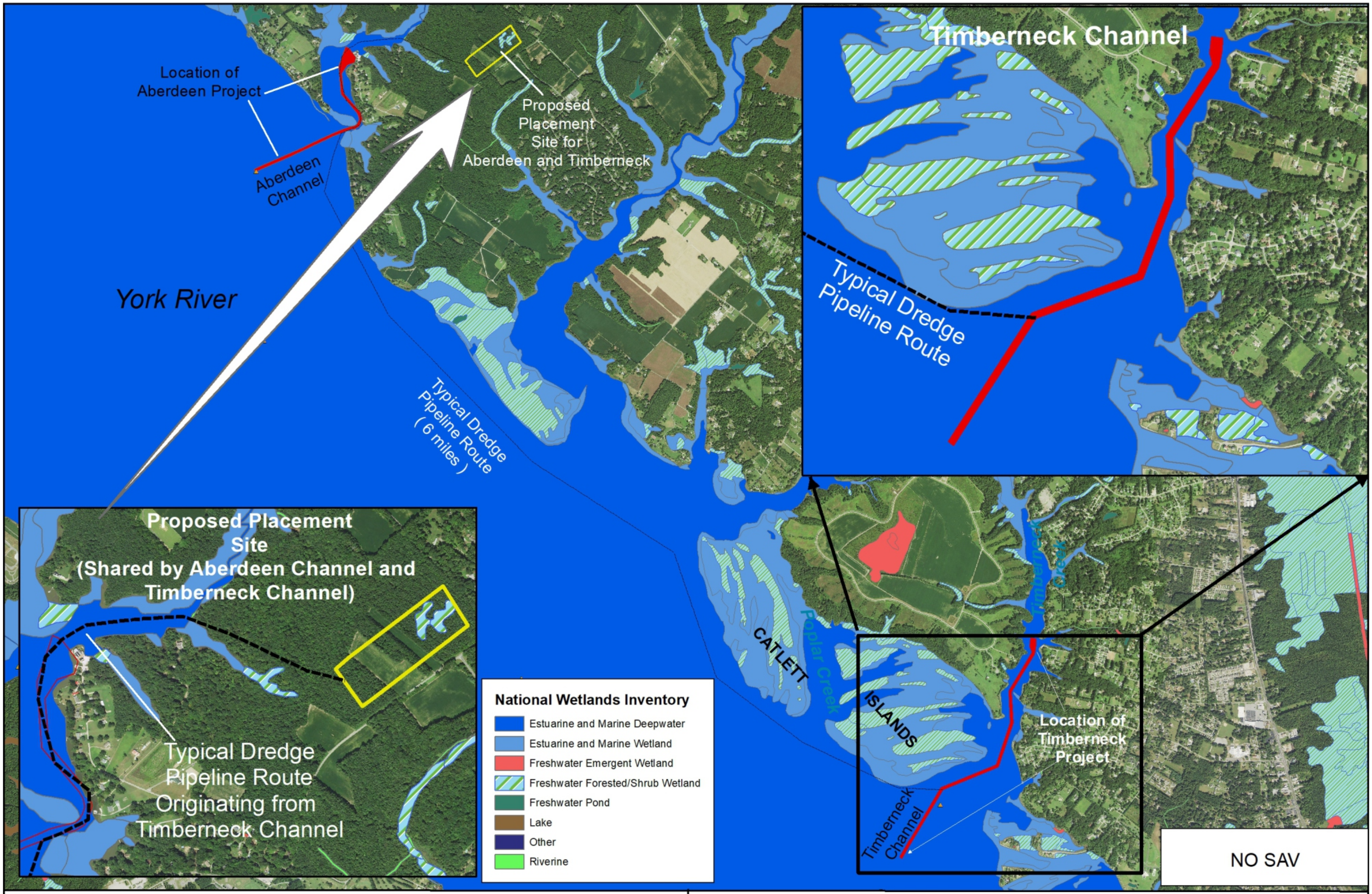

PROPOSED PLACEMENT SITE

TIMBERNECK CHANNEL
GLOUCESTER COUNTY, VIRGINIA

SCALE: AS SHOWN Image: NAIP 2018

Shoreline Studies Program VIMS

December 2020

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Appendix F

Sediment Dating

Sedimentation Rate Sampling

Sediments contain a background level of ^{210}Pb that is continuously deposited over time as it becomes fixed on sediment particles. With a half-life time of 22.3 years, ^{210}Pb is the sole natural radioactive lead isotope, the presence of which in the environment is directly related to the presence of the parent isotope. ^{210}Pb that was incorporated into the sediments 22.3 years ago will be only one half as radioactive as when initially deposited. This property of radioactive decay can be used to calculate the approximate age of sediments at other depths in the sediment column and/or the rate of sediment accumulation over about the last 100 years.

Sedimentation rates were obtained by analyzing core samples for ^{210}Pb and ^{137}Cs radioisotopes using gamma spectroscopy. Dried and homogenized samples were packed in Petri dishes and sealed with electrical tape and paraffin wax 30 days prior to analysis to allow for equilibration between 226Ra and its daughter isotopes, 214Pb and 214Bi (supported ^{210}Pb). Total ^{210}Pb (46.5 keV photopeak) and ^{137}Cs (662 keV photopeak) activity was measured for all samples along each core using a Canberra GL 2020 Low Energy Germanium detector (Virginia Institute of Marine Science Geochronology Lab). Total ^{210}Pb counts were corrected for detector efficiency and self-attenuation using the point-source method (Cutshall et al., 1983). Concentrations of excess ^{210}Pb used to obtain age models were determined as the difference between total ^{210}Pb and supported ^{210}Pb (Table 1). ^{137}Cs is a bomb-produced radionuclide used to verify accumulation rates determined by ^{210}Pb geochronology. ^{137}Cs is a by-product of nuclear weapons testing. It first occurred in the atmosphere in about 1952 and peaked during 1963-64. It adsorbs strongly to fine-grained sediments and therefore can be used to determine the time of deposition of sediments that have been exposed to atmospheric fallout. Peak ^{137}Cs activity is assumed to be 1963.

The constant flux-constant sedimentation (CFCS) model (Corbett & Walsh, 2015) was used to calculate sedimentation rates over the last ~100 years at all sites, assuming a constant rate of accumulation and flux of excess ^{210}Pb. These rates were calculated using the following formulas:

$$Az = A0 \text{ e-}\lambda t$$

$$t = z / S$$

where Az is the excess (unsupported) ^{210}Pb activity for a sample at depth z, A0 is the excess ^{210}Pb activity at the time of sample collection, λ is the ^{210}Pb decay constant, and t is elapsed time since burial. To calculate a vertical accretion rate (S), the natural log of excess ^{210}Pb activities were plotted against depth to obtain a slope of the best-fit line (m):

$$S = \lambda / m$$

Using Timberneck's core 4, 4-centimeter (cm) samples were taken from the top of the core at 12 cm intervals until a depth of 140 cm was reached. Each sample farther along the core was still 4 cm along the length of the core, but it occurred at 28 cm intervals (Table F-1). Using this method, the natural sediment accretion rate in Timberneck Creek within the last 60 years averaged about 1.3 cm/yr. ^{137}Cs radioisotopes also were used to determine the approximate age of the sediments at a particular depth by assuming the peak of ^{137}Cs is the year 1963. As the ^{137}Cs peak is located at a mid-range depth (approximately 40 to 44 cm), it supports the findings of a moderate (1.3 cm/yr) accretion rate.

Table F-1. Table 1. Summary table of ^{210}Pb and ^{137}Cs sedimentation analysis of Timberneck Creek core 4.

Sample ID	Depth Range (cm)	Mean Depth (cm)	Depth Range ± (cm)	Excess ^{210}Pb DPM/g	^{210}Pb Error (±DPM/g)	Ln(Excess)	Total ^{137}Cs (DPM/g)	^{137}Cs Error (±DPM/g)
TC-04_8-12cm	8 - 12 cm	10	2	3.493761292	0.210183335	1.25097889	0.120740369	0.01303771
TC-04_40-44cm	40 - 44 cm	42	2	1.84121156	0.141304761	0.610423811	0.152915335	0.012640499
TC-04_72-76cm	72 - 76 cm	74	2	0.479173886	0.090587152	-0.735691728	0	0
TC-04_104-108cm	104 - 108 cm	106	2	0.571285205	0.09544483	-0.55986671	0	0
TC-04_136-140cm	136 - 140 cm	138	2	0.134115801	0.107871087	-2.009051668	0	0
TC-04_168-172cm	168 - 172 cm	170	2	-0.181057971	0.096376587	0	0	0
TC-04_200-204cm	200 - 204 cm	202	2	-0.192173555	0.092856636	0	0	0
TC-04_232-236cm	232 - 236 cm	234	2	0.224893252	0.111046509	-1.492129425	0.051387924	0.00688518
TC-04_264-268cm	264 - 268 cm	266	2	0.194863949	0.106049621	-1.63545366	0	0

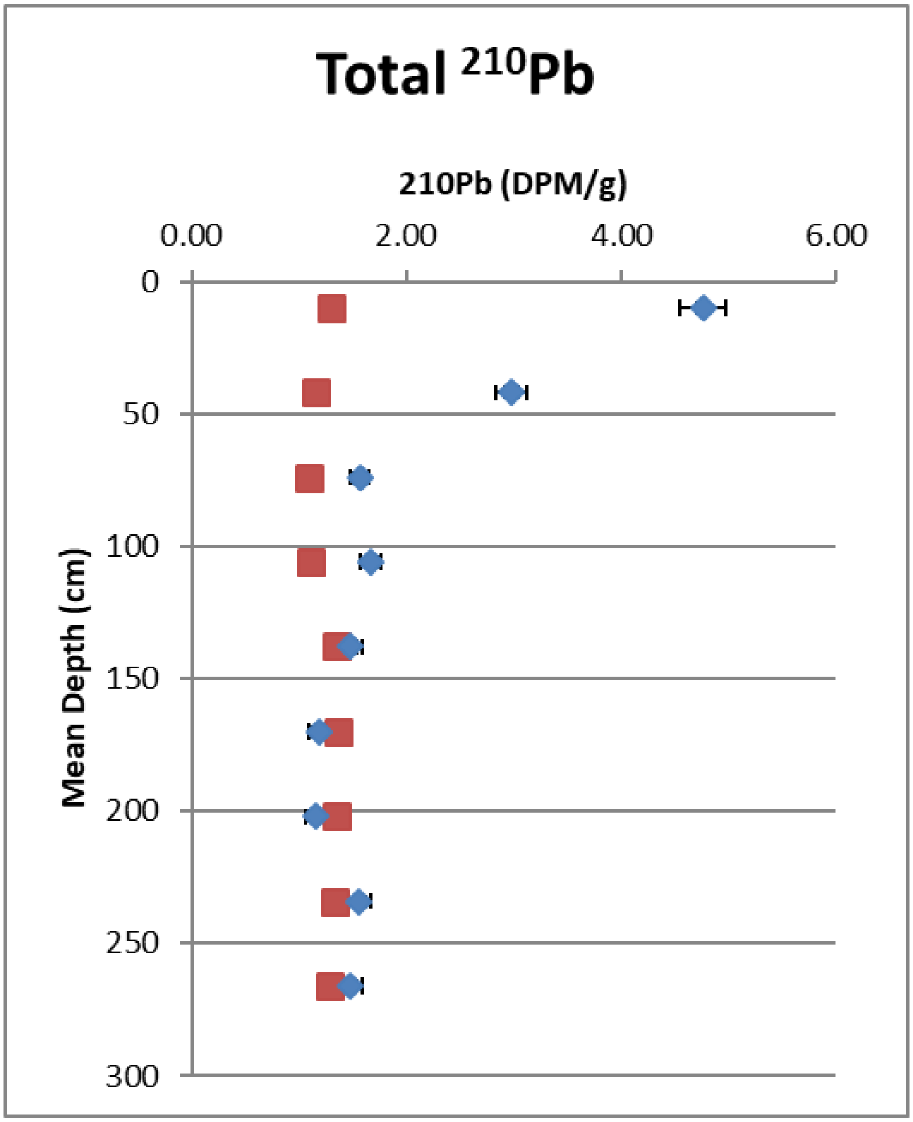

Figure F-1. Total ^{210}Pb from the sample at Timberneck Creek.

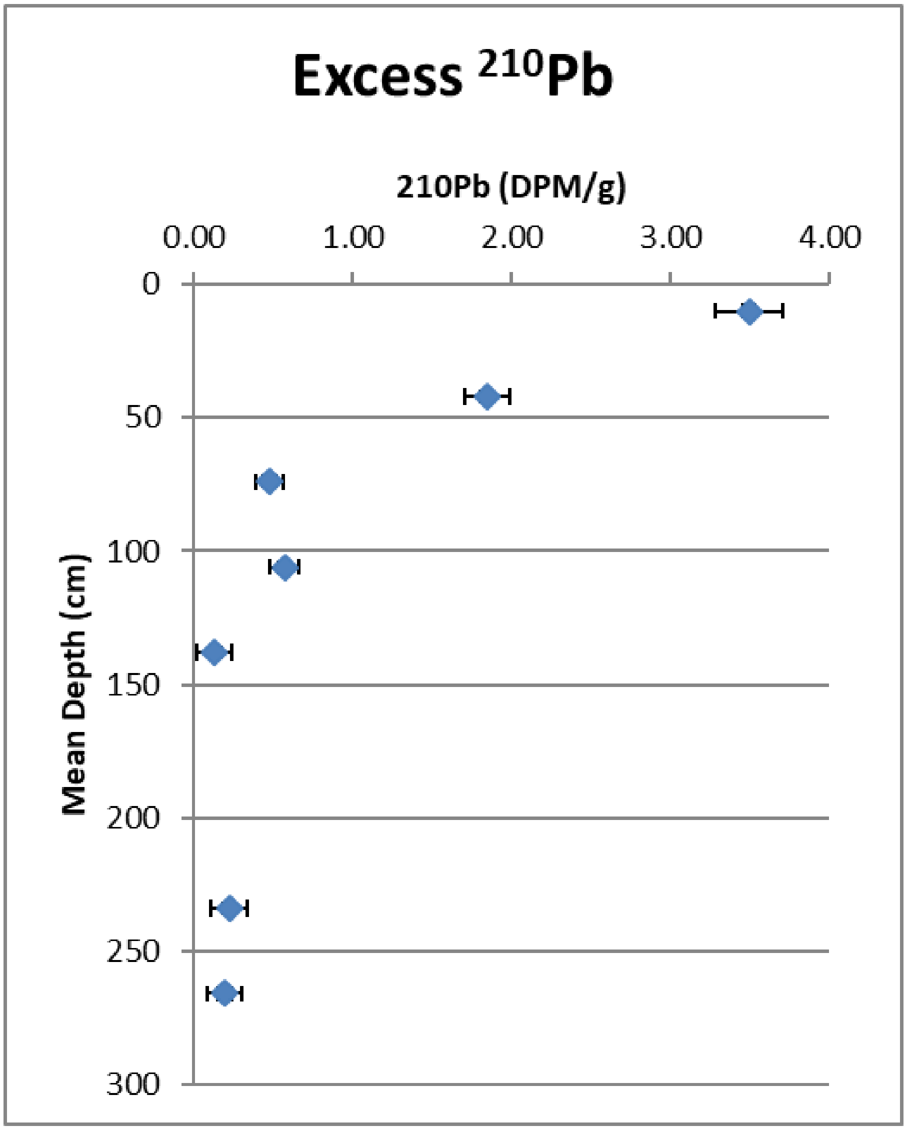

Figure F-2. Excess ^{210}Pb from the sample at Timberneck Creek.

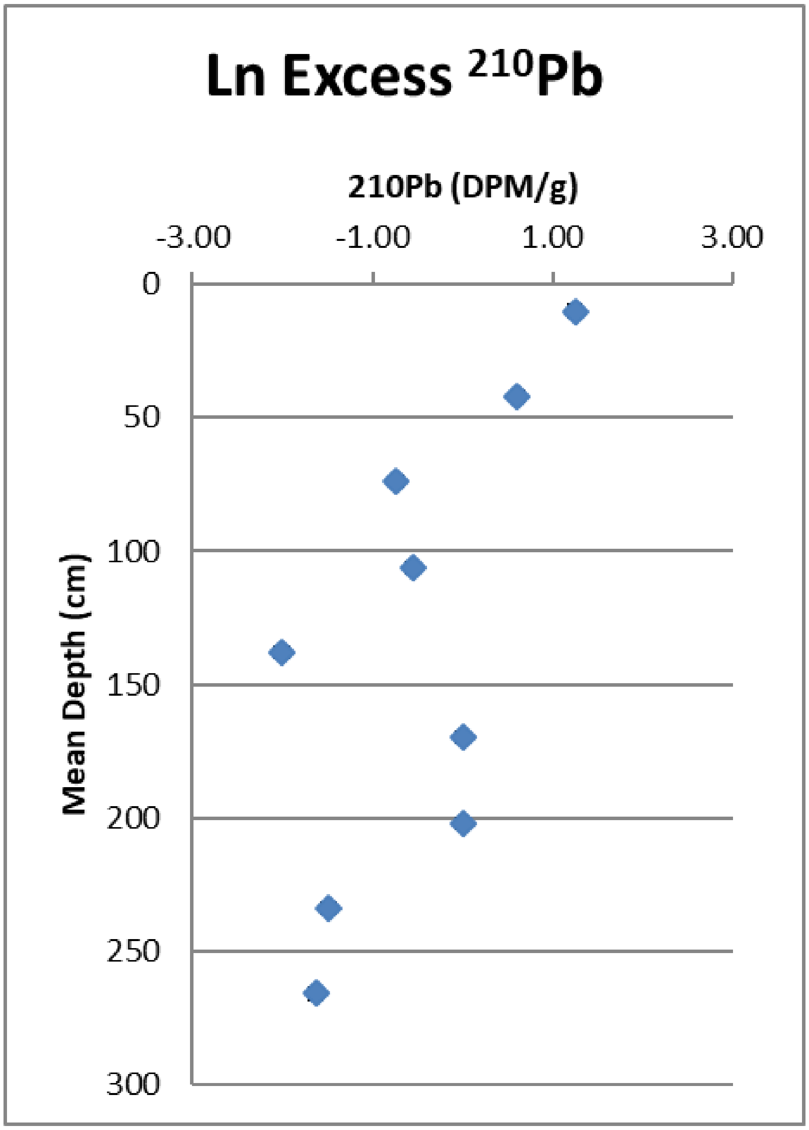

Figure F-3. Natural logarithm of excess ^{210}Pb from the sample at Timberneck Creek.

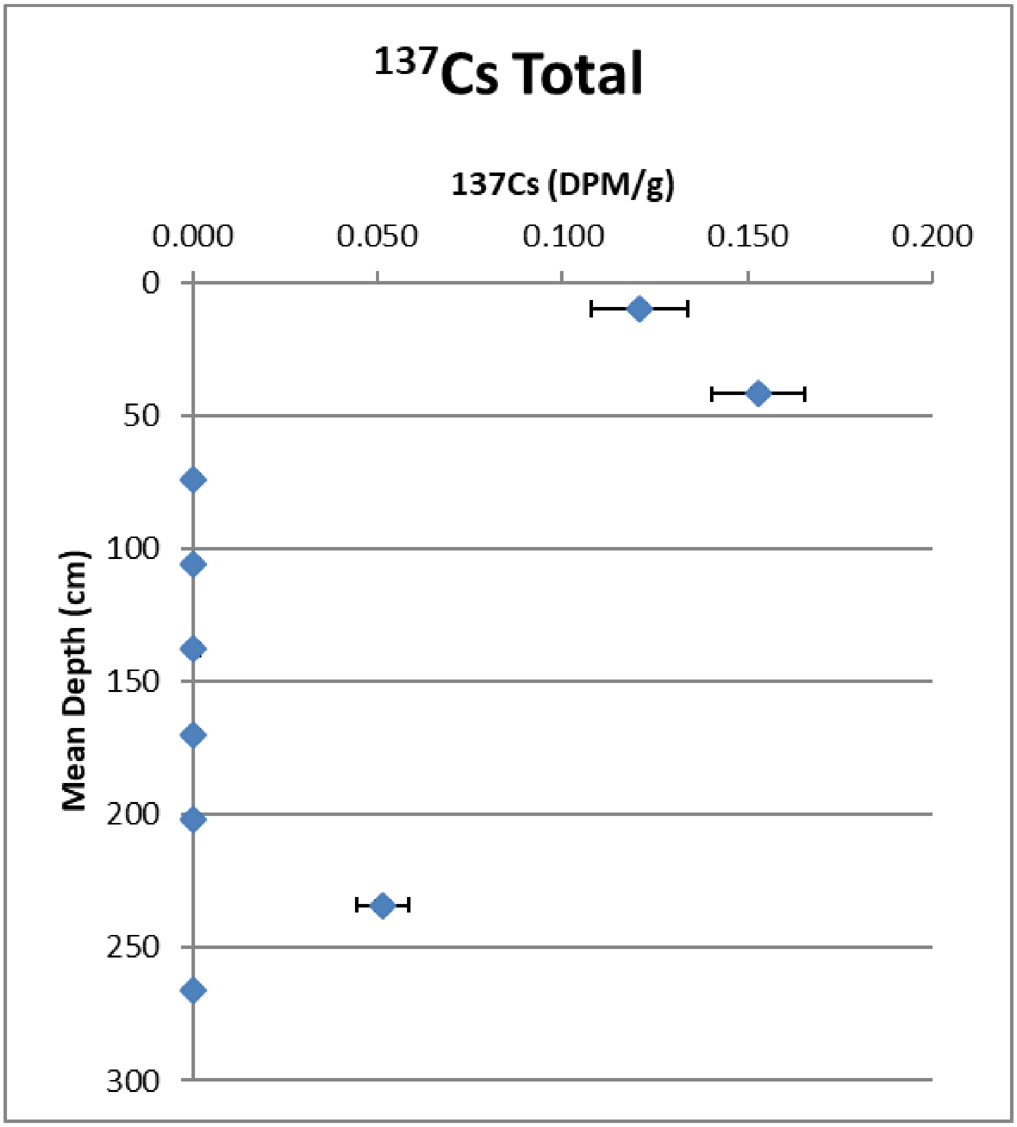

Figure F-4. Total ^{137}Cs from the sample at Timberneck Creek.