VINEYARD NORTHEAST

CONSTRUCTION AND OPERATIONS PLAN
VOLUME II APPENDIX

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VINEYARD OFFSHORE

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Appendix II-B11 2019 Benthic Report

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ALPINE VINEYARD WIND

Lease Area OCS-A 0522 Benthic Report

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1 INTRODUCTION

RPS was contracted by Alpine Ocean to collect, process, analyze, and compile benthic data from a towed video sled and grab sampler for two lease areas offshore of Martha's Vineyard, Massachusetts (OCS-A 0522) intended for the construction of offshore wind turbines. The field program focused on environmental data acquisition throughout Lease OCS-A 0522 (522). The grab samples and video imagery data conclusions presented here will support interpretation of geophysical data to characterize surficial sediment conditions and classify the benthic habitat in both lease areas according to the Coastal and Marine Ecological Classifications Standards (CMECS; FGDC, 2012) and recent guidance for mapping fish habitat from National Marine Fisheries Service (NMFS, 2020) for inclusion in permitting documentation required by Bureau of Ocean Energy Management (BOEM). This report provides:

- A description of the benthic grab sampling methods, results, and analysis;
- The analysis of benthic grab sampling results using key statistical analyses such as taxa richness, density per cubic meter, community composition, etc.;
- A description and analysis of the video data collected; and
- CMECS classifications of each sample site based on the video, grain size, and benthic community lab results.

2 METHODS

2.1 Field Survey

2.1.1 Towed Camera Sled

Underwater video transects were taken in conjunction with grab samples for visual classification of the seafloor from mid-October to late-December 2019. The camera sled was equipped with an altimeter to record distance above sea floor, temperature probe, parallel-mounted lasers 7.5 centimeters (cm) apart, and a cable that transmitted real-time viewing of images to the vessel. The video sled was deployed from a side-oriented A-frame by the Alpine Ocean crew and lowered until positioned 0.5-1.5 meters (m) above the seafloor. Distance of camera to the seafloor varied along each transect due to differences in sediment type, vessel speed, swells, and low visibility/high turbidity.

Video transects were recorded in accordance with procedures approved by Alpine and Vineyard Wind and following BOEM's Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2019). Vessel speed was usually kept to 1 knot or lower to accommodate the tow sled and never exceeded 3 knots. Direction was given from the video operator to the winch operator to raise and lower the towed camera sled as needed to maintain proximity to the seafloor; however, a combination of difficult weather and the location of the tow sled off the side of the vessel instead of the stern created changes in deck height relative to the seafloor which frequently pulled the towed camera sled out of visible range of the seafloor. While recording, field notes were taken containing sample information (date, time, global positioning satellite [GPS] coordinates, station ID, depth, and video file name) and observations of sediment/seafloor characteristics of note to aid in post-processing of video data. Special notes were made for the beginning and end of the transect as well as any changes in weather or visibility conditions, sediment, or species. During video recording, attention was given to noting if potentially sensitive benthic habitats (e.g., exposed hard bottom, seagrass/kelp/algal beds, coral species) were present, as per BOEM's guidelines (BOEM, 2019). Video transects were roughly 200 m in length.

2.1.2 Grab Sampling

Benthic grab samples were acquired using a Harmon/Day Grab Sampler owned by Alpine Ocean. The standard sampler had been modified to improve penetration and reduce sample disturbance, contamination, and washout during retrieval by the addition of weights, the use of stainless-steel sample doors and bucket, and an extended bucket lip. An ultra-short baseline (USBL) beacon was fixed to the grab sampler to obtain GPS coordinates in conjunction with a pole-mounted USBL system. An attached video camera was intended to be used to collected additional information concerning the area surrounding the grab sample site but high turbidity/low visibility and rapid changes in grab sampler altitude due to weather and side deployment made it difficult to assess bottom type without contact.

Upon retrieval, the grab sampler was examined for sample acceptability. A sample was initially deemed acceptable only if the bucket was more than 50% full, the sample was not over penetrated (i.e., not full to the top), and sample surface structures were undisturbed and even (i.e., not slumped). However, due to the frequency of soft-bottom habitat comprised of mud and silt, RPS was authorized by onboard client representatives to accept over penetrated samples with disturbed surfaces (though discretion was used in cases of severely compromised samples).

If a sample did not fulfil these requirements, the contents were deposited into a clean bucket and another sample attempt was made. All subsequent failed samples (up to three attempts per station) were collected in the same bucket, contents mixed thoroughly, and core and sediment samples collected from the mixture to acquire the sample. If more than three failed sample attempts occurred at one station, sampling moved on to the next station (no more than three fails occurred in any one sampling station). The results of each attempted grab were recorded in field notes.

Once an acceptable sample was obtained, the following steps were taken:

1. A photograph was taken of the sample next to an identification label containing sample identification number.

2. Field notes included descriptions of physical features (depth of penetration, sediment color, texture, surface features) and surface macrofauna; large surface fauna were returned to the water (crabs and a skate were returned at different sites).

3. The grab sample was then divided into an “A” and backup “B” sample based on the bucket design which was accessed via two hinged doors divided by a central support bar. The “A” designation was assigned to the least disturbed side or arbitrarily when samples were of equal quality.

4. A four-inch diameter plexiglass tube was inserted and sediment cores were removed from each side of the grab sampler bucket and placed in sieving buckets.

5. A 100-mL sample was taken from the sediment surrounding the cores on both sides and placed in plastic bags for grain size analysis.

After collection, the “A” sample was then photographed and described more thoroughly (grain size and characteristics at depth) and both samples were then loaded onto a processing table and material washed through a 500-µm sieve using seawater under gentle pressure.

Organisms, shell fragments, and other remaining material was placed into a plastic container using stainless steel forceps as needed. The container was filled no more than two-thirds full of sample and seawater. If the quantity of sample exceeded this volume, it was placed in a second container. The sample was fixed/preserved with 10% buffered formalin solution dyed with Rose Bengal by filling the remaining space within the bottle with solution. Containers were tightly sealed with electrical tape and stored in a cooler at ambient temperature (not frozen or refrigerated). Prior to sieving the next sample, the sieve was cleaned by backwashing with pressurized water. The infaunal benthic community samples for OCS-A 0522 were sent to EcoAnalysts (Moscow, ID) and the grain size samples were sent to TerraSense (Totowa, NJ) for processing.

2.2 Lab Analysis

2.2.1 Grain Size and TOC Analysis

Grain size samples were analyzed by TerraSense using the American Society for Testing and Materials (ASTM) soil classification system standards D2487 and D2488 (ASTM, 2016a;b).

2.2.2 Benthic Infauna Analysis

The benthic infauna analysis was conducted by EcoAnalysts on OCS-A 0522 samples according to the following steps:

1. Benthic infaunal samples were catalogued and verified against the Chain of Custody to ensure samples received match those listed in the shipment.

2. Samples were rinsed with freshwater to remove the formalin and transferred to 70 percent ethanol alcohol for sorting and storage.

3. Organisms were identified to the lowest practical taxonomic level (LPTL) (at least to Family) and counted by taxonomists using the most appropriate taxonomic references for the region (Bousfield, 1973; Cutler, 1994; Winston and Hayward, 2012).

4. Species classification and abundance were recorded in project data sheets and summarized in both tabular and graphical formats.

5. Prior to performing the infaunal data analysis, the overall dataset was scanned for noninfaunal taxa (i.e., pelagic or planktonic organisms) that were excluded from all analyses; examples include chaetognaths, hyperiid amphipods, and decapod zoea/megalopae.

6. Calculations of abundance included all taxa occurring in each sample whether identified to species level or not.

7. Calculations based on species (diversity, evenness, and number of species) included only those taxa identified to species level.

2.3 Video Data Post-Processing

2.3.1 Objectives

Post-processing and analysis of video transect data were conducted by RPS to provide:

- General characterization of substrate including bottom type, texture, micro-topography, and presence and approximate thickness (absent, light, moderate, or heavy) of sedimentation ("drape") covering hard substrates;
- Evidence of benthic activity by organisms (burrows, trails, biogenic reefs);
- Identification of epibenthic macroinvertebrates (decapod crustaceans, mollusks including squid mops], echinoderms) and benthic habitat;
- Presence/evidence and general characterization of submerged aquatic vegetation (macroalgae, sea grass);
- Identification of fish and fish habitat (where feasible) as classified by Auster (1998) to provide back compatibility with prior sampling work in the region;
- Identification of organisms to the lowest practical taxonomic level (generally to Order to Family) using standard taxonomic keys for the geographic area;
- Evidence of fishing activity, such as trawl scars, pots, and working nets; and
- Presence of derelict fishing gear, military expended materials, shipwrecks, cultural artifacts, or other marine debris.

All still images from videos were classified according to CMECS (FGDC, 2012), which focuses closely on details of grain size and composition to describe benthic habitats and is being used to define complex and otherwise valuable fish habitats. Auster (1998) classification is also included as it is indicative of overall habitat features that can be important to fish and has been historically used for habitat classification. The BOEM Benthic Habitat Survey guidelines (BOEM, 2019) also require that the developer characterize the benthic community composition which includes documentation of abundance, diversity, percent cover, and community structure. The following were recorded when present and identifiable:

- Characterization and delineation of any submerged aquatic vegetation (seagrass or macro-algae) that occurs within the area of potential adverse effect;
- Characterization and delineation of any hard-bottom gradients of low to high relief such as coral (heads/reefs), rock or clay outcroppings, or other shelter-forming features; and
- Identification of communities of sessile and slow-moving marine invertebrates (clams, quahogs, mussels, polychaete worms, anemones, sponges, echinoderms) that may be within the area of potential adverse effect.

2.3.2 Methods

The video data post-processing methods were developed based on relevant information presented in various peer-reviewed publications and technical guidelines, such as:

- “Northeast Atlantic Marine Biological Analytical Quality Control Scheme (NMBAQC) and Joint Nature Conservation Committee (JNCC): Epibiota remote monitoring from digital imagery: interpretation guidelines (Turner et al., 2016);
- “NMBAQC and JNCC: Epibiota remote monitoring from digital imagery: operational guidelines” (Hitchin et al., 2015).
- “Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects” (Judd, 2011);
- “Mapping European Seabed Habitats (MESH) Seafloor video mapping: collection, analysis, and interpretation of seafloor video footage for the purpose of habitat classification and mapping” (White et al., 2007);
- “Video analysis, experimental design, and database management of submersible-based habitat studies” (Tissot, 2008); and
- “Photographic evaluation of the impacts of bottom fishing on benthic epifauna” (Collie et al., 2000).

Videos were reviewed and analyzed in two separate steps. First, each video was reviewed in its entirety multiple times and any notable seafloor features or epifaunal/benthic/demersal species were recorded. When a feature or species was identified, the reviewer recorded the time, rated video visibility, categorized the bottom based on Auster (1998), and recorded the lowest possible taxon and abundance of organisms greater than ~4 cm in size (equal to roughly half the distance between the laser points). CMECS classification was applied to each individual still image during a later processing step using percent cover information. Most portions of the videos were reviewed multiple times using slower playback speeds and replay functions. After review, the taxonomic details of each macrofaunal observation were investigated and data were recorded at the lowest possible taxonomic level identifiable through the video.

Second, each video was subsampled to produce still images at 5-second intervals. Metadata were recorded for each still image including latitude and longitude, transect, and ID number. The quality of each image was assessed with a categorical scale from 0 to 4. Still images with quality scores of "moderate" (2 or greater) were analyzed with seabed image processing software photoQuad (Trygonis and Sini, 2012). Each image was calibrated using the reference laser points and the area of the visible portion was recorded. Poorly lighted or blurry edges of "passing" images were excluded from analysis.

The abundance of macrofauna was recorded along with presence/absence benthic biotic activity, submerged aquatic vegetation (macroalgae, sea grass), fishing activity, derelict gear, military expended materials, shipwrecks, coral heads/reefs, rock outcroppings, other shelter features, and other marine debris. A score for visibility, Auster (1998) fish habitat characterization, and rugosity (i.e., seafloor roughness or habitat complexity based on visual estimation) were assigned for each image as a whole (see definitions in Table 2).

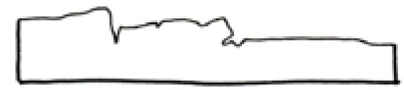
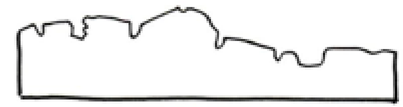
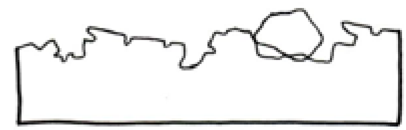
For CMECS classification, fifty points were distributed uniformly across the entire visible portion of each still image using photoQuad. Percent cover data were recorded as the number of points under which different substrate types or features were visible: boulder/cobble, pebble/granule, sand/mud, shells, infaunal structures (e.g., worm or amphipod tubes), burrows (e.g., crab depressions or clam siphon holes), mobile macrofauna, sessile macrofauna, algae, or encrusting organisms. These point counts were multiplied by two to approximate percent cover for the still image and used to assign the appropriate substrate classifications of the habitat to the furthest extent possible according to CMECS standards (FGSC, 2012). Biogenic shell substrate was characterized by the size and percent cover of the biogenic features (Table 1). Other biological elements were recorded (e.g., burrows, infaunal structures, macrofoauna) even though they are not part of the CMECS substrate categories.

Table 1. CMECS biogenic modifier size and percent cover categories.

Biogenic Size	Definition	Biogenic Cover	Definition*
Reef	> 4,096 mm	Trace	< 2%
Rubble	64 – 4,096 mm	Sparse	1 – 30%
Hash	2 – 64 mm	Moderate	30 – 70%
Sand	< 2 mm	Dense	70 – 90%
		Complete	> 90%

* Adapted from FGDC, 2012.

Table 2. Still image data analysis categories for visibility, Auster sediment class, and rugosity.

Visibility Score	Visibility Definition	Auster Category	Auster Definition*	Rugosity Score	Rugosity Definition**
0 – none	obscured or turbid, lasers not visible on seafloor	1 – flat sand/mud	areas with no vertical structure	0 – none	
1 – low	some visibility but still blurry, lasers may or may not be visible	2 – sand waves	troughs and waves in sand	1 – low	
2 – moderate	some features distinguishable, both lasers in view	3 – biogenic structures	burrows, depressions, and other features created or used by mobile fauna for shelter	2 – moderate	
3 – high	most features distinguishable, both lasers in view	4 – shell aggregates	shells create complex interstitial spaces for shelter and high-contrast background	3 – high	
4 - excellent	all features clearly visible, both lasers in view	5 – pebble-cobble	small interstitial spaces, less ephemeral than shell	4 - extreme	
		6 – pebble-cobble with sponge cover	attached fauna increase spatial complexity		
		7 – partially buried or dispersed boulders	partially buried boulders provide high vertical relief while dispersed boulders over cobble provide simple crevices		
		8 – piled boulders	provide deep interstitial spaces of variable sizes		

*Adapted from Auster, 1998. ** Adapted from Turner et al., 2016.

2.4 Benthic Infaunal Data Post-Processing

The benthic infaunal community analysis was based on the laboratory results provided by EcoAnalysts and ESS for the 38 successful grab samples OCS-A 0522. Infaunal community statistics were calculated using species and abundance estimates in each sample, which were reported as count per 0.008 m^2 (area of subsample core). Community composition parameters included: total abundance, number of phyla, number of taxa, Margalef's Richness Index, Shannon Diversity Index, and Pielou's Index of Evenness for each station and within each lease area.

2.4.1 Taxonomic Composition

Taxa composition was assessed to characterize the high-level trends in taxa data. Taxa composition includes the relative proportions of taxonomic groups by number of identifiable taxa and number of individuals, and was used to evaluate dominance of common phyla across all samples. Taxa composition was summarized for individual samples.

2.4.2 Richness, Diversity, and Evenness

Species richness, evenness, and diversity are common ecological parameters used to measure the overall biodiversity of a community or discrete unit. Because some taxa were not identified to the species level, we used abundance data for organisms identified to the LPTL but no further than family, modifying the indices to be taxonomic richness, evenness, and diversity indices. Taxonomic richness is the number of unique species or taxonomic groups represented in an area of interest. In this assessment, taxonomic richness was calculated using Margalef's Richness Index (Formula 1) for each station and lease area to acquire sample and average richness indices.

Formula 1. Margalef's Richness Index (RI).

$$\mathrm{RI} = \frac{(\mathrm{S} - 1)}{\ln(\mathrm{n})}$$

Where:

S= the number of unique taxa

n= the total number of individuals in the sample

Interpretation: The higher the index, the greater the richness.

The diversity index for a community considers taxonomic richness and the proportion of each unique taxa. The Shannon Diversity Index (H'; Formula 2) was calculated using the number of each taxa, the proportional abundance of each taxa relative to the total number of individuals, and the sum of the proportions. This index was used to assess diversity of each station and lease area. The diversity index (H') increases with increasing taxonomic richness and evenness.

Formula 2. H'- Shannon Diversity Index.

$$\mathrm{H}' = -\sum_{\mathrm{i}=1}^{\mathrm{R}} \mathrm{p_i} \ln(\mathrm{p_i})$$

Where:

p_i = the proportion of individuals belonging to the taxa i

Interpretation: The greater the H', the greater the richness and evenness.

Evenness of a community refers to the similarity in abundances of different taxa comprising a population or sample. Pielou's Index of Evenness includes H' (Shannon-Weiner Diversity Index) in its calculation.

Formula 2. J'- Pielou's Index of Evenness.

$$J' = \frac{H'}{H_{Max}}$$

Where:

H' = the Shannon- Weiner Diversity Index

H_{Max} = the maximum possible value of H', where each taxon occurs in equal abundances.

$$H_{Max} = \ln(s)$$

Where: s = Number of taxa

Interpretation: J' is constrained between 0 and 1. The greater the value of J', the more evenness in the sample.

3 OCS-A 0522 RESULTS

3.1 Video Analysis

The characteristics and locations of the 25 underwater video transects within OCS-A 0522 are described in Table 3 and locations are shown in Figure 1. Note that three transects collected near the beginning of the survey effort in November 2019 (VT01, VT13, and VT31) used a fiberglass tow sled frame that did not perform well under rough sea conditions. The camera was transferred to a heavier metal tow sled frame that provided more stability for the remaining transects.

Table 3. Underwater video transect locations and characteristics in OCS-A 0522.

Transect	Date	Recorded Duration (min:sec)	Start Latitude (°N)	Start Longitude (°W)	End Latitude (°N)	End Longitude (°W)	Total # Stills	# Analyzed Stills
VT01	3-Nov-2019	0:12:21	40.673915	70.218842	40.671418	70.218723	138	15
VT02	14-Nov-2019	0:10:42	40.690992	70.165337	40.689175	70.165745	118	34
VT03	21-Dec-2019	0:11:33	40.814423	70.202223	40.816777	70.202295	122	32
VT04	21-Dec-2019	0:12:12	40.755872	70.223282	40.758232	70.223282	133	18
VT05	21-Dec-2019	0:11:40	40.749162	70.135350	40.751475	70.135377	128	33
VT06	21-Dec-2019	0:11:42	40.750105	70.071185	40.749840	70.068050	131	36
VT07	21-Dec-2019	0:11:32	40.739695	70.303628	40.739212	70.300757	117	30
VT08	21-Dec-2019	0:11:26	40.732910	70.026017	40.735105	70.024958	122	42
VT09	21-Dec-2019	0:11:20	40.726720	70.026903	40.725872	70.023757	121	27
VT10	21-Dec-2019	9:55:00	40.725248	70.092308	40.724840	70.089130	118	31
VT11	21-Dec-2019	0:11:12	40.711353	70.167895	40.708757	70.168548	136	35
VT12	21-Dec-2019	0:08:26	40.708765	70.297938	40.708092	70.294805	93	21
VT13	3-Nov-2019	0:22:13	40.693133	70.242712	40.692345	70.245217	226	27
VT14	21-Dec-2019	0:06:49	40.676502	70.088877	40.678602	70.089942	75	30
VT15	21-Dec-2019	0:06:45	40.677433	70.121417	40.676703	70.118470	76	22
VT16	21-Dec-2019	0:07:28	40.675533	70.352873	40.673225	70.352848	84	14
VT17	21-Dec-2019	0:09:39	40.662570	70.032940	40.660187	70.032147	131	32
VT18	21-Dec-2019	0:08:59	40.661227	70.165255	40.658795	70.165873	107	33
VT19	21-Dec-2019	0:12:14	40.660083	70.265432	40.657790	70.265302	145	36
VT20	21-Dec-2019	0:07:45	40.640497	70.393580	40.642145	70.392237	98	11
VT21	21-Dec-2019	0:09:43	40.628758	70.046775	40.626917	70.044660	115	17
VT22	21-Dec-2019	0:08:31	40.627562	70.177270	40.625232	70.177202	100	18
VT23	22-Dec-2019	0:16:15	40.603522	70.396223	40.601712	70.394683	255	44
VT24	22-Dec-2019	0:14:22	40.590808	70.482930	40.588733	70.482888	121	32
VT31	3-Nov-2019	0:11:59	40.710478	70.222183	40.708143	70.222098	138	17

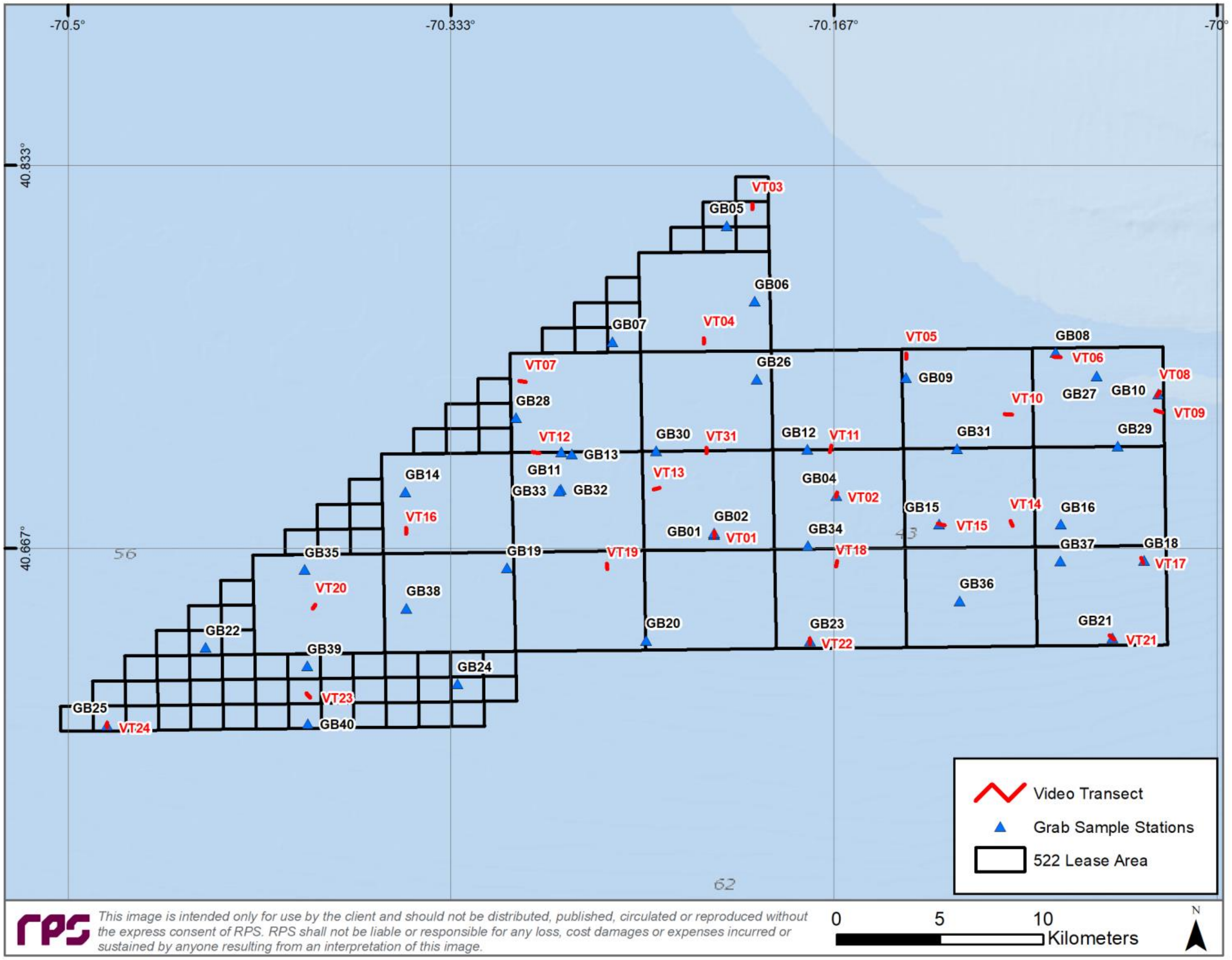


Figure 1. Map of OCS-A 0522 lease area video transects (red) and grab sample sites (blue).

3.1.1 Macrofauna Counts

The presence and abundance of macrofauna > 4 cm were recorded during the video review process (Table 4 and Figure 2). Organisms were identified to the LPTL, usually Order or Family. Six fish taxa, ten invertebrate taxa, and two kinds of egg cases (skate and moon snail) were observed in the OCS-A 0522 lease area. A total of 6,751 macrofauna were counted, 83% of which (5,606 individuals) were sand dollars (*Echinarachnius parma*) observed in relatively large numbers across several of the video transects (most numerous in VT05, VT06, VT14, VT15, and VT17). Other relatively numerous taxa across transects include sea star (*Asterias* spp.), crab (*Cancer* spp.), sea urchin (Echinoidea), moon snail (Naticidae), and skate (Rajidae). A few observations of anemone (Actinaria) and sea sponge (Porifera) were made in VT03 through VT08 and VT21. Representative images of some of the macrofauna identified can be seen in Table 5.

Table 4. Macrofauna enumerated during review of the video transects in OCS-A 0522 (continued on next page).

Common Name	Lowest Taxonomic Grouping	Counts per Transect												
		VT01	VT02	VT03	VT04	VT05	VT06	VT07	VT08	VT09	VT10	VT11	VT12	VT13
American eel	*Anguilla rostrata*	-	-	-	-	-	-	-	-	-	-	-	-	-
Anenome	Actinaria	-	-	-	-	-	-	-	1	-	-	-	-	-
Cancer crab	Cancer	1	6	4	-	1	-	-	-	-	-	4	-	-
Flounder	Pleuronectiformes	-	-	-	-	-	-	-	-	-	-	-	-	-
Hake	Merluccius	-	-	-	2	-	-	3	-	-	-	-	7	-
Hermit crab	Pagurus	1	-	-	-	-	-	-	-	-	9	-	1	-
Little skate	*Leucoraja erinacea*	-	-	-	-	-	-	-	-	-	-	-	-	-
Moon snail	Naticidae	-	1	4	4	6	1	4	-	-	4	26	4	-
Moon snail egg case	Naticidae egg case	2	-	-	-	-	-	-	-	-	-	-	-	-
Northern sea robin	Prionotus	-	-	-	-	-	-	-	-	-	-	-	-	1
Sand dollar	*Echinarachnius parma*	-	-	-	-	268	577	49	-	627	46	-	56	-
Sea scallop	*Placoopecten meagellanicus*	-	-	-	-	-	-	-	-	-	-	-	-	-
Sea sponge	Porifera	-	-	1	-	2	1	1	1	-	-	-	-	-
Sea urchin	Echinoidea	-	-	-	-	-	-	-	-	-	1	3	1	-
Seastar	Asterias	-	-	-	-	-	-	1	-	-	-	-	-	-
Shrimp	Decapoda	-	-	-	-	-	-	-	-	-	1	1	-	-
Skate	Rajidae	2	1	-	-	-	-	8	-	-	-	-	2	-
Skate egg case	Rajidae egg case	1	-	2	1	1	1	-	2	-	1	-	2	-
Unidentified fish	Actinopterygii	-	-	-	1	-	-	-	1	-	0	-	1	-
Total		**7**	**8**	**11**	**8**	**278**	**580**	**66**	**5**	**627**	**62**	**34**	**74**	**1**

Lowest Taxonomic Grouping	Common Name	Counts per Transect												
		VT14	VT15	VT16	VT17	VT18	VT19	VT20	VT21	VT22	VT23	VT24	VT31	**Total**
American eel	*Anguilla rostrata*	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Anenome	Actinaria	-	-	-	-	-	-	-	1	-	-	-	-	**2**
Cancer crab	Cancer	-	-	-	-	82	1	-	1	-	3	2	-	**105**
Flounder	Pleuronectiformes	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Hake	Merluccius	2	-	1	-	-	1	-	-	-	1	3	-	**20**
Hermit crab	Pagurus	-	-	-	-	1	-	-	-	-	-	-	2	**14**
Little skate	*Leucoraja erinacea*	-	-	-	-	-	-	-	-	-	1	-	-	**1**
Moon snail	Naticidae	-	28	-	1	-	-	-	2	1	-	-	-	**86**
Moon snail egg case	Naticidae egg case	-	-	-	-	-	-	-	-	-	-	-	-	**2**
Northern sea robin	Prionotus	-	-	-	1	-	1	-	-	-	-	-	1	**4**
Sand dollar	*Echinarachnius parma*	1164	2597	-	222	-	-	-	-	-	-	-	-	**5606**
Sea scallop	*Placoopecten meagellanicus*	-	2	-	-	-	-	-	-	-	-	-	-	**2**
Sea sponge	Porifera	-	-	-	-	-	-	-	-	-	-	-	-	**6**
Sea urchin	Echinoidea	1	-	-	1	38	1	-	-	3	-	-	-	**49**
Seastar	Asterias	-	-	-	-	-	-	-	-	-	-	772	-	**773**
Shrimp	Decapoda	-	-	-	-	-	-	-	-	-	-	-	7	**9**
Skate	Rajidae	1	-	4	-	-	8	1	-	2	1	1	3	**34**
Skate egg case	Rajidae egg case	-	1	-	-	1	-	-	1	-	-	-	-	**14**
Unidentified fish	Actinopterygii	-	9	-	-	-	3	1	1	1	3	-	1	**22**
Total		**1168**	**2637**	**5**	**225**	**122**	**15**	**2**	**6**	**7**	**9**	**780**	**14**	**6751**

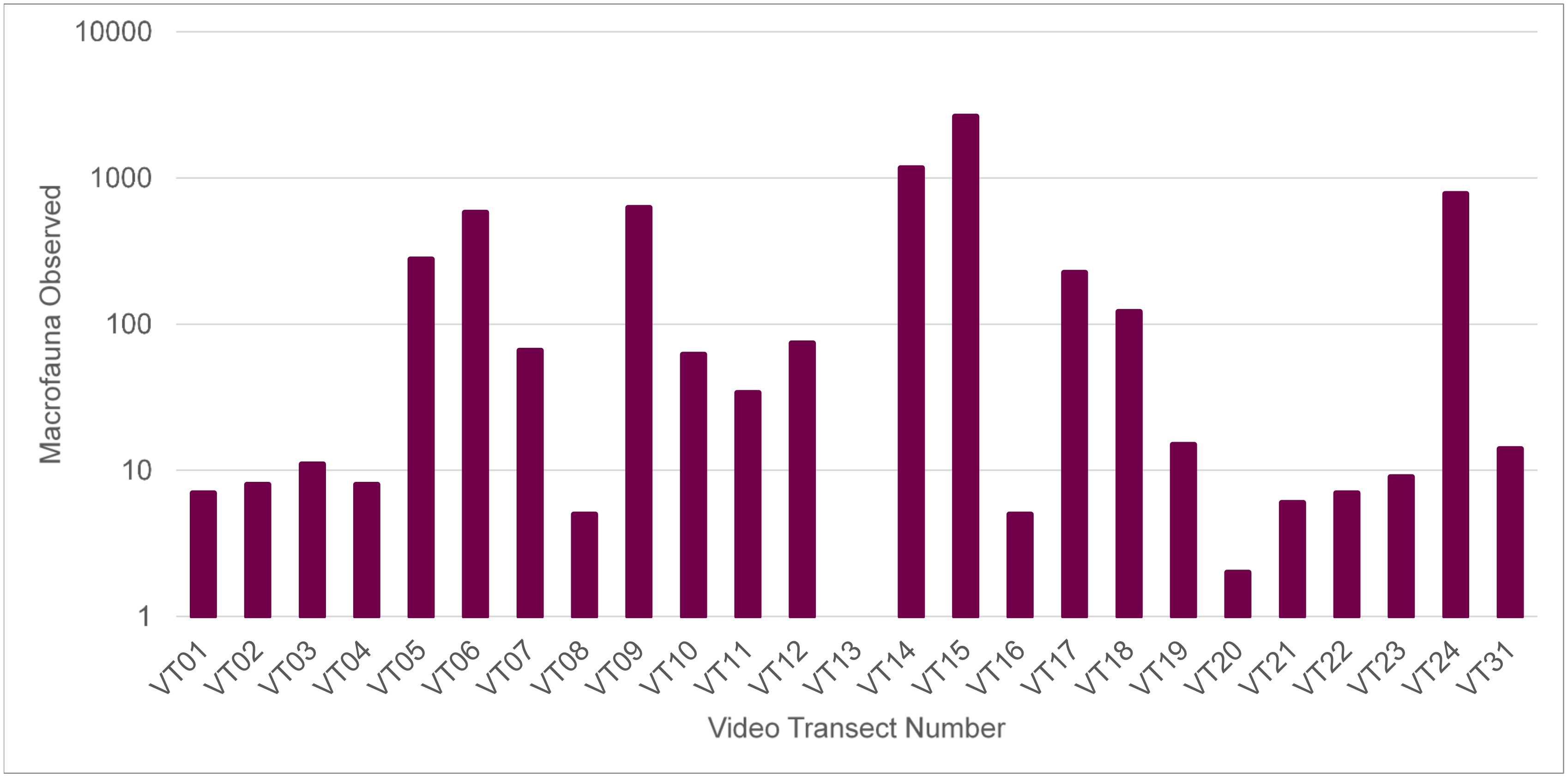


Figure 2. Counts of macrofauna enumerated in OCS-A 0522 during video review for each transect, identified to lowest practical taxonomic level. Note that Logarithmic scale was used on y-axis to reconcile large range.

Table 5. Representative images of macrofauna observed and identified in transects within OCS-A 0522 (continued on next page).

Sand Dollar (*Echinarachnius parma*) VT06	
Eel (Anguilliformes) Sea Star (*Asterias* spp.) VT24	
Moon Snail (*Euspira* spp.) VT04	

Little Skate (*Leucoraja erinacea*) VT23	
Skate egg case (Rajidae) VT08	

3.1.2 Percent Cover

The following sections summarize the percent cover data obtained from still images taken throughout the underwater video transects in OCS-A 0522 (Table 6). CMECS substrate categories were combined to the level detectable via visual analysis. Finer resolution classification into different subgroups requires grain size analysis of samples overlapping the video transect directly, which was done using grain size data in the CMECS classifications in Section 5. For these percent cover estimates, our grain size categories were sand/mud, pebble/granule, and boulder/cobble. Additional categories, included in CMECS as biotic or geoform classes, were included to assess the percent cover of anthropogenic debris, infaunal structures (e.g., worm tubes, amphipod beds), shells, burrows (> 5-100 mm width), sessile fauna, and macrofauna. Visual examples of habitat types defined using the still images are presented in Table 7.

The substrate with the highest percent cover across all transects sampled in OCS-A 0522 was fine sand/mud. There were no visual observations of boulder, cobble, pebble, or gravel substrates of geologic origin. Deposits of larger substrates of biogenic origin (i.e., shell rubble) were observed in three transects (VT02, VT11, and VT18) which could serve similar habitat functions as larger geologic origin substrates. Of the biological elements, infaunal structures had the highest average percent cover. Macrofauna occurred most frequently and were observed in 16 of the 25 video transects.

Table 6. Area and mean percent cover summarizing point count data across all stills in each of the 25 video transects in OCS-A 0522.

Transect	Total Area Analyzed (m^2)	Total # Stills Analyzed	Anthro-pogenic (%)	Biogenic	Geologic		Other Biological Elements				Primary CMECS Substrate Component
				Shells (%)	Gravel (%)	Sand/Mud (%)	Infaunal Structures (%)	Burrows (%)	Sessile (%)	Macrofauna (%)	
VT01	2.3	15	-	0.2	-	97.2	2.6	-	-	-	Geologic Unconsolidated Fine Sand / Mud
VT02	13.4	34	-	21.6	-	78.4	-	-	-	-	Geologic Unconsolidated Fine Sand / Mud
VT03	9.7	32	-	-	-	88.3	11.5	0.1	-	0.1	Geologic Unconsolidated Fine Sand / Mud
VT04	4.1	18	-	0.9	-	94.0	4.6	0.1	-	0.4	Geologic Unconsolidated Fine Sand / Mud
VT05	14.6	33	-	-	-	99.8	0.1	-	-	0.1	Geologic Unconsolidated Fine Sand / Mud
VT06	14.8	36	-	-	-	99.0	-	-	-	1.0	Geologic Unconsolidated Fine Sand / Mud
VT07	7.4	30	-	0.1	-	99.2	-	0.2	-	0.5	Geologic Unconsolidated Fine Sand / Mud
VT08	18.8	42	-	-	-	100.0	-	-	-	-	Geologic Unconsolidated Fine Sand / Mud
VT09	9.2	27	-	0.1	-	87.4	-	-	-	12.5	Geologic Unconsolidated Fine Sand / Mud
VT10	10.9	31	-	-	-	97.7	-	-	2.3	-	Geologic Unconsolidated Fine Sand / Mud
VT11	14.1	35	-	8.9	-	91.1	-	-	-	-	Geologic Unconsolidated Fine Sand / Mud
VT12	5.2	21	-	-	-	99.7	-	0.1	-	0.3	Geologic Unconsolidated Fine Sand / Mud
VT13	3.7	27	-	-	-	98.9	1.0	-	-	0.1	Geologic Unconsolidated Fine Sand / Mud
VT14	13.0	30	-	0.1	-	99.2	-	-	-	0.7	Geologic Unconsolidated Fine Sand / Mud
VT15	12.8	22	-	-	-	96.1	-	-	-	3.9	Geologic Unconsolidated Fine Sand / Mud
VT16	3.6	14	-	-	-	99.5	-	0.5	-	-	Geologic Unconsolidated Fine Sand / Mud
VT17	16.6	32	-	1.8	-	98.2	-	-	-	-	Geologic Unconsolidated Fine Sand / Mud
VT18	12.8	33	-	12.7	-	87.1	-	0.2	-	-	Geologic Unconsolidated Fine Sand / Mud
VT19	12.0	36	-	-	-	99.4	-	0.6	-	-	Geologic Unconsolidated Fine Sand / Mud
VT20	1.6	11	-	-	-	91.4	5.3	2.9	-	0.5	Geologic Unconsolidated Fine Sand / Mud
VT21	2.1	17	-	-	-	90.0	9.4	0.6	-	-	Geologic Unconsolidated Fine Sand / Mud
VT22	5.0	18	-	-	-	93.2	5.7	1.0	0.1	-	Geologic Unconsolidated Fine Sand / Mud
VT23	12.6	44	-	-	-	97.7	1.0	0.8	-	0.4	Geologic Unconsolidated Fine Sand / Mud
VT24	7.3	32	-	-	-	97.2	0.6	0.7	-	1.5	Geologic Unconsolidated Fine Sand / Mud
VT31	2.0	17	-	0.6	-	89.4	7.6	2.3	-	0.1	Geologic Unconsolidated Fine Sand / Mud

Table 7. Representative still images of various habitat types observed in 25 video transects in OCS-A 0522.

Fine sand/mud (VT10)	
Fine sand/mud with clam rubble (VT11)	
Fine sand/mud with infaunal holes (VT23)	

Fine sand/mud with burrow and infaunal structures (VT20)	
Fine sand/mud with infaunal structures (VT31)	
Fine sand/mud with sessile fauna (VT10)	

3.2 Grab Samples

The characteristics and locations of the 38 stations at which grab samples were obtained within the OCS-A 0522 lease area are described in Table 8 and shown in Figure 1 (see Section 4.1). No sediment sample was obtained at GB03 due to the presence of large ocean quahog clam shells preventing retrieval. Three attempts were made at GB17 but none were successful at retrieving a passing sediment sample due to improper closure. One partial sample at this site contained fine sand with large clam rubble and sand dollars but did not contain enough intact surface sediment to send for grain size analysis; however, the partial samples were mixed and sent for infaunal analysis.

Table 8. Grab sample station locations and characteristics in OCS-A 0522 (continued on next page).

Sample	Date	Time (EST)	Latitude (°N)	Longitude (°W)	Water Depth (m)	Sample Penetration Depth
GB01	14-Nov-19	7:29 AM	40.672558	70.218810	50.0	13 cm
GB02	14-Nov-19	7:45 AM	40.673318	70.218835	49.9	14 cm
GB04	14-Nov-19	8:44 AM	40.689734	70.165650	45.8	5 cm
GB05	19-Oct-19	10:58 PM	40.807081	70.213357	42.0	9 cm
GB06	19-Oct-19	12:03 AM	40.774146	70.201124	47.7	13 cm
GB07	20-Oct-19	1:01 AM	40.756586	70.263000	50.0	8 cm
GB08	14-Nov-19	1:12 PM	40.751979	70.070067	42.1	5 cm
GB09	14-Nov-19	12:22 PM	40.741042	70.135280	43.3	8 cm
GB10	14-Nov-19	1:54 PM	40.73398	70.025537	33.5	6.5 cm
GB11	20-Oct-19	2:18 AM	40.708672	70.285357	52.1	9 cm
GB12	20-Oct-19	5:39 AM	40.709788	70.178225	49.5	4.5 cm
GB13	20-Oct-19	2:39 AM	40.707663	70.280759	50.7	9 cm
GB14	20-Oct-19	8:50 PM	40.69133	70.353128	55.2	15 cm
GB15	26-Nov-19	10:01 PM	40.677207	70.120735	49.7	5 cm
GB16	26-Nov-19	9:23 PM	40.67717	70.067948	50.6	9 cm
GB18	26-Nov-19	8:28 PM	40.661419	70.031688	53.1	7 cm
GB19	26-Nov-19	2:12 PM	40.658153	70.308823	54.1	15 cm
GB20	26-Nov-19	5:23 PM	40.626633	70.248398	55.6	15 cm
GB21	26-Nov-19	7:51 PM	40.627811	70.045296	58.2	15 cm
GB22	20-Oct-19	10:15 PM	40.623554	70.439989	58.9	14 cm
GB23	26-Nov-19	6:24 PM	40.626435	70.176995	57.8	15 cm
GB24	26-Nov-19	4:29 PM	40.607647	70.330356	60.4	16 cm
GB25	20-Oct-19	11:01 PM	40.589665	70.482926	62.1	15.5 cm
GB26	20-Oct-19	5:05 AM	40.740349	70.200264	48.0	4 cm

Sample	Date	Time (EST)	Latitude (°N)	Longitude (°W)	Water Depth (m)	Sample Penetration Depth
GB27	14-Nov-19	1:29 PM	40.741708	70.052310	39.1	5 cm
GB28	20-Oct-19	1:54 AM	40.723501	70.304957	52.6	9.5 cm
GB29	14-Nov-19	2:23 PM	40.711282	70.043092	44.7	6 cm
GB30	20-Oct-19	4:10 AM	40.709101	70.244084	50.7	14 cm
GB31	14-Nov-19	3:11 PM	40.710038	70.113009	44.7	6.5 cm
GB32	20-Oct-19	3:27 AM	40.692363	70.285408	52.8	13 cm
GB33	20-Oct-19	3:38 AM	40.691783	70.286181	52.4	14 cm
GB34	20-Oct-19	6:33 AM	40.66781	70.177821	51.2	4.5 cm
GB35	20-Oct-19	9:35 PM	40.657497	70.396841	54.3	15 cm
GB36	26-Nov-19	7:14 PM	40.643774	70.111930	54.5	8 cm
GB37	25-Oct-19	4:27 AM	40.661085	70.068195	54.9	10 cm
GB38	26-Nov-19	2:54 PM	40.640654	70.352622	57.3	8 cm
GB39	26-Nov-19	3:32 PM	40.615456	70.395883	58.9	15 cm
GB40	21-Oct-19	12:27 AM	40.590283	70.395627	65.7	14 cm

3.2.1 Sediment Analysis

The following section presents grab sample grain size composition results from the TerraSense lab analysis. The grain size data in Section 3.2.1 conform to ASTM D6913, according to contractual agreement. During analysis, it was discovered that the grain sizes reported under this standard do not exactly align with CMECS grain size bins (see **Error! Reference source not found.** in Section 3.2.1 for comparison). For the sake of applying NMFS (2020) modified CMECS, differences in the threshold for silt or clay (0.0625 mm vs. 0.075 mm) is the only significant factor and may impact classification of muddy sand vs. sand and sandy mud vs. muddy sand in rare instances. To simplify interpretation for CMECS habitat classification in future analyses, requesting CMECS-specific grain size bins from the lab is recommended.

Samples from 38 grab sample stations in OCS-A 522 were generally sandy, comprised of 23 – 99.8% sand grains (0.075 mm – 2 mm) with a mean across samples of 80% (Table 9 and Figure 3). Twenty-nine samples contained no gravel-sized particles (> 2 mm) while 6 samples contained < 0.2% gravel. Just three samples (GB15, GB18, and GB29) were comprised of 0.8-1% gravel-sized particles, with maximum sieve sizes retaining sediment for these samples of 4.75 mm, 9.53 mm, and 25.4 mm, respectively. Fine silt and clay particles (< 0.075 mm) comprised < 1 – 77% of each sample (mean of 20%), with seven samples containing more than 50% silt and clay (GB22, GB24, GB25, GB35, GB38, GB39, and GB40). The fines component may be a slight overestimate because CMECS classifies silt/clay at a smaller scale (< 0.0625 mm) than the lab results (< 0.075 mm).

Table 9. Grain size composition and moisture content from grab samples in OCS-A 0522 (continued on next page).

Sample	% Grains > 4.75 mm	% Grains 2 – 4.75 mm	% Grains 0.41 – 2 mm	% Grains 0.075 – 0.41 mm	% Grains < 0.075 mm	% Moisture Content
GB01	0	0	0.3	82.2	17.5	59.8
GB02	0	0	1.3	85.5	13.2	42.8
GB04	0	0.1	0.4	93.5	6.0	35.3
GB05	0	0	0.5	86.8	12.7	41.9
GB06	0.2	0	0.6	85.9	13.3	46.3
GB07	0	0	0.7	91.1	8.2	32.8
GB08	0	0.1	0.8	93.4	5.7	36.8
GB09	0	0	0.5	95.7	3.8	31.9
GB10	0	0	1.6	97.5	0.9	25.3
GB11	0	0	69.4	29.5	1.1	18.3
GB12	0	0	0.1	94.9	5.0	32.2
GB13	0	0.1	39.1	59.3	1.5	21.9
GB14	0	0	2.5	60.8	36.7	58.0
GB15	0	1.0	45.0	53.0	1.0	19.7
GB16	0	0	70.0	29.0	1.0	18.6
GB18	0	1.0	63.0	35.0	1.0	20.8
GB19	0	0	0	59.0	41.0	39.4
GB20	0	0	0	64.0	36.0	45.7
GB21	0	0	1.0	82.0	17.0	40.9
GB22	0	0	0.2	28.5	71.3	68.6
GB23	0	0	1.0	73.0	26.0	42.8
GB24	0	0	0	47.0	53.0	55.6
GB25	0	0	0.1	22.8	77.1	74.0
GB26	0	0	0.4	93.7	5.9	31.0
GB27	0	0	0.5	98.1	1.4	24.2
GB28	0	0	84.9	14.9	0.2	17.2
GB29	0.5	0.3	1.0	95.6	2.6	28.5
GB30	0	0	0.8	90.0	9.2	37.0
GB31	0	0.1	0.5	95.5	3.9	32.2
GB32	0	0	68.6	30.3	1.1	19.9
GB33	0	0	7.7	80.4	11.9	36.1
GB34	0	0	0.2	95.1	4.7	32.5

Sample	% Grains > 4.75 mm	% Grains 2 – 4.75 mm	% Grains 0.41 – 2 mm	% Grains 0.075 – 0.41 mm	% Grains < 0.075 mm	% Moisture Content
GB35	0	0	0.2	45.8	54.0	58.6
GB36	0	0	0	85.0	15.0	42.7
GB37	0	0	0.4	86.2	13.4	42.1
GB38	0	0	0.2	44.1	55.7	51.4
GB39	0	0	0.3	34.3	65.4	69.3
GB40	0	0.1	0.2	38.6	61.1	57.7

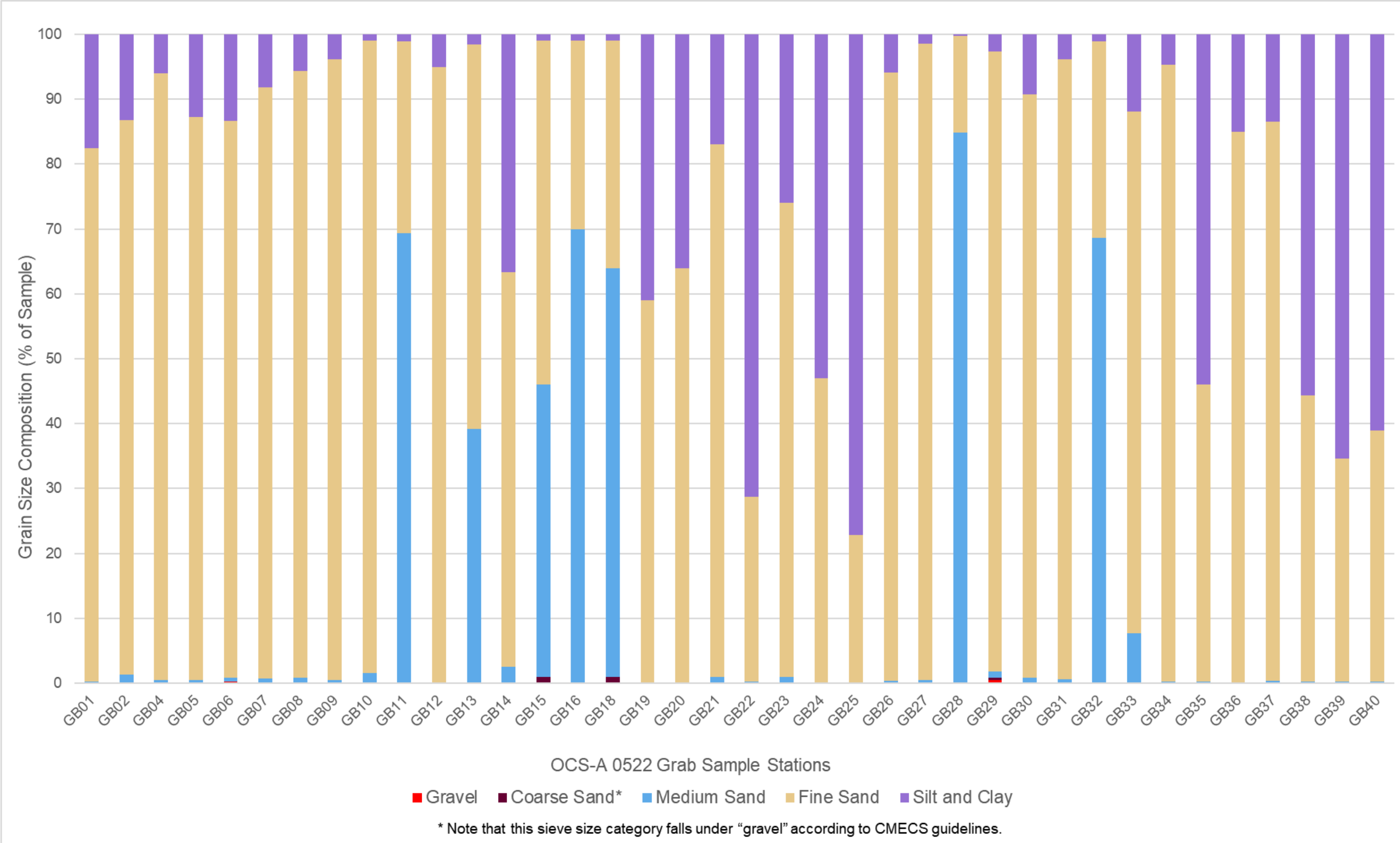


Figure 3. Grain size composition at each grab sample station in OCS-A 0522. Note that the size classifications do not exactly match those within the CMECS guidelines, see text for details.

3.2.2 Benthic Community Analysis

3.2.2.1 Taxonomic Composition

Grab samples were collected for infaunal analysis from 39 sites in the OCS-A 522 lease area (GB03 did not have a taxonomic sample due to shell rubble preventing proper closure of the grab sampler). The grab samples yielded a total of 7,749 individual macrofaunal organisms (per all forty 0.008 m^2 core samples). Organisms collected in this lease area were from 10 unique phyla and 82 families or LPTL (Table 10). The phyla Arthropoda, Mollusca, and Annelida dominated samples in both abundance and unique taxa, representing 96% of all organisms and 84% of the unique taxa (Figure 4).

Table 10. Phyla present in the 39 benthic grab samples in OCS-A 0522.

Phyla	Abundant Taxonomic Groups (common names)	Density (Abundance per forty 0.008 m^2 samples)	Number of Taxa
Annelida	Polychaete worms (segmented and bamboo worms)	1,152	24
Arthropoda	Amphipods, calanoid copepods, ostracods	3,481	23
Chordata	Tunicate	1	1
Cnidaria	Hydroid	1	1
Echinodermata	Sand dollars, sea cucumbers	57	3
Ectoprocta	Bryzoa	1	1
Mollusca	Nut clams	2,789	22
Nematoda	Nematodes	239	1
Nemertea	Ribbon worms	27	5
Sipuncula	Peanut worm	1	1
Totals		**7,749**	**82**

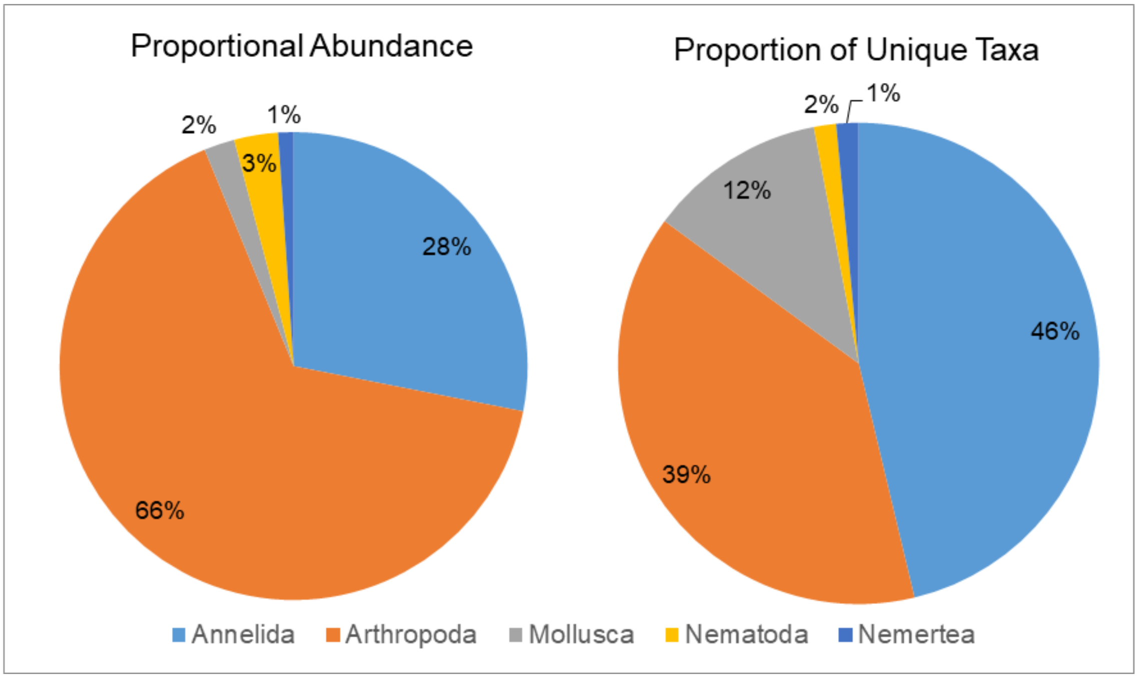


Figure 4. Proportional abundance and proportion of unique taxa (Family or LPTL) for each phylum collected in all benthic grab samples in OCS-A 0522. Results presented as percentage of total.

Density across the 39 benthic grab sites ranged from 24 organisms in GB25 to 1,301 in GB05 (Table 11). The large quantity of macrofaunal organisms present at GB05 were primarily from a single taxon (87%), nut clams from the Nuculidae family. The number of unique taxa represented in each sample ranged from 5 at GB15 and GB34 to 28 at GB06 and GB23. Over half (66%) of the total number of organisms collected across the 39 samples in the 522 lease area were nut clams from the Nuculidae family (34%) or amphipods from the Ampeliscidae family (32%). The percent composition of each sample by phyla is shown in Figure 5 and abundance of unique taxa is presented in Table 12.

Table 11. Abundance of each Phylum counted within each grab sample for OCS-A 0522 (continued on next page).

Station	Annelida	Arthropoda	Chordata	Cnidaria	Echino-dermata	Ectoprocta	Mollusca	Nematoda	Nemertea	Sipuncula	Density (Abundance per 0.008 m^2)
522-19-GB01	53	129	0	0	0	0	11	1	0	0	194
522-19-GB02	74	192	0	0	0	0	24	4	1	0	295
522-19-GB04	4	14	0	0	0	0	109	0	0	0	127
522-19-GB05	88	76	0	0	0	0	1,136	1	0	0	1301
522-19-GB06	62	102	0	0	0	0	558	2	0	1	725
522-19-GB07	15	27	0	0	0	0	21	0	1	0	64
522-19-GB08	0	11	0	0	0	0	14	1	3	0	29
522-19-GB09	11	40	0	0	0	0	29	0	2	0	82
522-19-GB10	1	27	1	1	36	0	1	0	0	0	67
522-19-GB11	9	2	0	0	0	0	2	67	3	0	83
522-19-GB12	2	11	0	0	0	0	83	3	0	0	99
522-19-GB13	7	7	0	0	3	0	1	18	1	0	37
522-19-GB14	40	233	0	0	1	0	35	5	3	0	317
522-19-GB15	15	62	0	0	0	0	0	0	0	0	77
522-19-GB16	15	41	0	0	0	0	0	8	0	0	64
522-19-GB17	3	70	0	0	0	1	7	0	0	0	81
522-19-GB18	2	83	0	0	0	0	1	1	1	0	88
522-19-GB19	21	189	0	0	0	0	24	0	1	0	235
522-19-GB20	37	133	0	0	0	0	21	0	0	0	191
522-19-GB21	89	320	0	0	0	0	9	1	0	0	419
522-19-GB22	95	353	0	0	0	0	14	2	2	0	466
522-19-GB23	65	218	0	0	0	0	7	2	1	0	293
522-19-GB24	36	99	0	0	0	0	28	3	1	0	167
522-19-GB25	14	6	0	0	0	0	3	1	0	0	24
522-19-GB26	15	20	0	0	0	0	303	4	0	0	342
522-19-GB27	2	21	0	0	8	0	0	0	0	0	31
522-19-GB28	11	4	0	0	0	0	2	60	0	0	77

Station	Annelida	Arthropoda	Chordata	Cnidaria	Echino-dermata	Ectoprocta	Mollusca	Nematoda	Nemertea	Sipuncula	Density (Abundance per 0.008 m^2)
522-19-GB29	4	22	0	0	3	0	14	0	0	0	43
522-19-GB30	43	102	0	0	0	0	24	2	0	0	171
522-19-GB31	36	47	0	0	0	0	10	0	0	0	93
522-19-GB32	5	1	0	0	4	0	1	34	1	0	46
522-19-GB33	36	145	0	0	0	0	8	5	0	0	194
522-19-GB34	0	3	0	0	0	0	225	1	0	0	229
522-19-GB35	47	188	0	0	0	0	12	3	1	0	251
522-19-GB36	32	112	0	0	0	0	6	4	3	0	157
522-19-GB37	62	160	0	0	0	0	5	3	2	0	232
522-19-GB38	9	119	0	0	2	0	29	1	0	0	160
522-19-GB39	39	91	0	0	0	0	12	2	0	0	144
522-19-GB40	53	1	0	0	0	0	0	0	0	0	54
Totals	**1,152**	**3,481**	**1**	**1**	**57**	**1**	**2,789**	**239**	**27**	**1**	**7,749**

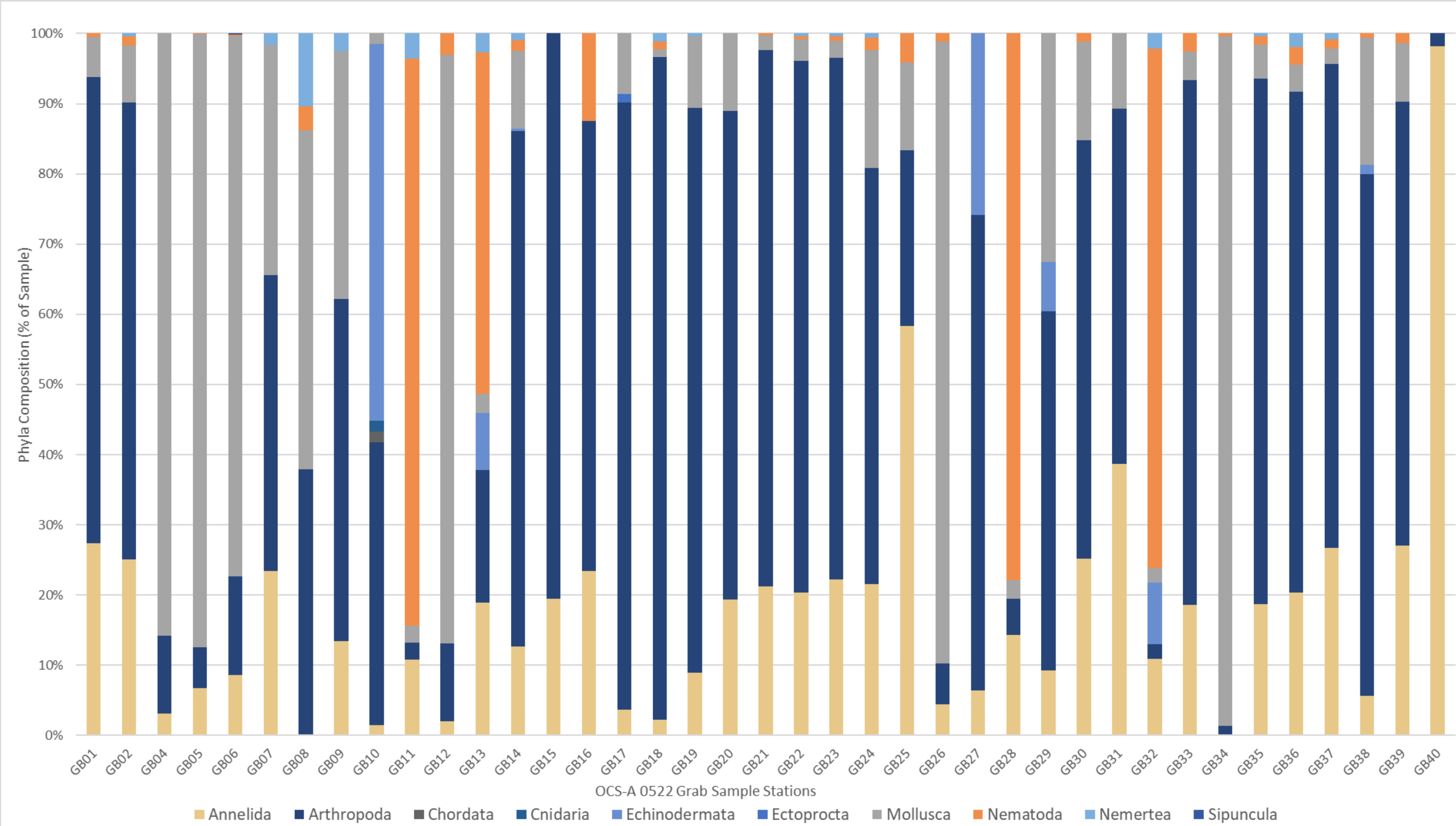


Figure 5. Percent composition of organisms in each represented phylum for the 39 benthic grab samples in OCS-A 0522.

Table 12. Abundance of each phyla and taxa (family or LPTL) across all samples for OCS-A 0522 (continued on next page).

Phylum	Family or LPTL	Abundance Across All Samples	Median Abundance per 0.008 m^2	Frequency of Occurrence
Annelida	Paraonidae	477	1	20
	Lumbrineridae	194	2	27
	Cirratulidae	97	0	18
	Maldanidae	76	0	18
	Oligochaeta (LPTL)	45	0	19
	Nephtyidae	34	0	16
	Oweniidae	32	0	4
	Goniadidae	29	0	4
	Ampharetidae	26	0	7
	Polygordiidae	24	0	10
	Flabelligeridae	23	0	8
	Cossuridae	20	0	2
	Syllidae	15	0	10
	Sigalionidae	12	0	7
	Glyceridae	9	0	9
	Trichobranchidae	9	0	3
	Oenonidae	8	0	8
	Orbiniidae	5	0	5
	Polynoidae	4	0	4
	Opheliidae	3	0	3
	Phyllodocidae	3	0	3
	Sabellidae	3	0	3
	Scalibregmatidae	2	0	2
	Spionidae	2	0	2
Total Annelida		1,152	0	37
Arthropoda	Ampeliscidae	2,448	13	33
	Calanoida (LPTL)	454	0	17
	Ostracoda (LPTL)	146	2	24
	Phoxocephalidae	130	2	30
	Leuconidae	81	0	14
	Corophiidae	43	0	12
	Ischyroceridae	38	0	13
	Unciolidae	35	0	16
	Diastylidae	25	0	13
	Haustoriidae	23	0	4

Phylum	Family or LPTL	Abundance Across All Samples	Median Abundance per 0.008 m^2	Frequency of Occurrence
	Tryphosidae	18	0	6
	Gammaridae	9	0	4
	Tanaissuidae	7	0	2
	Chaetiliidae	6	0	4
	Idoteidae	5	0	4
	Cheirocratidae	3	0	1
	Photidae	3	0	3
	Pleustidae	2	0	1
	Anthuridae	1	0	1
	Cancridae	1	0	1
	Caprellidae	1	0	1
	Halacaridae	1	0	1
	Harpacticoida (LPTL)	1	0	1
Total Arthropoda		3,481	0	39
Chordata	Polyclinidae	1	0	1
Total Chordata		1	0	1
Cnidaria	Hydrozoa (LPTL)	1	0	1
Total Cnidaria		1	0	1
Echinodermata	Echinarachniidae	54	0	5
	Synaptidae	2	0	1
	Ophiuroidea (LPTL)	1	0	1
Total Echinodermata		57	0	7
Ectoprocta		1	0	1
Total Ectoprocta		1	0	1
Mollusca	Nuculidae	2,639	6	34
	Tellinidae	33	0	10
	Lucinidae	21	0	8
	Thyasiridae	17	0	9
	Mactridae	15	0	7
	Yoldiidae	14	0	7
	Periplomatidae	10	0	8
	Veneridae	9	0	7
	Bivalvia (LPTL)	6	0	3
	Rissoidae	5	0	3
	Arcticidae	3	0	2
	Nassariidae	3	0	3

Phylum	Family or LPTL	Abundance Across All Samples	Median Abundance per 0.008 m^2	Frequency of Occurrence
	Cardiidae	2	0	2
	Pharidae	2	0	2
	Solemyidae	2	0	2
	Thraciidae	2	0	1
	Chaetodermatidae	1	0	1
	Columbellidae	1	0	1
	Gastropoda (LPTL)	1	0	1
	Lasaeidae	1	0	1
	Naticidae	1	0	1
	Pteriidae	1	0	1
Total Mollusca		2789	0	35
Nematoda	Nematoda (LPTL)	239	1	27
Total Nematoda		239	1	27
Nemertea	Nemertea (LPTL)	10	0	8
	Lineidae	7	0	4
	Tubulanidae	6	0	3
	Amphiporidae	2	0	1
	Emplectonematidae	2	0	2
Total Nermertea		27	0	16
Sipuncula	Sipuncula (LPTL)	1	0	1
Total Sipuncula		1	0	1

3.2.2.2 Richness, Diversity, and Evenness

Mean density was 198 organisms per station, averaged across 39 stations in OCS-A 0522. Taxonomic richness across all grab samples collected in the OCS-A 0522 lease area was 9.04, which was higher than the index score for each individual grab sample (Table 13). The richness of organisms collected at each grab sample location ranged from 0.74 at GB34 to 4.75 at GB23, with an average richness of 2.81. Average diversity across the individual grab samples was 1.43 with a range from 0.18 at GB34 to 2.29 at GB31. Evenness across the samples ranged from 0.11 at GB34 to 0.92 at GB08, GB25, and GB27. Although GB34 had above average abundance per sample, the low richness, diversity, and evenness values were a result of a single dominating taxa (nut clams), which represented all but 7 of the 229 identified organisms. Richness, diversity, and evenness are indices that do not have units; however, higher values indicate greater amounts of richness, diversity, or evenness in each sample.

Table 13. Community composition parameters calculated for each grab sample station in OCS-A 0522 (continued on next page).

Station	Density (Abundance per 0.008 m2)	# of Taxa	Ecological Indices		
			Richness	Diversity	Evenness
GB01	194	17	3.04	1.52	0.54
GB02	295	20	3.34	1.75	0.59
GB04	127	10	1.86	0.70	0.30
GB05	1301	20	2.65	0.67	0.22
GB06	725	28	4.10	1.14	0.34
GB07	64	12	2.64	1.95	0.79
GB08	29	9	2.38	2.03	0.92
GB09	82	19	4.08	2.26	0.77
GB10	67	13	2.85	1.62	0.63
GB11	83	7	1.36	0.79	0.40
GB12	99	9	1.74	0.87	0.40
GB13	37	10	2.49	1.70	0.74
GB14	317	27	4.51	1.76	0.53
GB15	77	5	0.92	0.81	0.50
GB16	64	8	1.68	1.34	0.65
GB17	81	11	2.28	1.21	0.50
GB18	88	9	1.79	0.98	0.45
GB19	235	23	4.03	1.45	0.46
GB20	191	17	3.05	1.83	0.65
GB21	419	19	2.98	1.61	0.55
GB22	466	27	4.23	1.47	0.44
GB23	293	28	4.75	1.88	0.56
GB24	167	18	3.32	1.80	0.62
GB25	24	11	3.15	2.20	0.92
GB26	342	15	2.40	0.71	0.26
GB27	31	6	1.46	1.65	0.92

Station	Density (Abundance per 0.008 m2)	# of Taxa	Ecological Indices		
			Richness	Diversity	Evenness
GB28	77	8	1.61	0.89	0.43
GB29	43	13	3.19	2.23	0.87
GB30	171	21	3.89	1.77	0.58
GB31	93	20	4.19	2.29	0.77
GB32	46	7	1.57	0.98	0.50
GB33	194	19	3.42	1.48	0.50
GB34	229	5	0.74	0.18	0.11
GB35	251	21	3.62	1.47	0.48
GB36	157	18	3.36	1.79	0.62
GB37	232	18	3.12	1.40	0.48
GB38	160	16	2.96	1.40	0.51
GB39	144	17	3.22	1.49	0.53
GB40	54	7	1.50	0.86	0.44
Average	**198**	**15**	**2.81**	**1.43**	**0.55**
Total	**7,749**	**82**	**9.04**	**2.15**	**0.49**

4 CMECS CLASSIFICATIONS

We assigned NMFS (2020) modified CMECS classifications to each grab sample station based on visual inspection of the sample on board the ship, as well as laboratory analysis of grain size. We also assigned a CMECS substrate classification for each still image from the underwater video transects that were analyzed for percent cover.

4.1 CMECS OCS-A 0522

Substrate classification results are presented as a hierarchy in Table 14 for grab sample stations in the OCS-A 0522 lease area. Table 15 shows the images of each grab sample and core after retrieval along with the CMECS classifications for each sample. All samples in OCS-A 0522 were dominated by fine unconsolidated substrate of geologic origin except for one that was dominated by shell rubble of biogenic origin. The remainder of the samples belonged to the sand, muddy sand, or sandy mud groups. Eight samples contained small (0.1% - 0.8%) fractions of gravel that may have been comprised of shell fragments rather than substrate of geologic origin but the grain size analysis did not differentiate between substrate origins and images of the cores are insufficient for determining the composition of the gravel at such a fine scale. Therefore, it is possible that these samples would be more appropriately classified as sand with trace shell hash, muddy sand with trace shell hash, or sandy mud with trace shell hash.

Maps displaying the location and CMECS classification of each individual still image analyzed for the video transects in OCS-A 0522 are provided in Appendix A Section 2.

Table 14. CMECS hierarchical classification of substrates collected at each grab sample or video transect within OCS-A 0522.

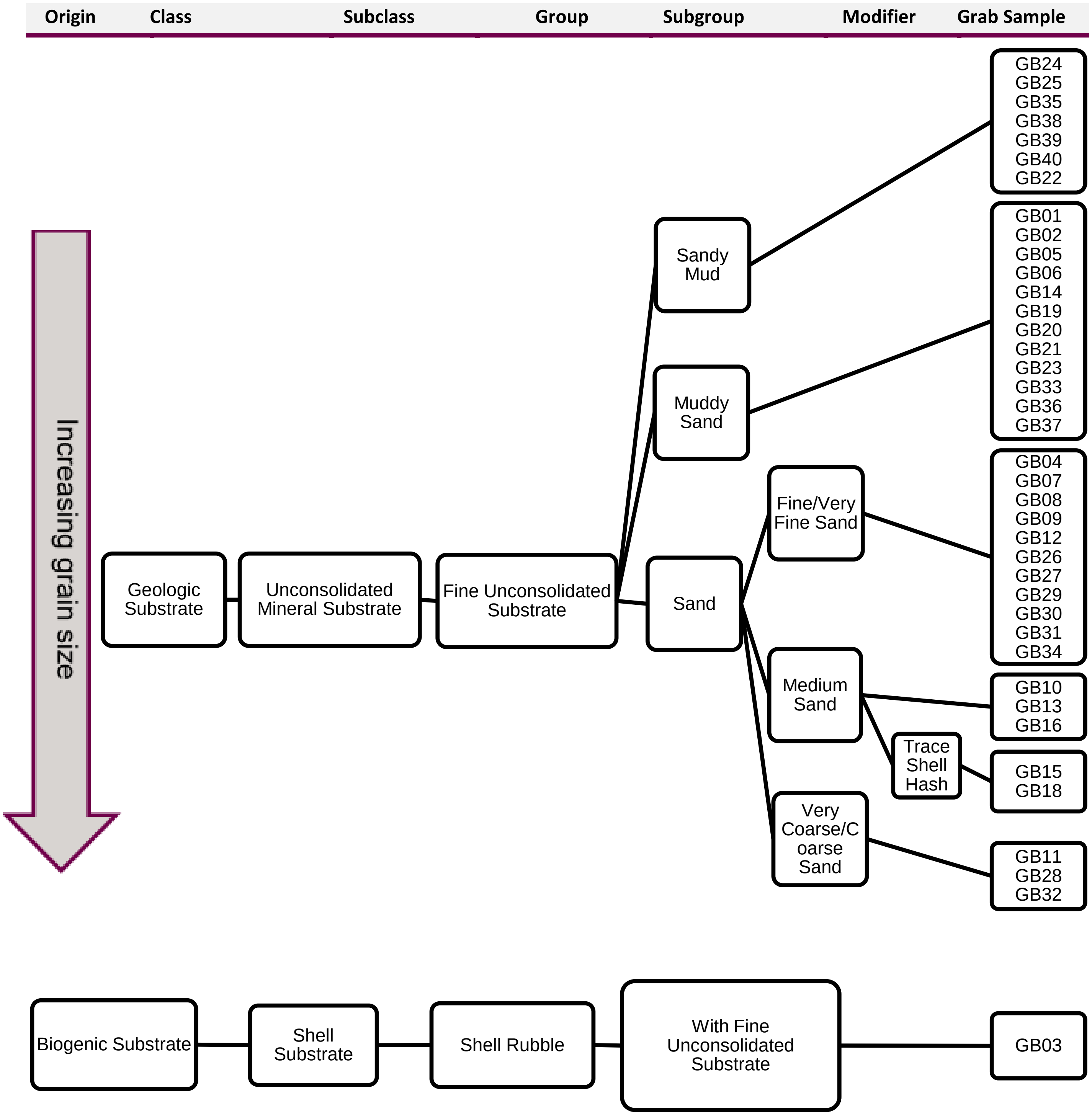
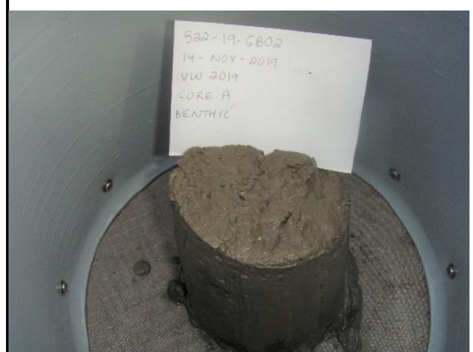
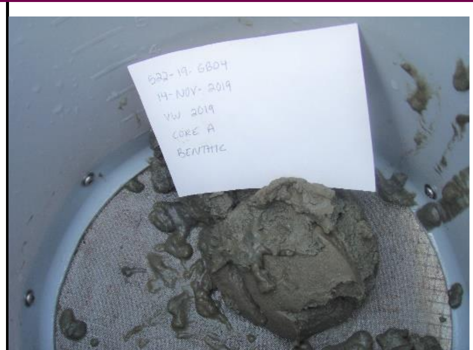
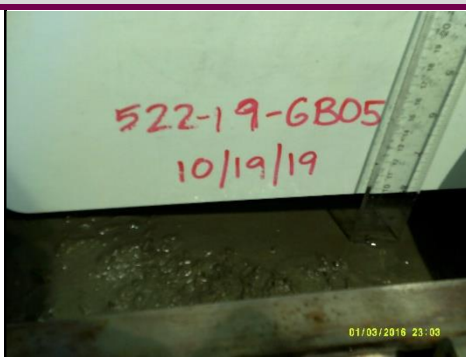
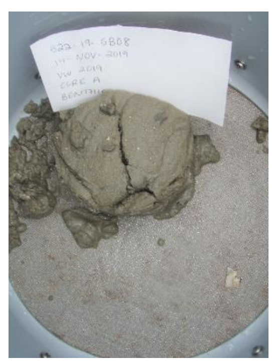
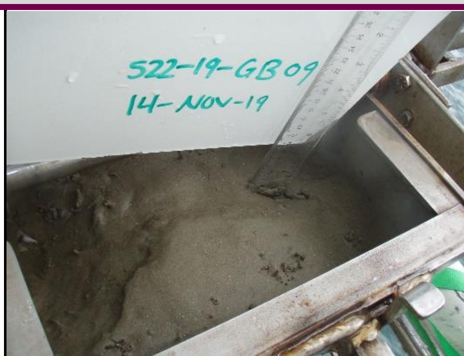
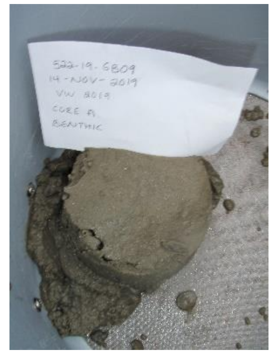
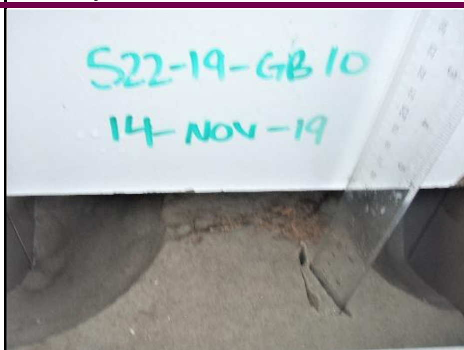
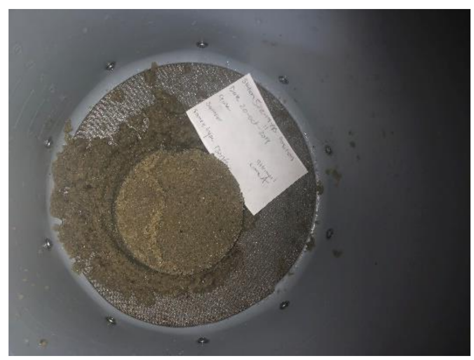
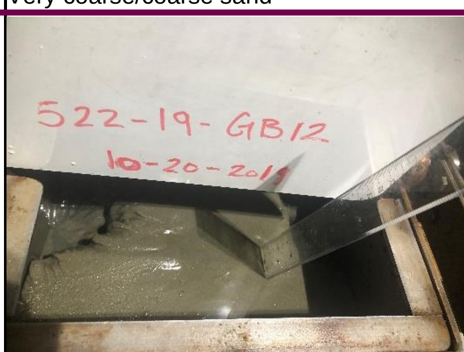
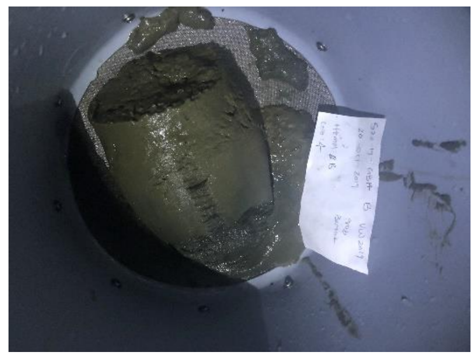
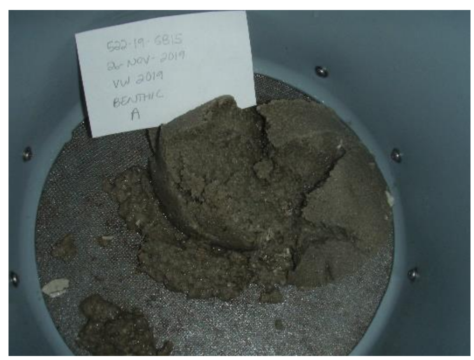


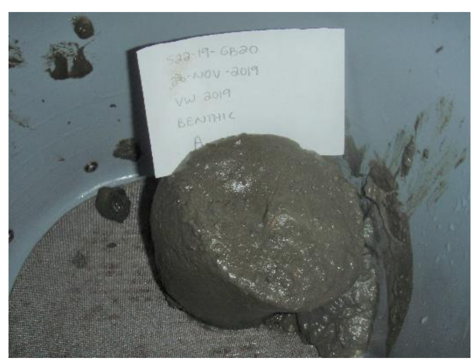
Table 15. Images of grab and subsequent core samples prior to processing from OCS-A 0522, along with CMECS classifications.

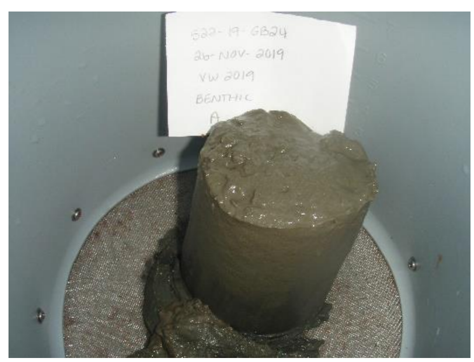
Station	Grab Sample	Core Sample
GB01	 Muddy sand	
GB02	 Muddy sand	
GB03	 Shell rubble with fine unconsolidated substrate	N/A
GB04	 Fine/very fine sand	

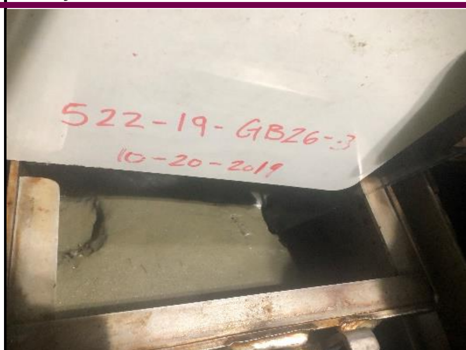
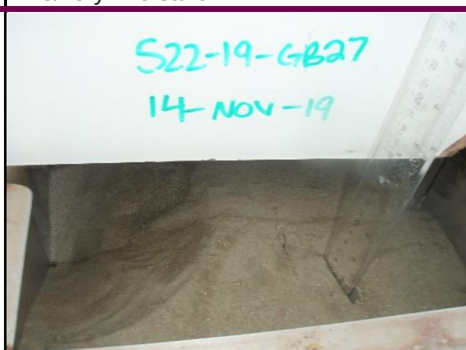
Station	Grab Sample	Core Sample
GB05	 Muddy sand	
GB06	 Muddy sand	
GB07	 Fine/very fine sand	
GB08	 Fine/very fine sand	

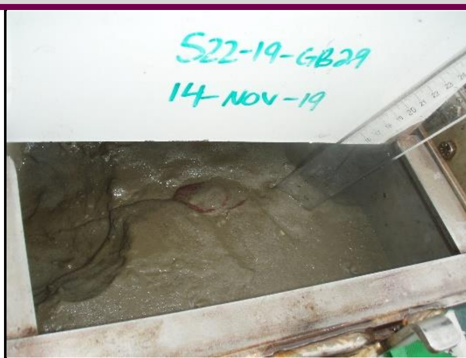
Station	Grab Sample	Core Sample
GB09	 Fine/very fine sand	
GB10	 Medium sand	
GB11	 Very coarse/coarse sand	
GB12	 Fine/very fine sand	

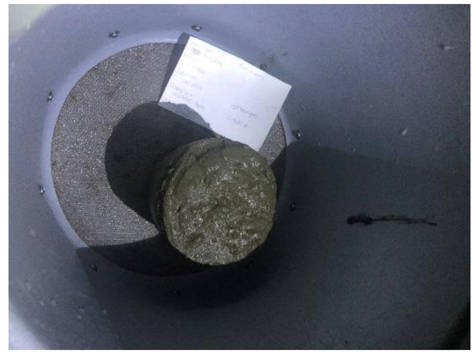
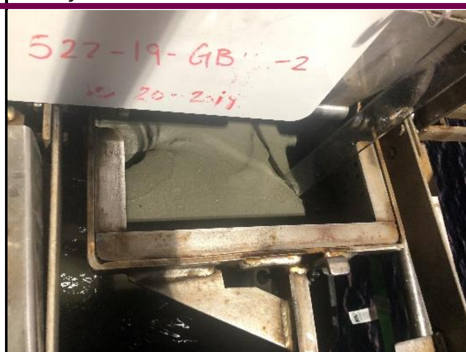
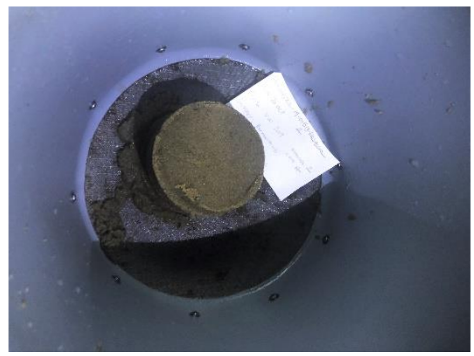
Station	Grab Sample	Core Sample
GB13	 Medium sand	
GB14	 Muddy sand	
GB15	 Medium sand with trace shell hash	
GB16	 Medium sand	

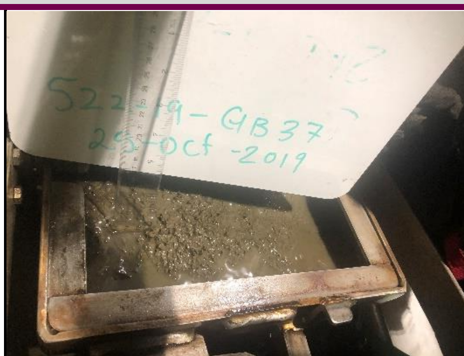
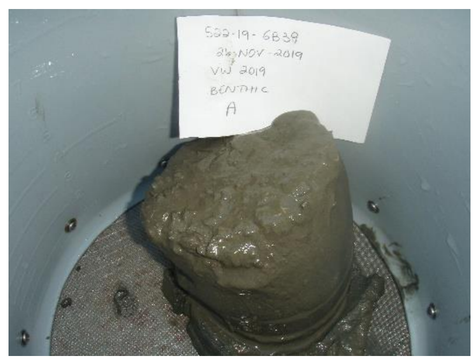
Station	Grab Sample	Core Sample
GB17	 Grab failed 3x	
GB18	 Medium sand with trace shell hash	
GB19	 Muddy sand	
GB20	 Muddy sand	

Station	Grab Sample	Core Sample
GB21	 Muddy sand	
GB22	 Sandy mud	N/A
GB23	 Muddy sand	
GB24	 Sandy mud	

Station	Grab Sample	Core Sample
GB25	 Sandy mud	
GB26	 Fine/very fine sand	
GB27	 Fine/very fine sand	
GB28	 Very coarse/coarse sand	

Station	Grab Sample	Core Sample
GB29	 Fine/very fine sand	
GB30	 Fine/very fine sand	
GB31	 Fine/very fine sand	
GB32	 Very coarse/coarse sand	

Station	Grab Sample	Core Sample
GB33	 Muddy sand	
GB34	 Fine/very fine sand	
GB35	 Sandy mud	
GB36	 Muddy sand	

Station	Grab Sample	Core Sample
GB37	 Muddy sand	
GB38	 Sandy mud	
GB39	 Sandy mud	
GB40	 Sandy mud	N/A

5 SUMMARY

OCS-A 0522 sampling locations consisted of muddy sand, sand, or sandy mud with one grab dominated by shell rubble and no evidence of consolidated substrate. Bottom complexity was low with some evidence of sand ripples to small sand waves. Video revealed that >78.5% of bottom in all transects was comprised of sand/mud with most transects revealing >97% sand/mud. Infaunal structures (seemingly small worm tubes and amphipod structures), burrows, macrofauna, and shells made up most of the remaining surface area. Sand dollars were the dominant benthic macrofauna but were not observed in roughly two- thirds of the video transects. Infauna was dominated by the Arthropoda phylum followed by the Mollusca and Annelida phylum.

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ALPINE VINEYARD WIND BENTHIC SAMPLING

APPENDIX A – LEASE AREA OCS-A 0522 CMECS MAPS

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Alpine Ocean – Vineyard Wind

19-P-206028 Alpine Vineyard Wind
Lease Areas OCS-A 0522
Benthic Sampling Appendix A

January 18, 2021

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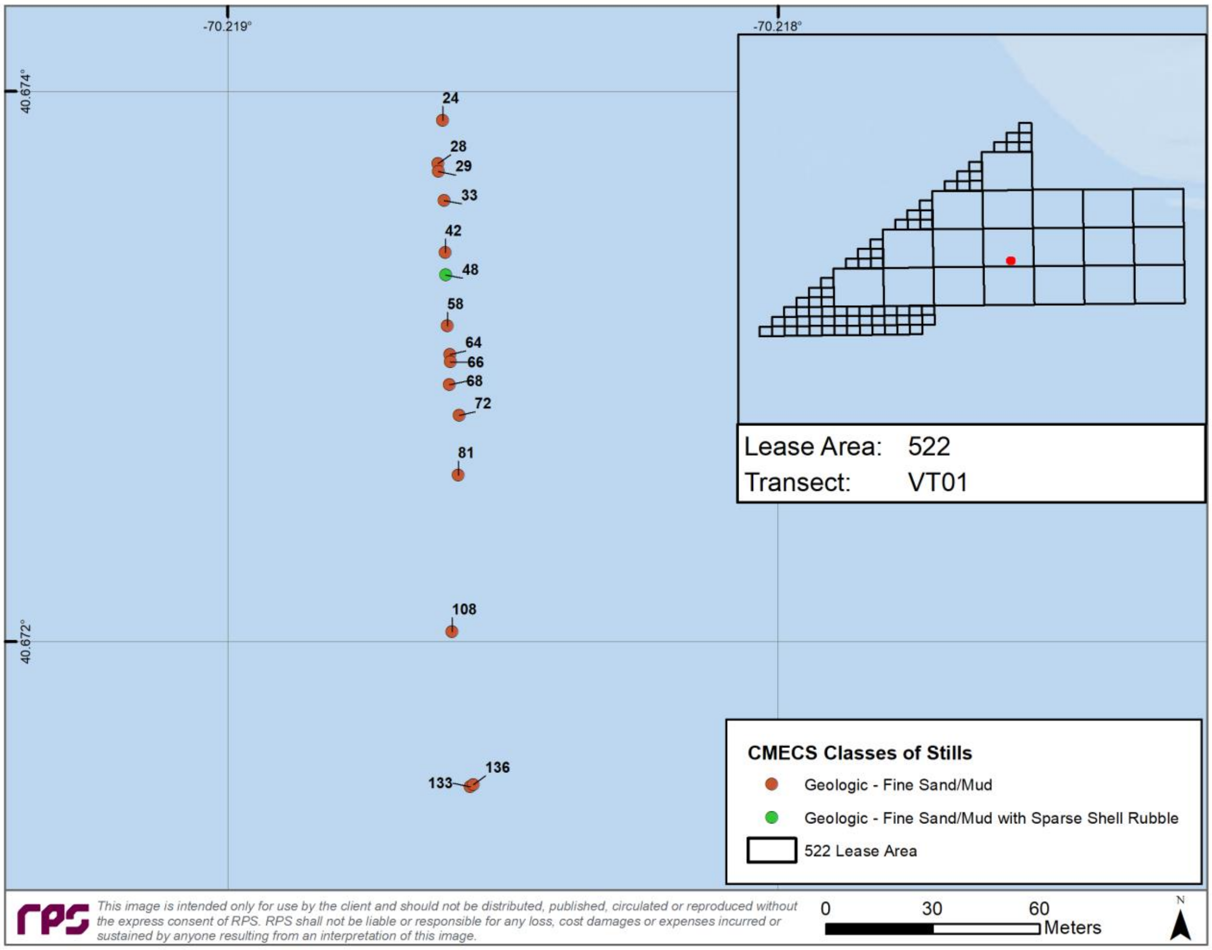

Figure 1 CMECS substrate classification for all viable still images in VT01 (numbers indicate still image ID).

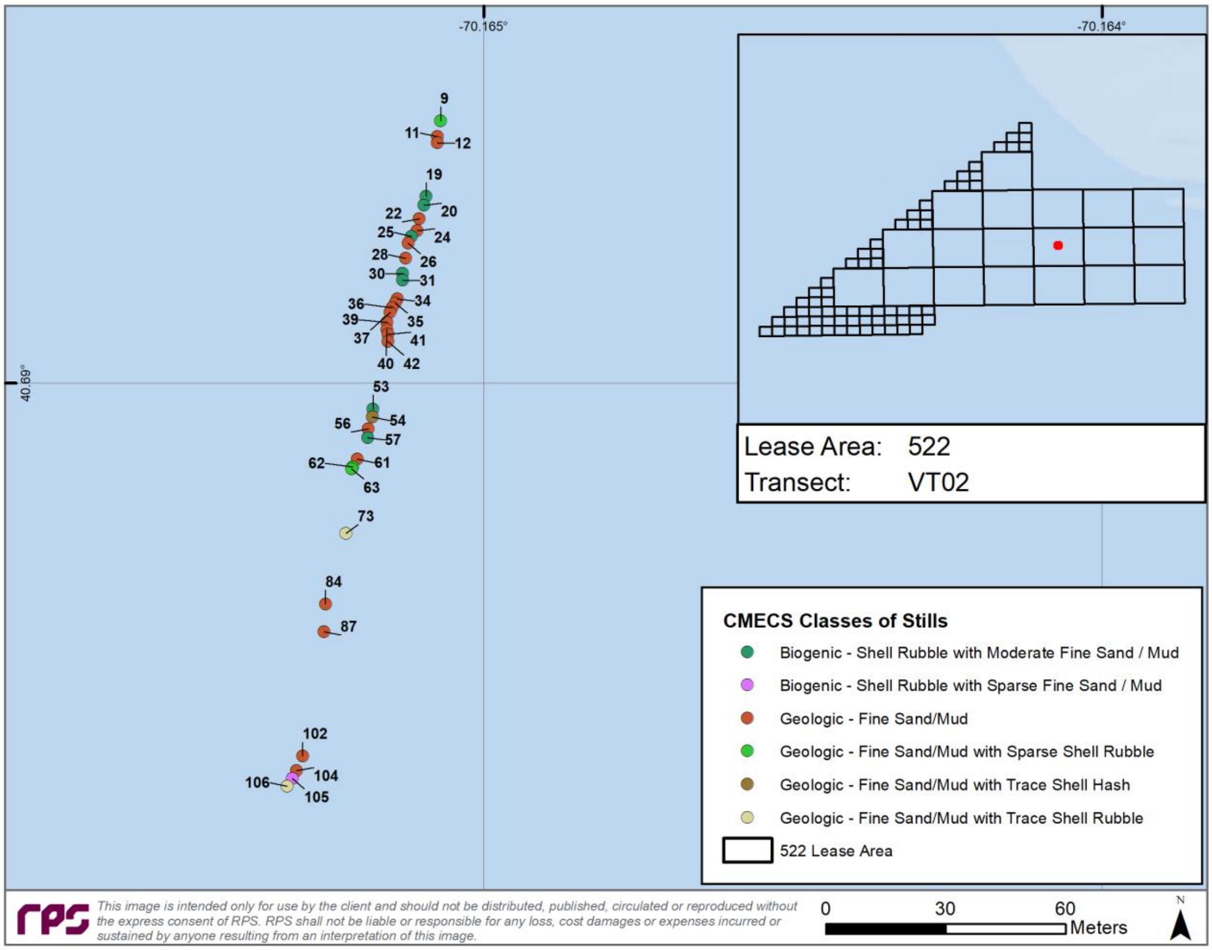

Figure 2 CMECS substrate classification for all viable still images in VT02 (numbers indicate still image ID).

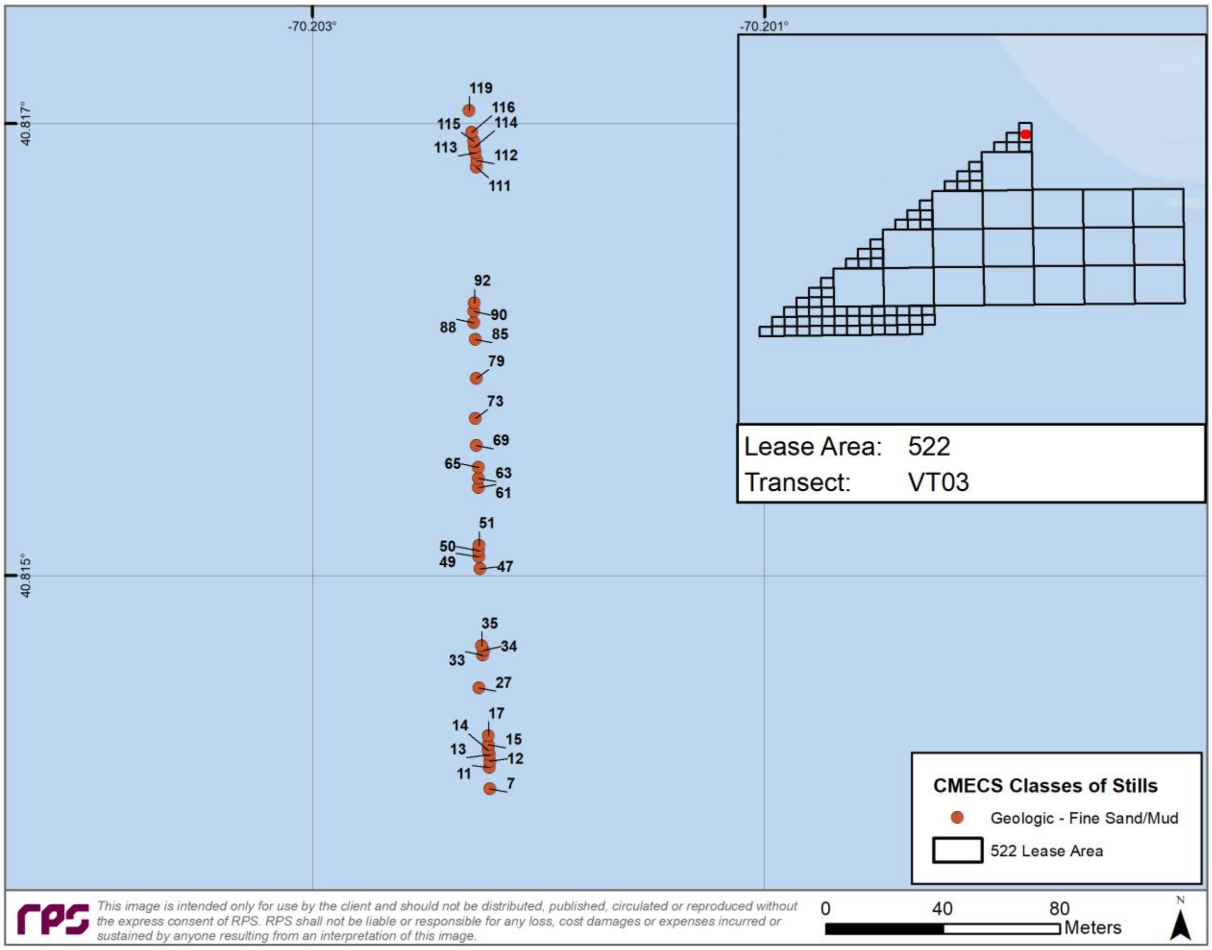

Figure 3 CMECS substrate classification for all viable still images in VT03 (numbers indicate still image ID).

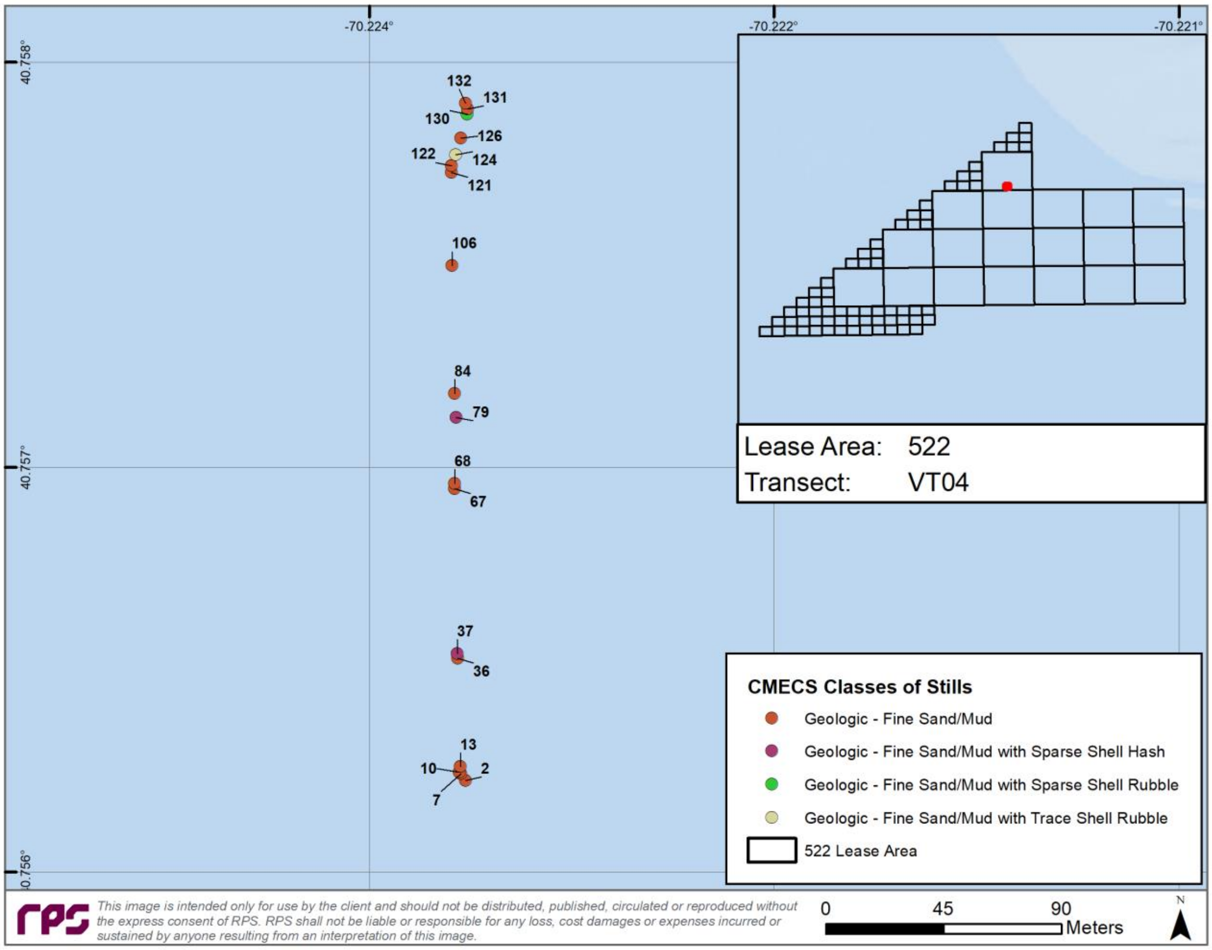

Figure 4 CMECS substrate classification for all viable still images in VT04 (numbers indicate still image ID).

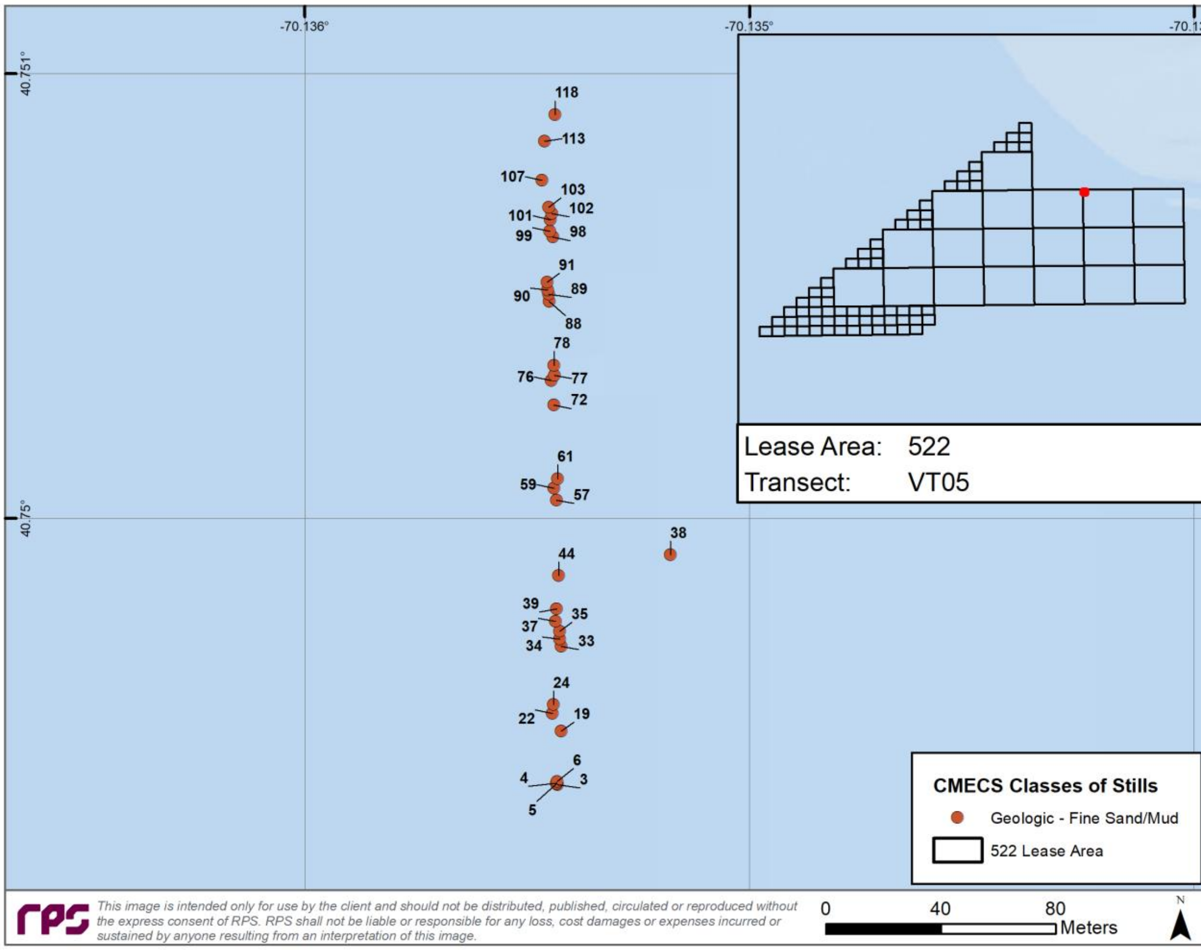

Figure 5 CMECS substrate classification for all viable still images in VT05 (numbers indicate still image ID).

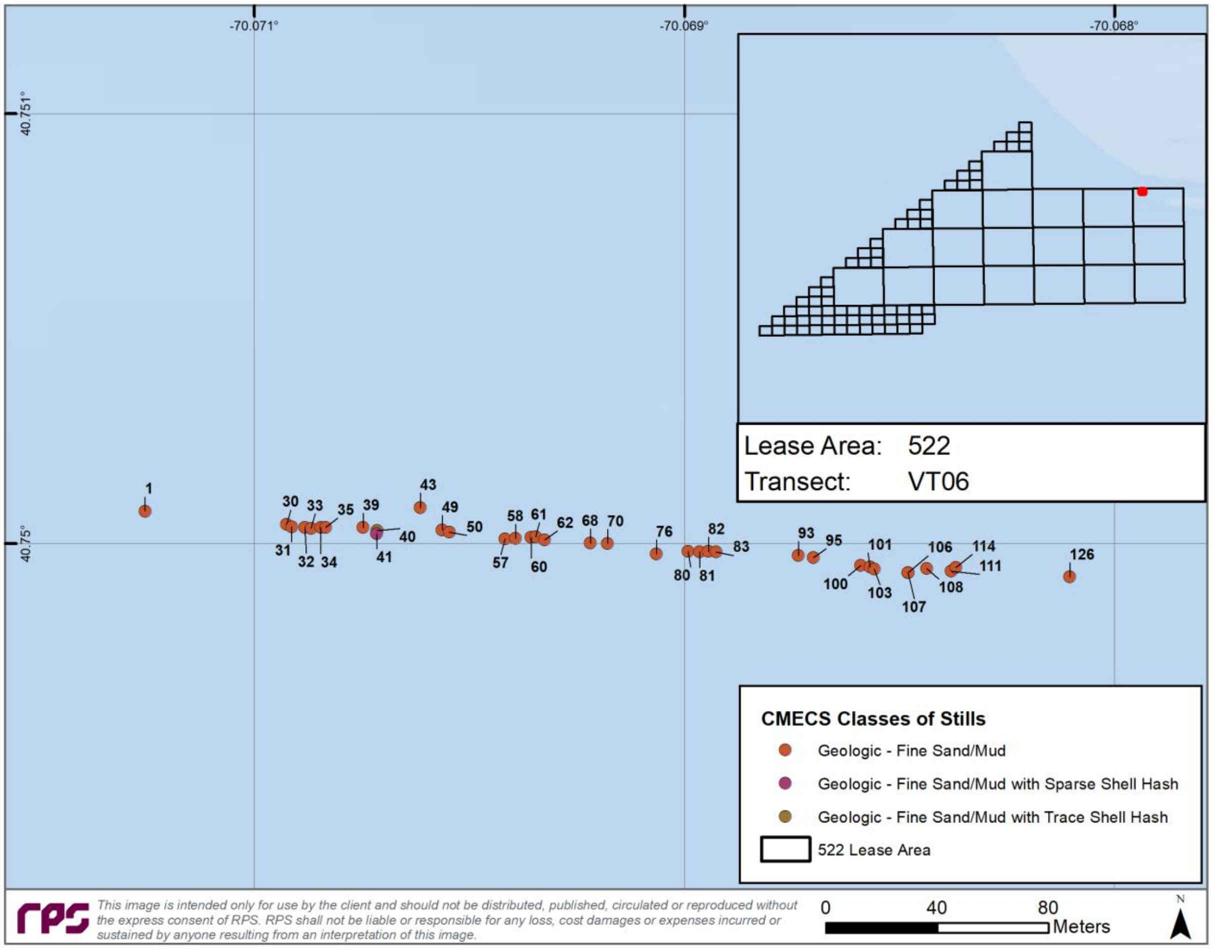

Figure 6 CMECS substrate classification for all viable still images in VT06 (numbers indicate still image ID).

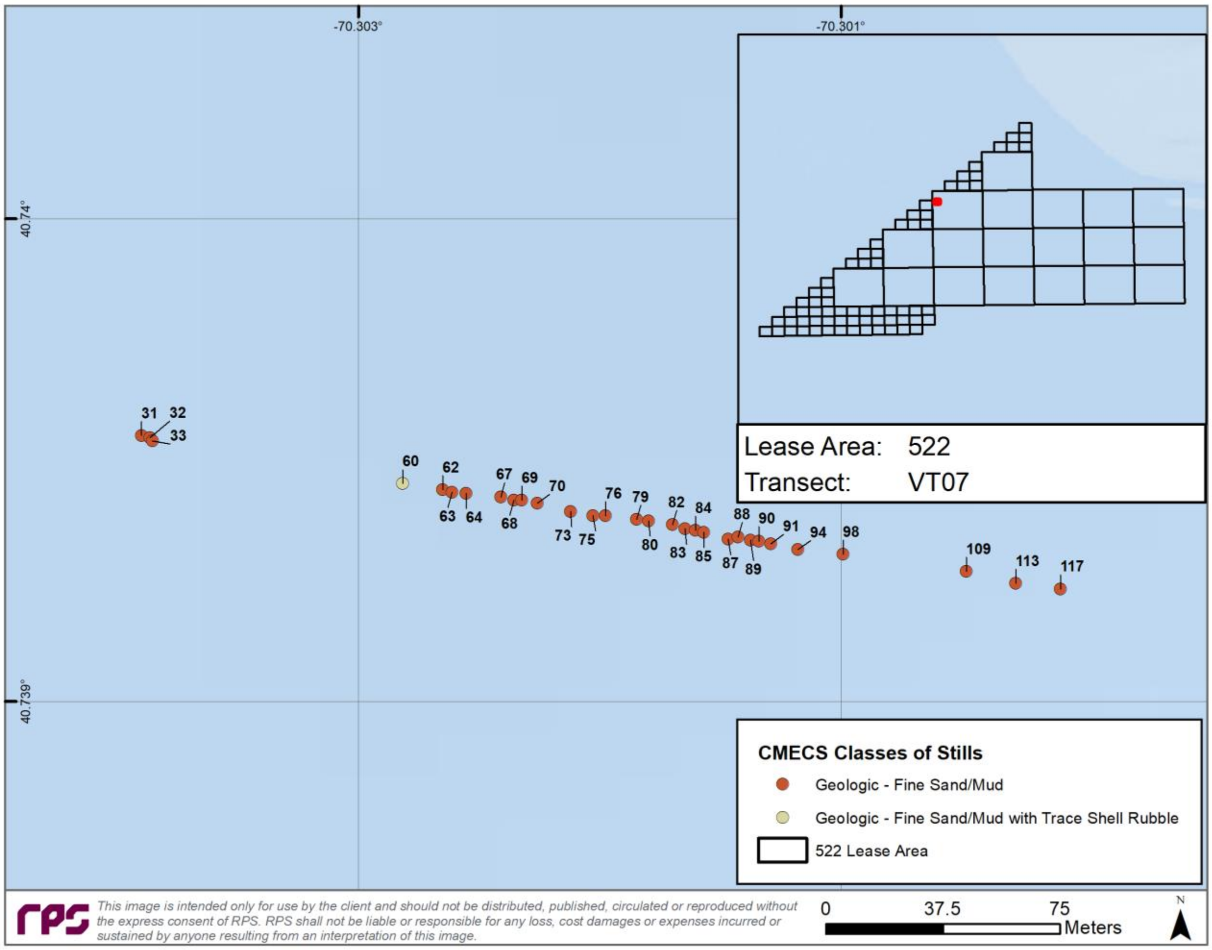

Figure 7 CMECS substrate classification for all viable still images in VT07 (numbers indicate still image ID).

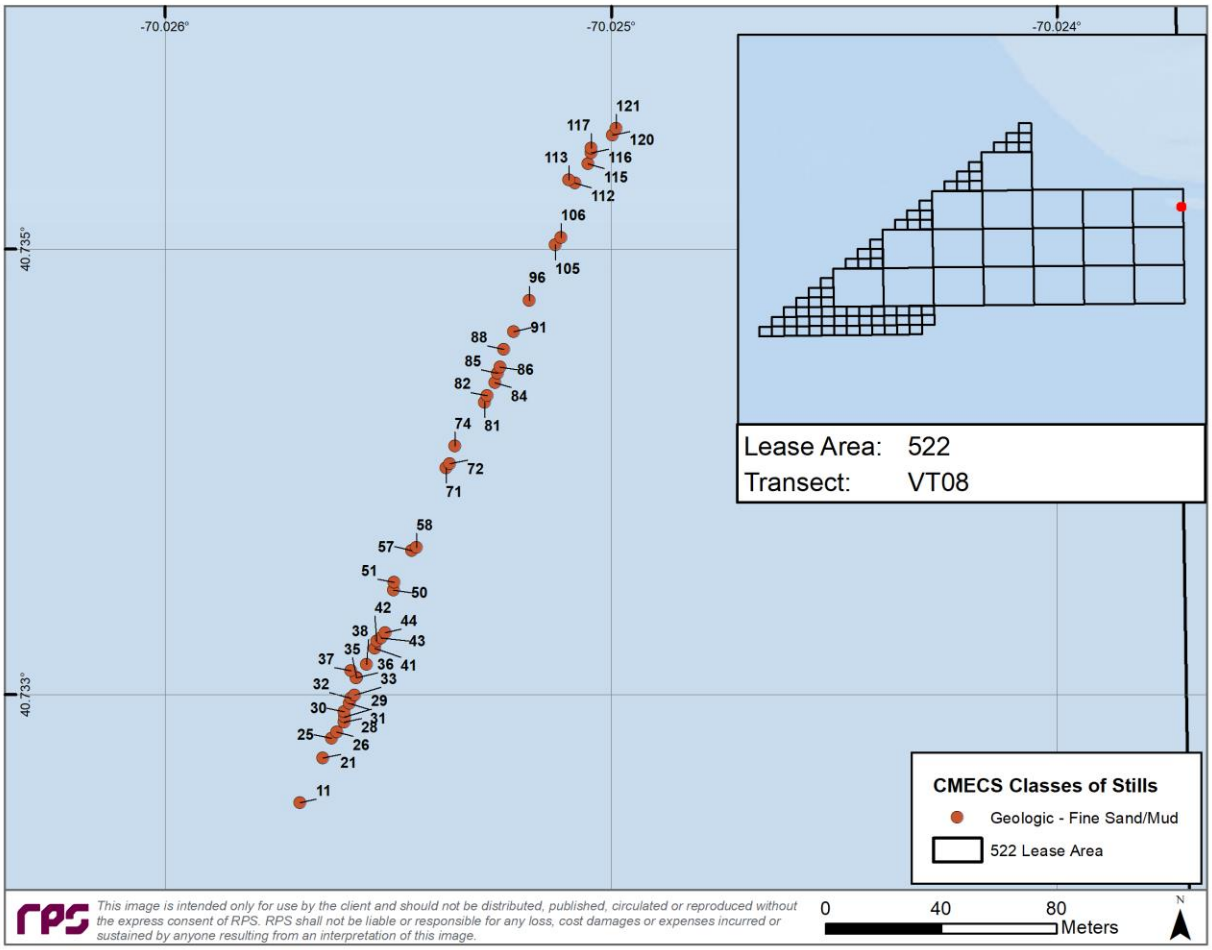

Figure 8 CMECS substrate classification for all viable still images in VT08 (numbers indicate still image ID).

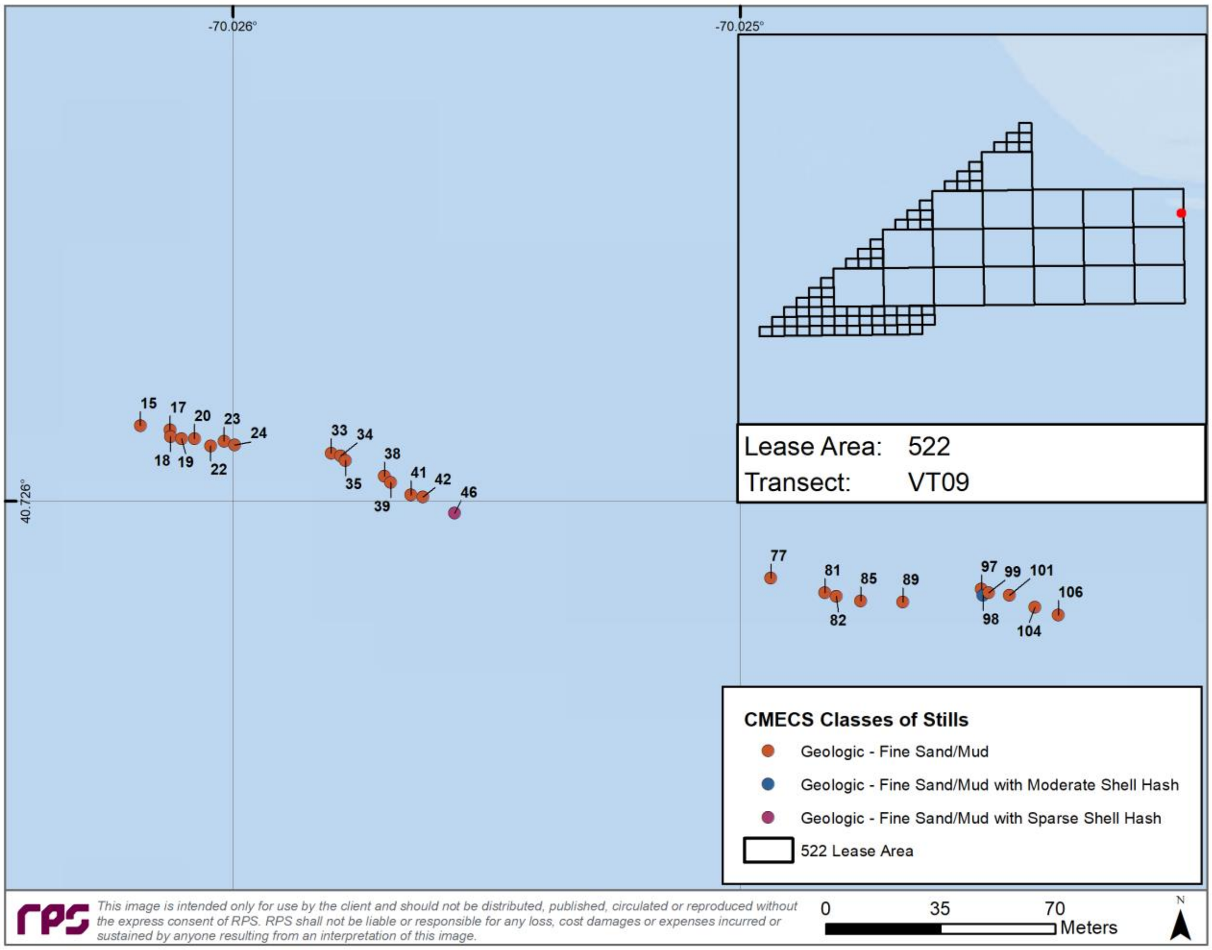

Figure 9 CMECS substrate classification for all viable still images in VT09 (numbers indicate still image ID).

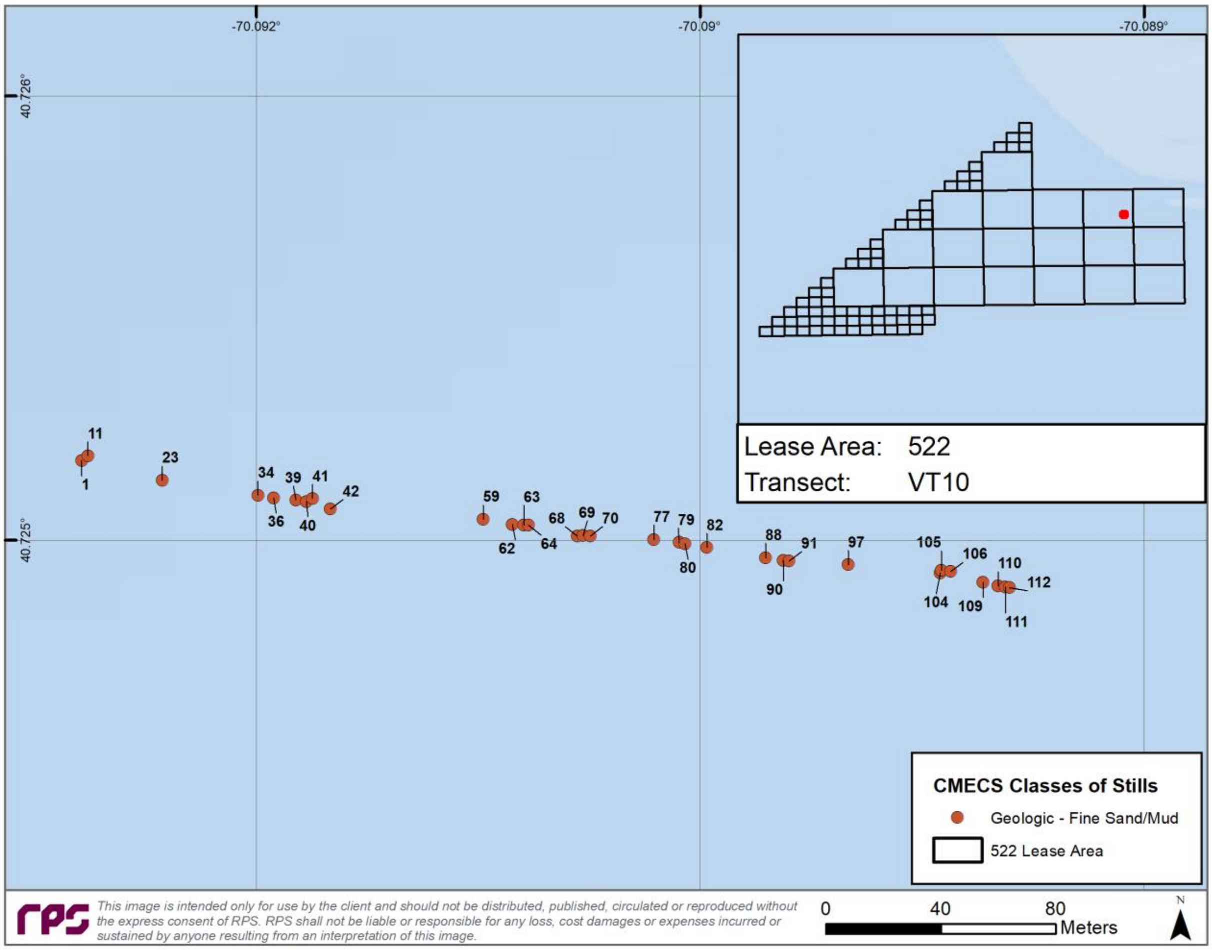

Figure 10 CMECS substrate classification for all viable still images in VT10 (numbers indicate still image ID).

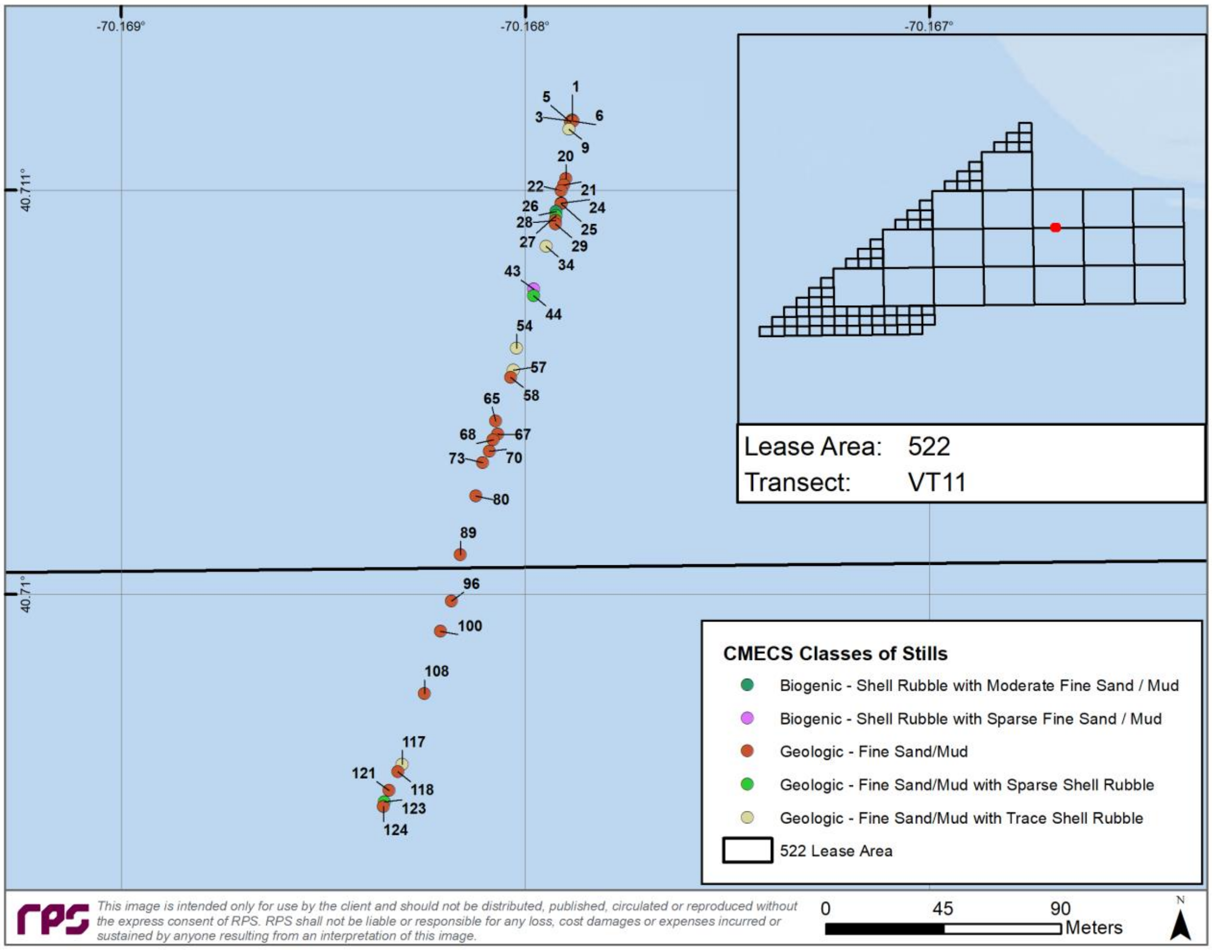

Figure 11 CMECS substrate classification for all viable still images in VT11 (numbers indicate still image ID).

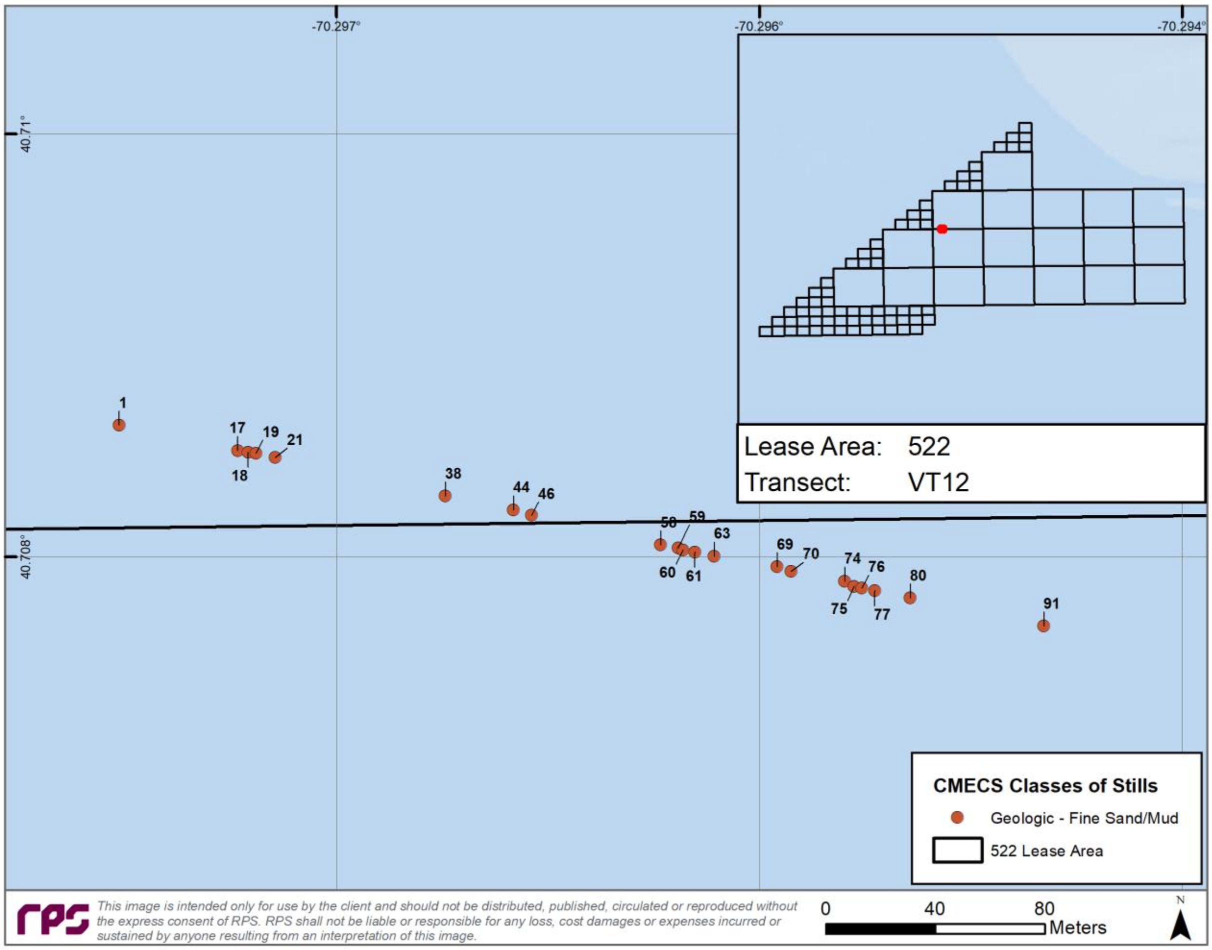

Figure 12 CMECS substrate classification for all viable still images in VT12 (numbers indicate still image ID).

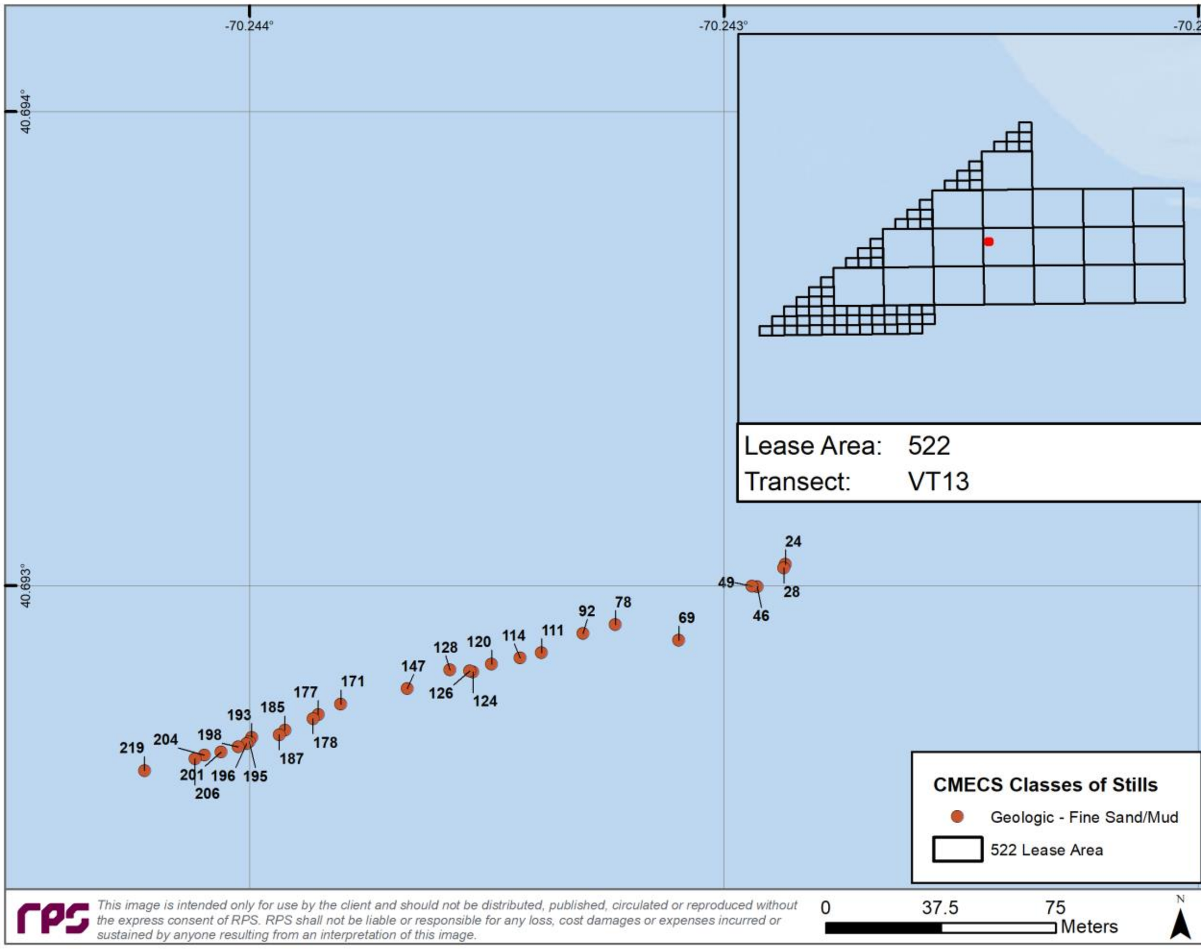

Figure 13 CMECS substrate classification for all viable still images in VT13 (numbers indicate still image ID).

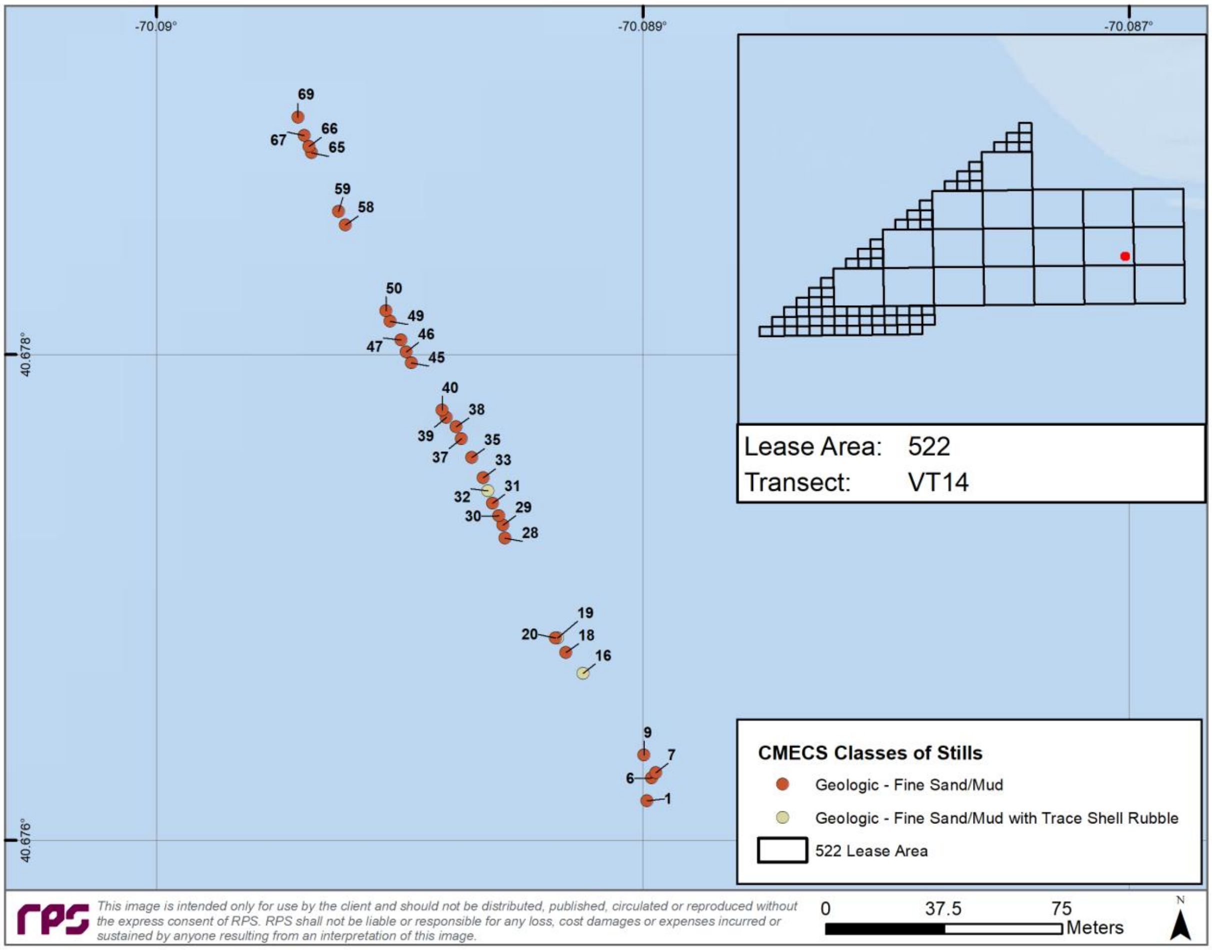

Figure 14 CMECS substrate classification for all viable still images in VT14 (numbers indicate still image ID).

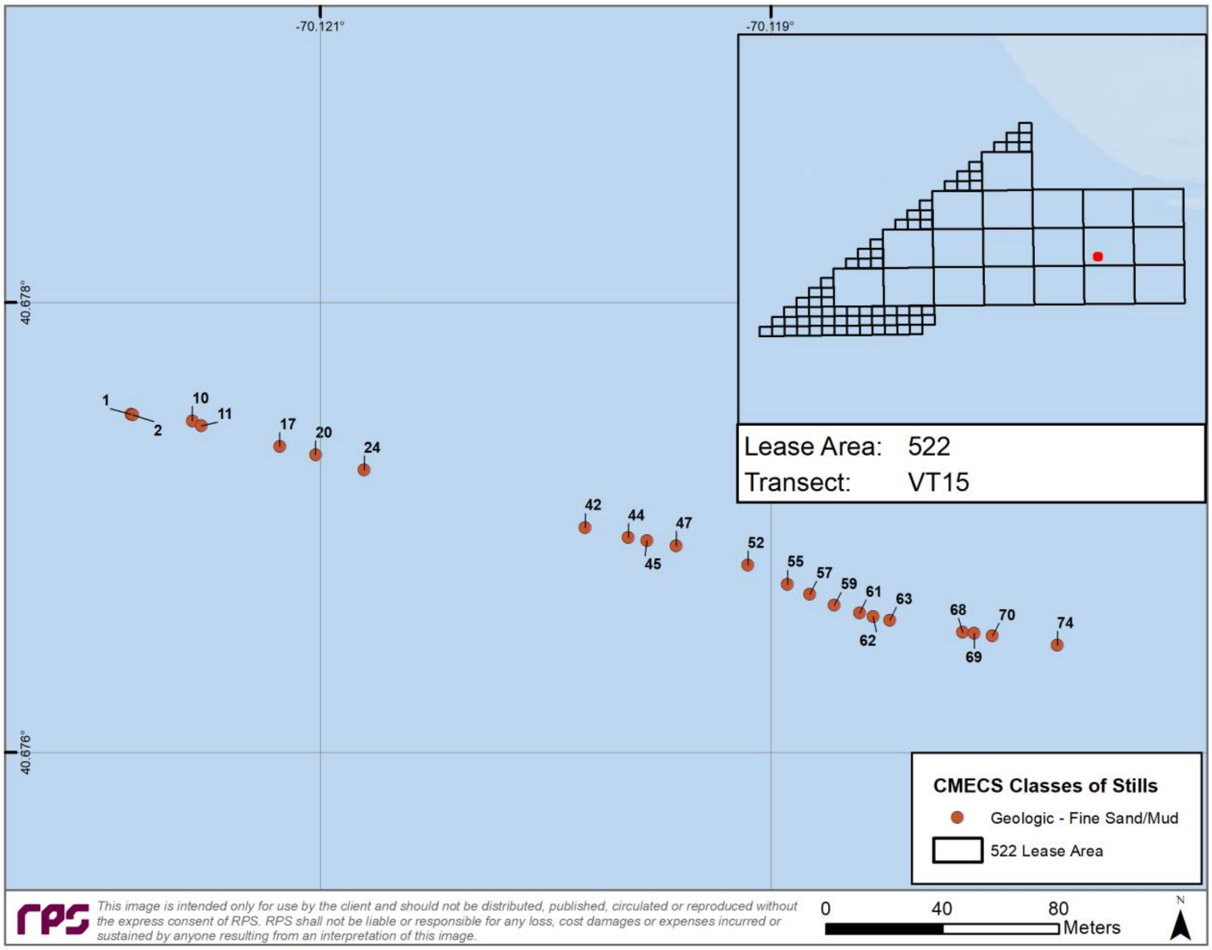

Figure 15 CMECS substrate classification for all viable still images in VT15 (numbers indicate still image ID).

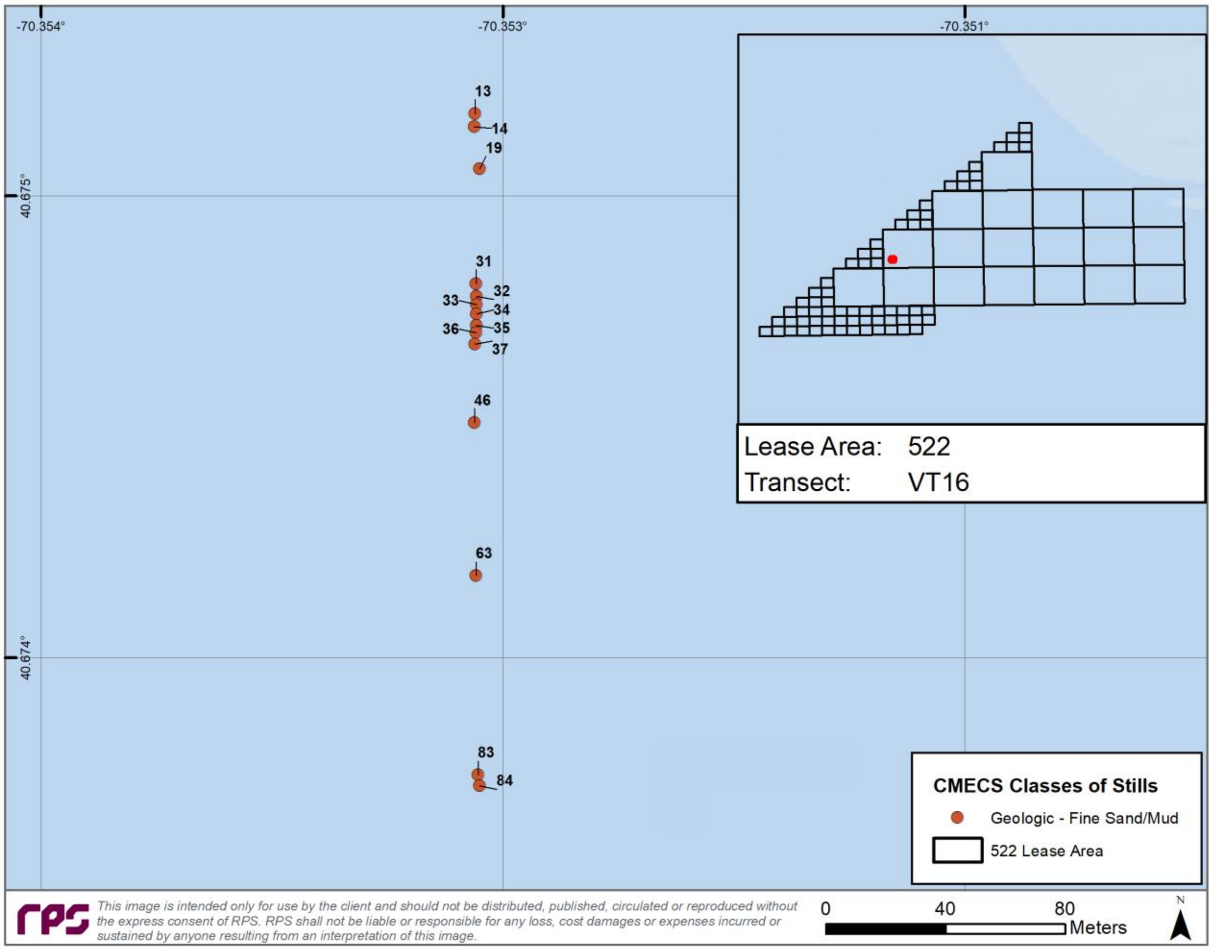

Figure 16 CMECS substrate classification for all viable still images in VT16 (numbers indicate still image ID).

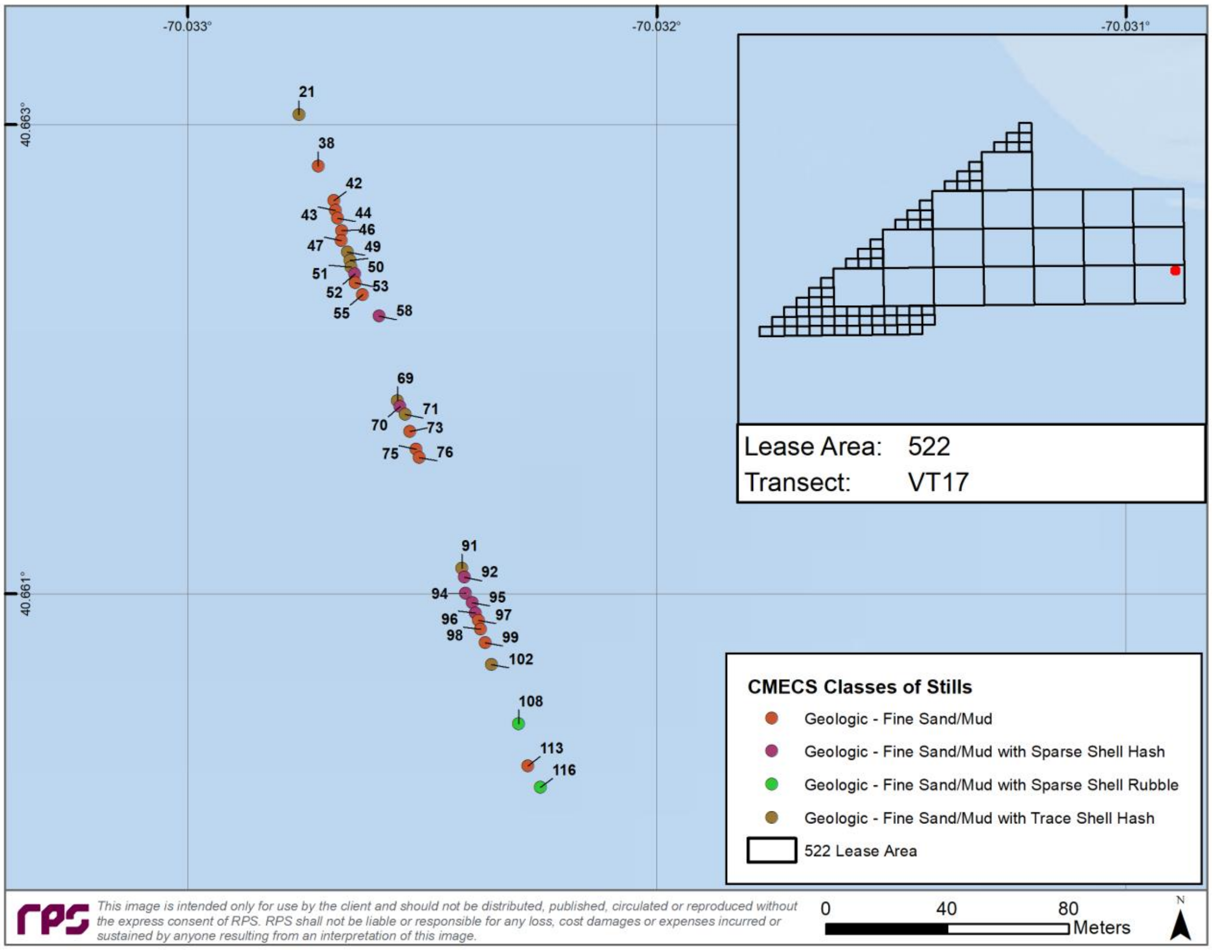

Figure 17 CMECS substrate classification for all viable still images in VT17 (numbers indicate still image ID).

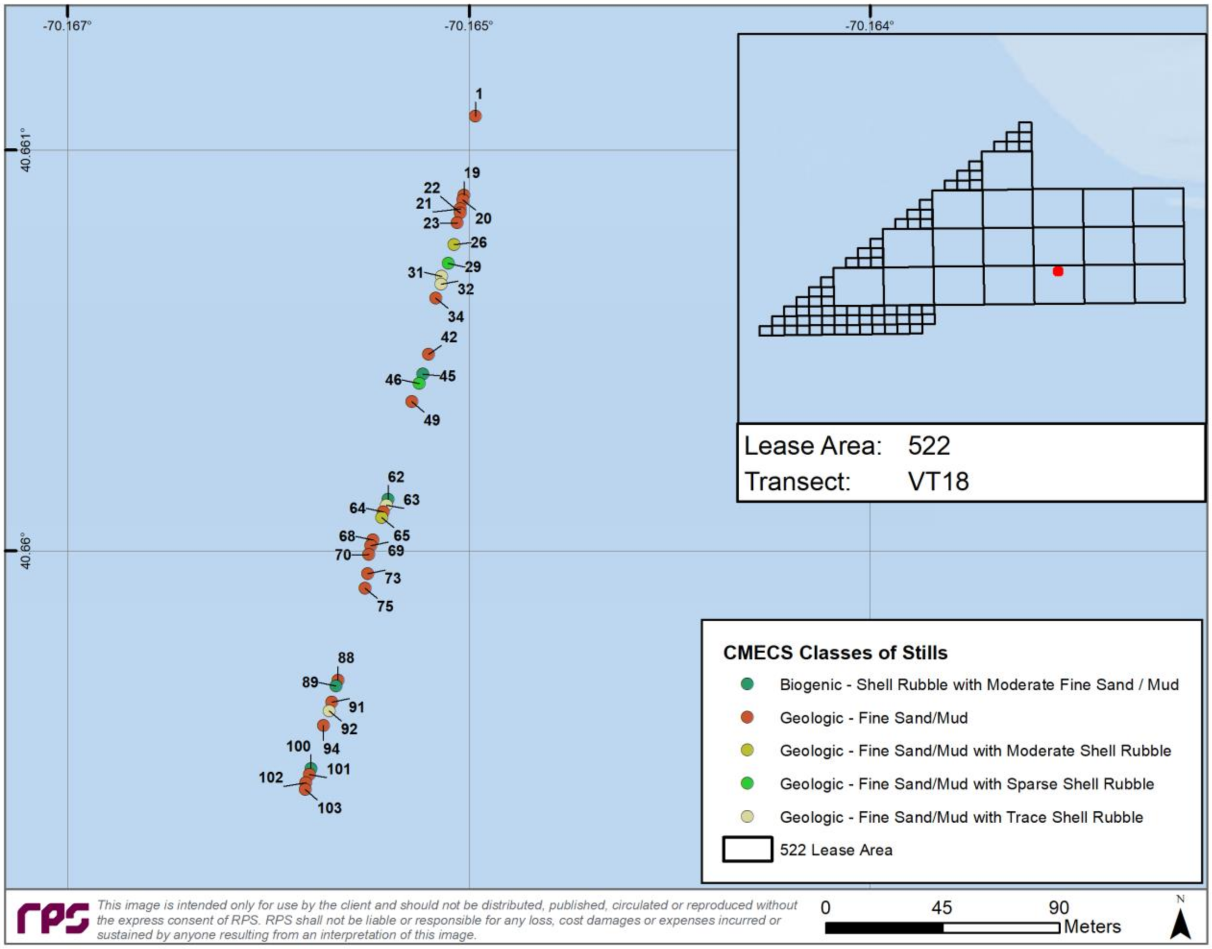

Figure 18 CMECS substrate classification for all viable still images in VT18 (numbers indicate still image ID).

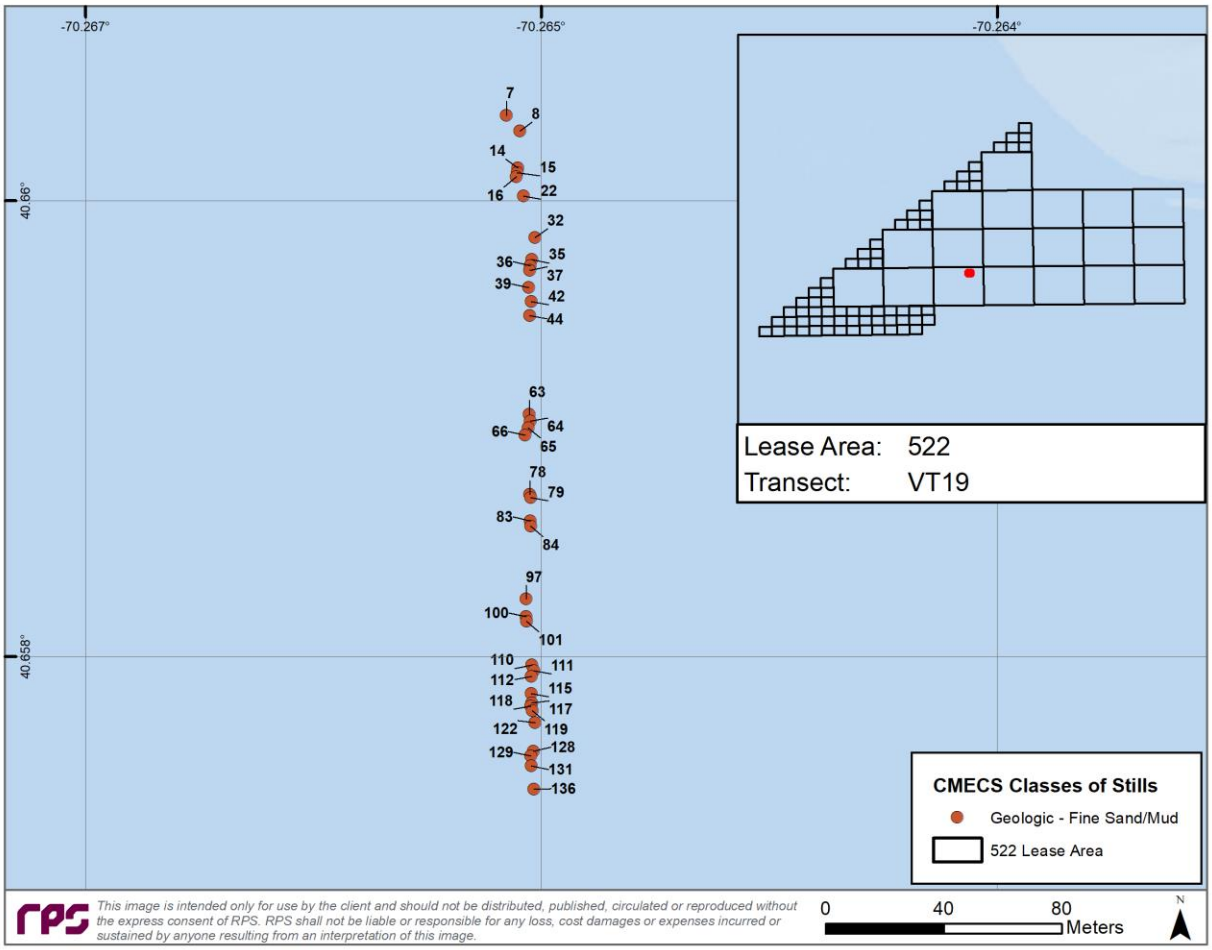

Figure 19 CMECS substrate classification for all viable still images in VT19 (numbers indicate still image ID).

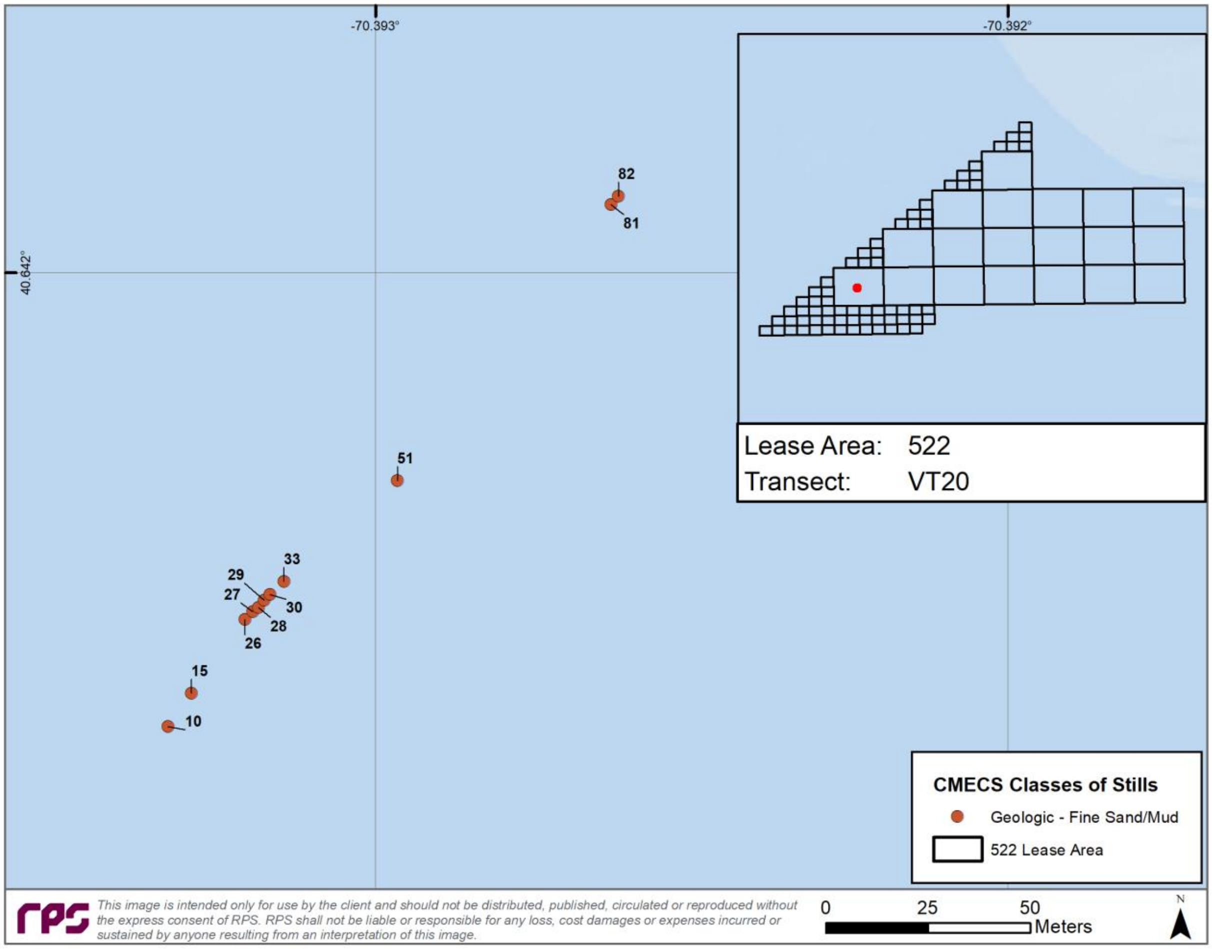

Figure 20 CMECS substrate classification for all viable still images in VT20 (numbers indicate still image ID).

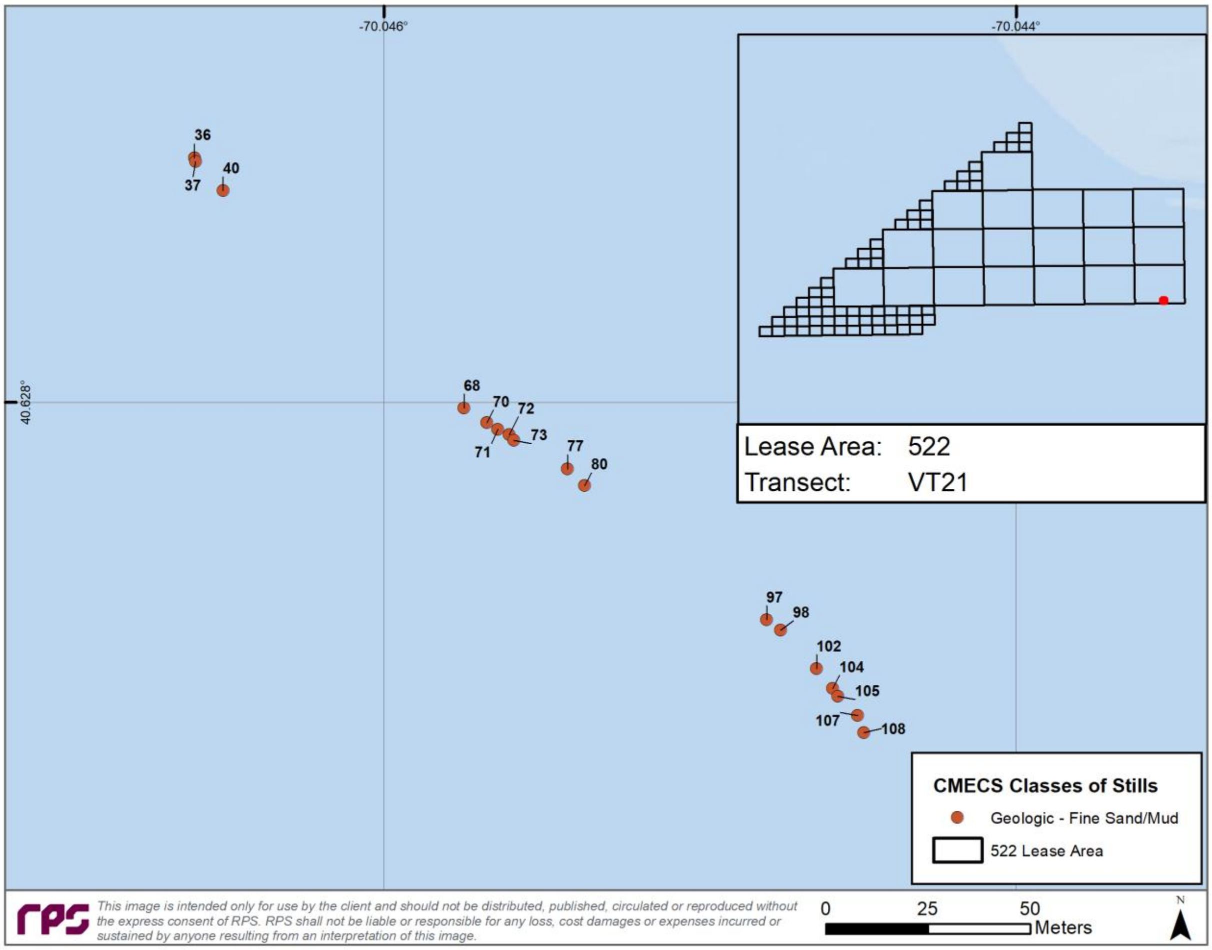

Figure 21 CMECS substrate classification for all viable still images in VT21 (numbers indicate still image ID).

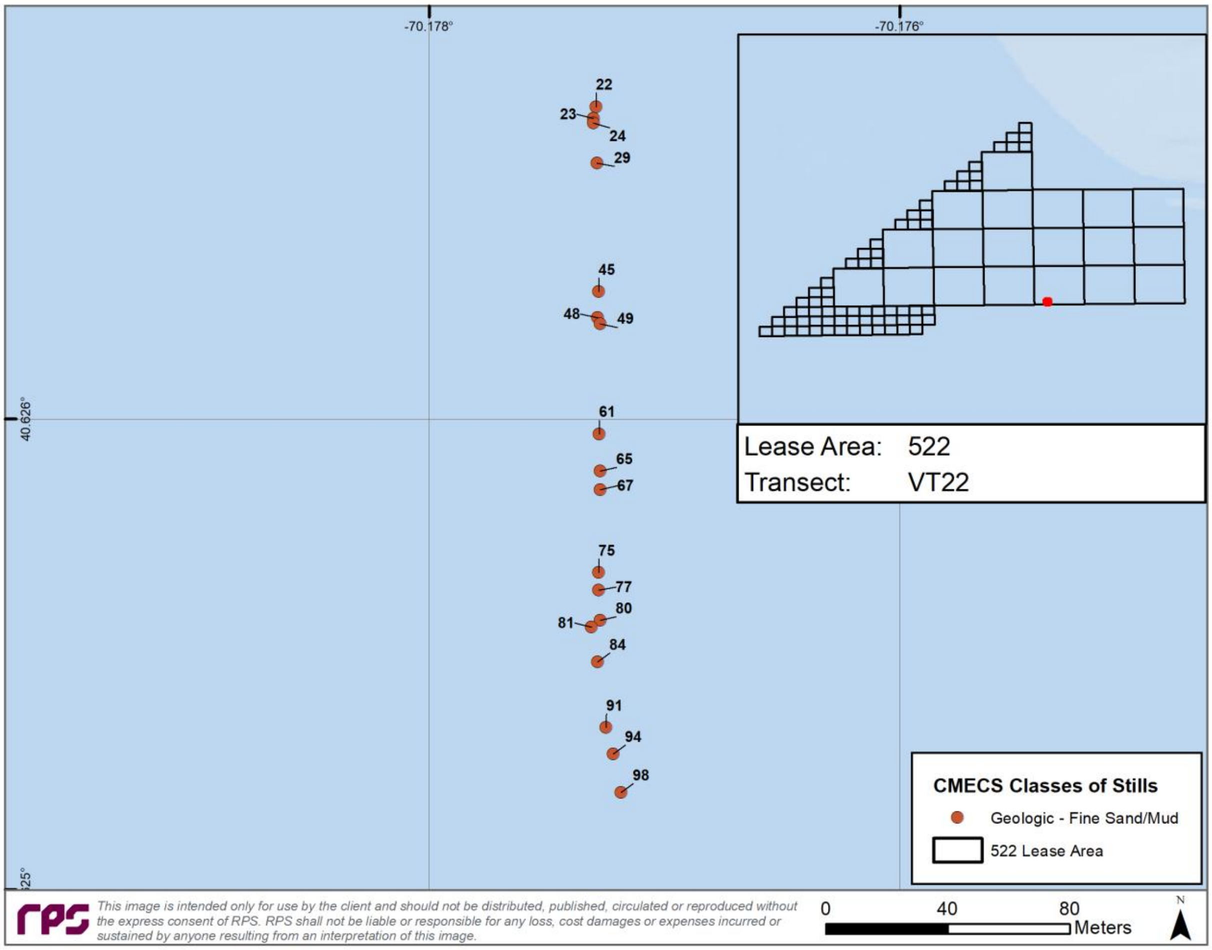

Figure 22 CMECS substrate classification for all viable still images in VT22 (numbers indicate still image ID).

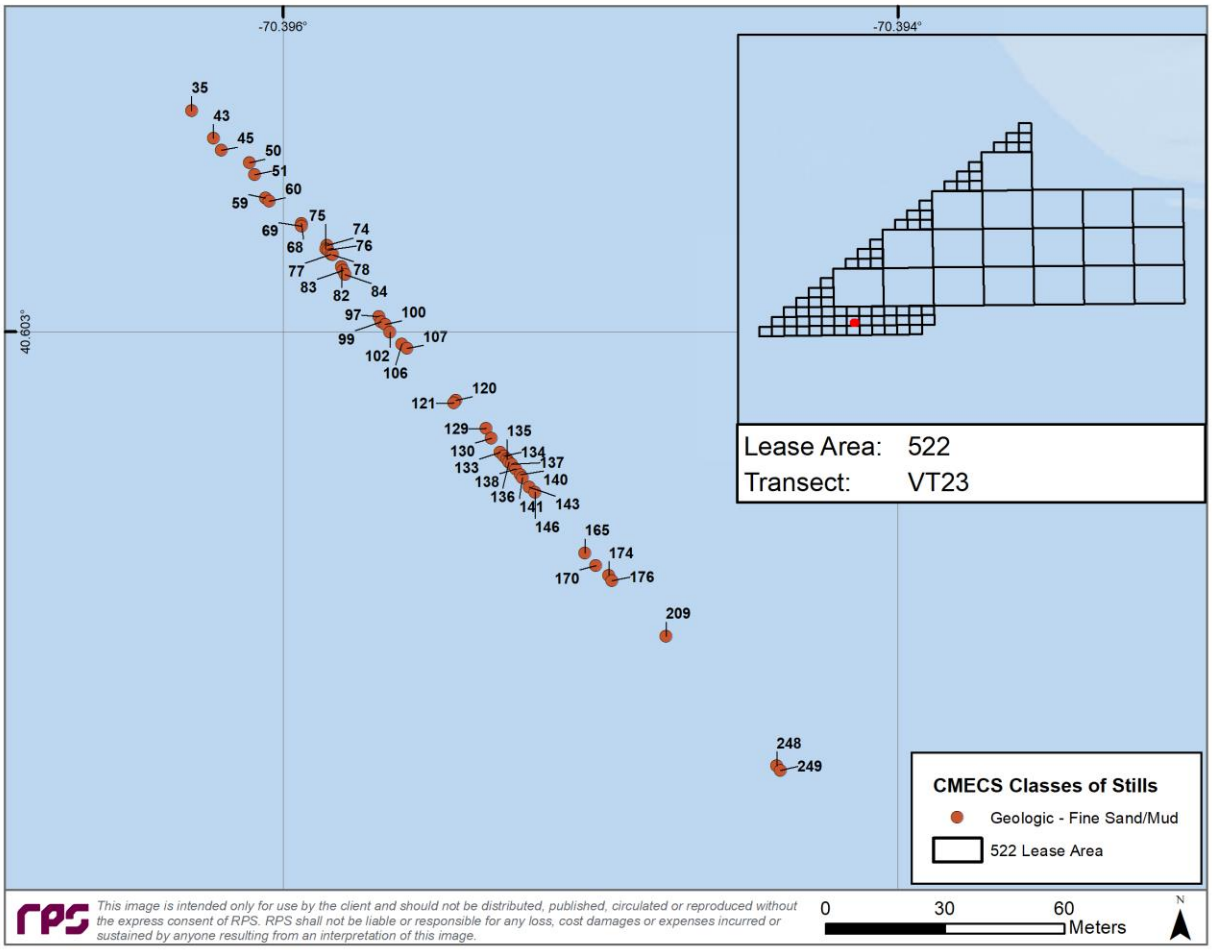

Figure 23 CMECS substrate classification for all viable still images in VT23 (numbers indicate still image ID).

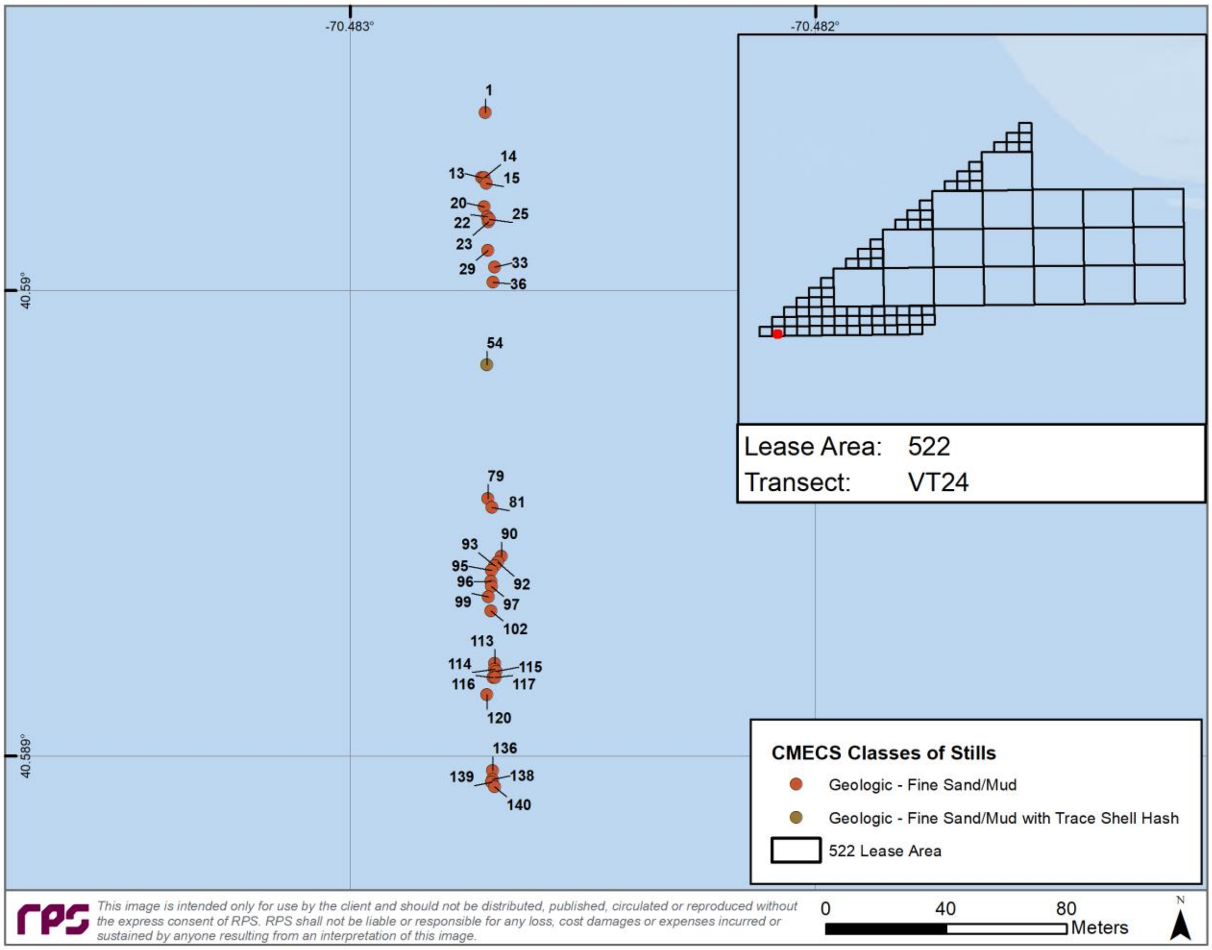

Figure 24 CMECS substrate classification for all viable still images in VT24 (numbers indicate still image ID).

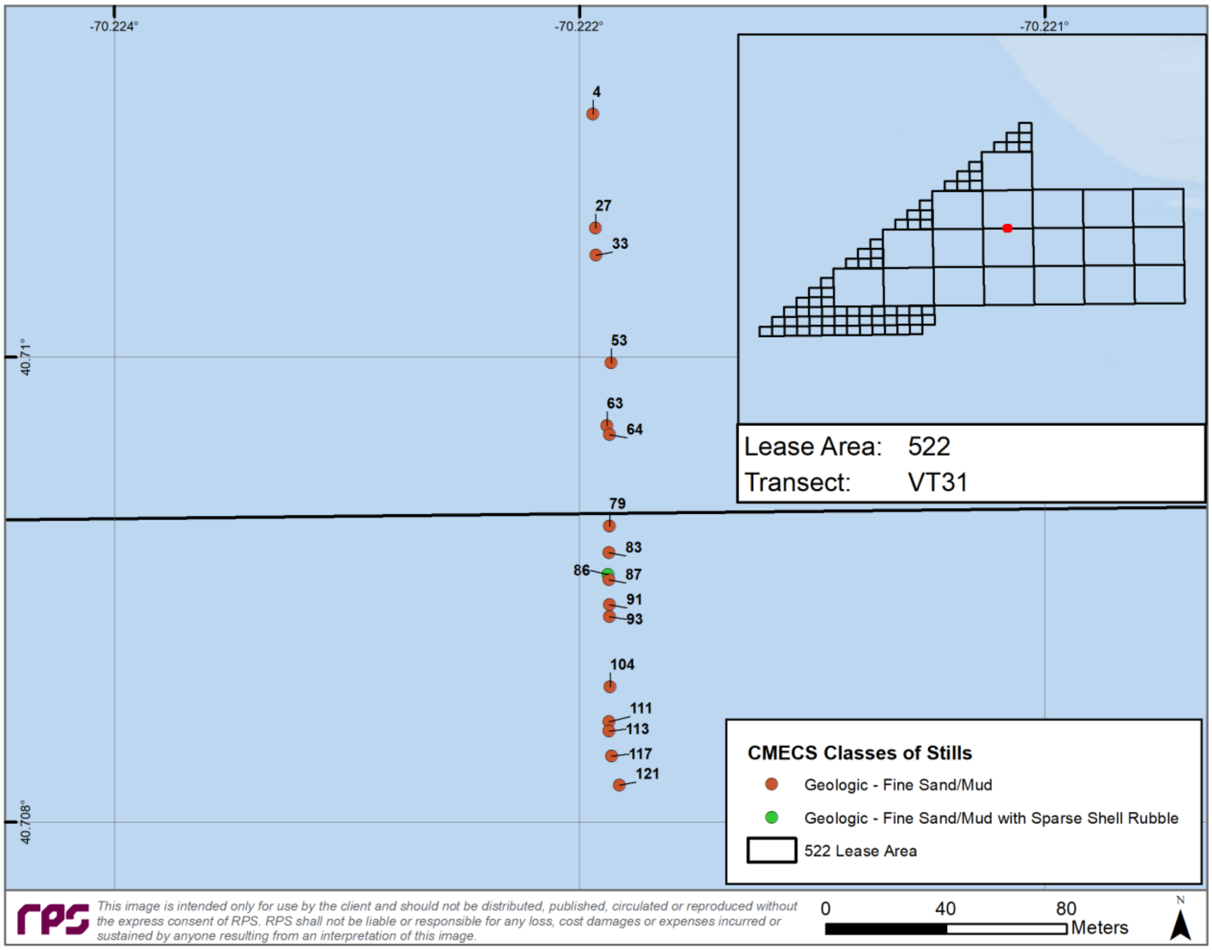

Figure 25 CMECS substrate classification for all viable still images in VT31 (numbers indicate still image ID).