CORE SAMPLING
BASELINE ASSESSMENT OF 2A1, 2B2, 2B3, & 2B4.
IN KING'S BAY

August 13, 2019

Baseline Report Prepared for:

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SCOPE OF WORK:

Kings Bay Restoration in Citrus County and Crystal River, Florida is currently under way through the de-mucking of thick organic flocculent sediments by contractors to Save Crystal River with State Funding (**Figure 1**). Johnson Engineering Inc. was retained as an independent contractor to conduct baseline and post-restoration benthic assessments using a standardized core sampling method to assess the effectiveness of the de-mucking. This report summarizes the baseline conditions of sediments from Kings Bay Restoration Areas Phase 2A and 2B prior to the de-mucking operation scheduled to begin in late August 2019. This Baseline Report includes the results of the pre-restoration (or baseline) benthic core sampling from 20 locations in Canal 2A1 and Areas 2B2, 2B3, and 2B4 (**Figure 2**). For the purpose of this study the sampling was divided into two phases, Phase 2A and 2B. Phase 2A represents the ten sample (2A, 1-10) sites within Canal 2A1. Phase 2B represents the ten sample sites (2B 1-10) within Areas 2B2, 2B3, and 2B4. The Post-restoration Core Sampling will be conducted within 30 days following the de-mucking operation and planting and will include a visual assessment of the canal bottom to compare with pre-restoration conditions.

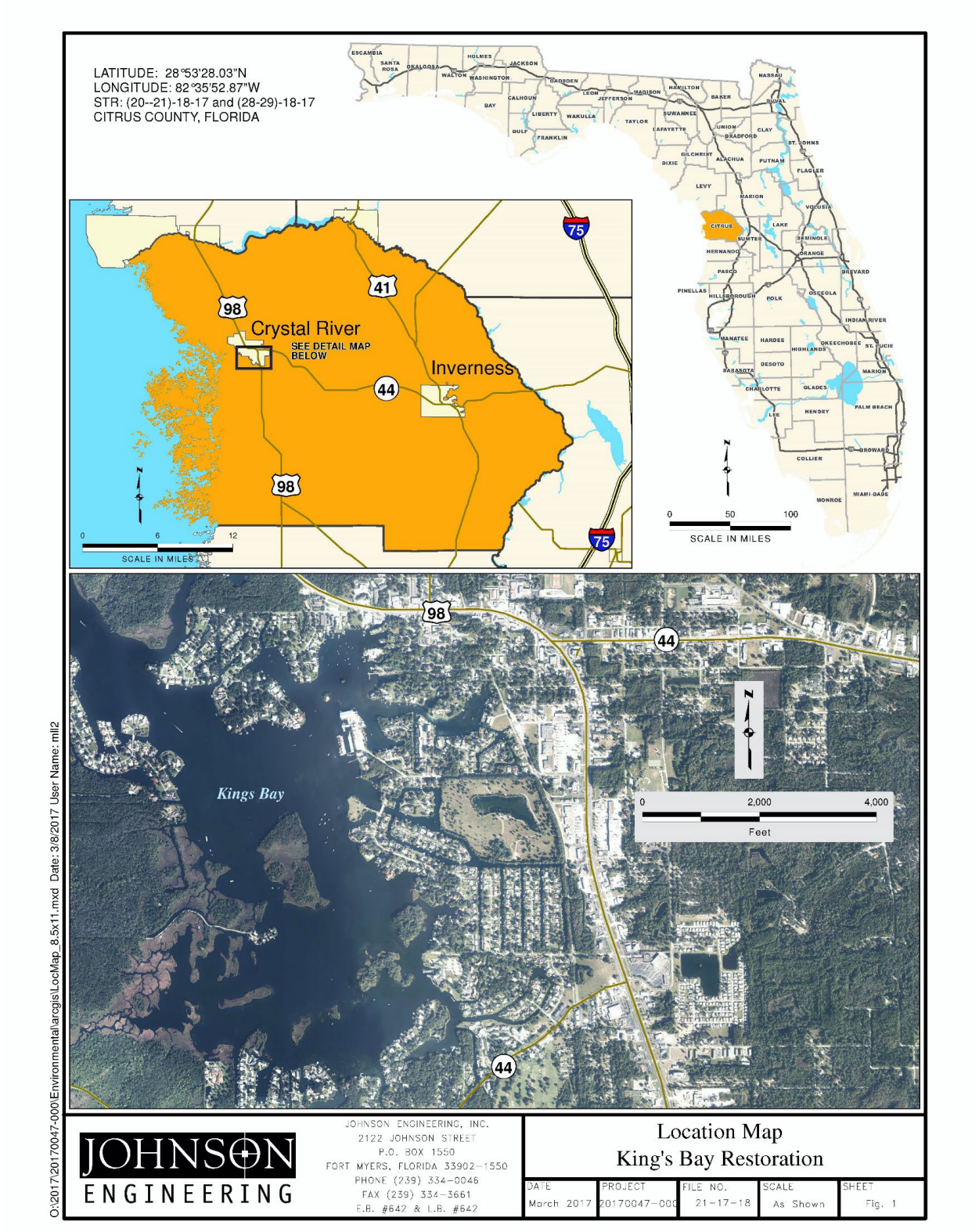


Figure 1. General location map of Kings Bay, Citrus County, Florida.

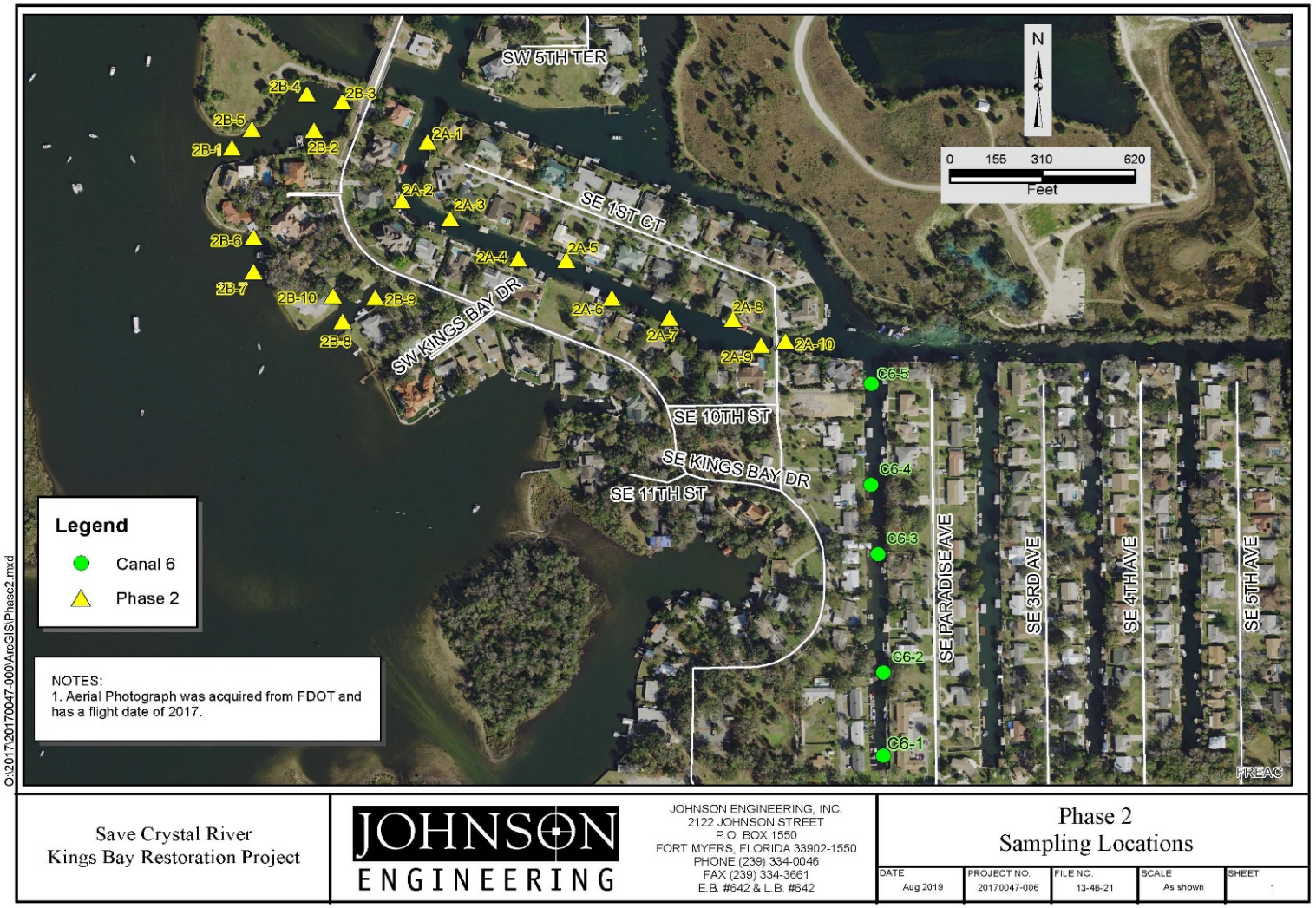


Figure 2. Core sampling locations in Phase 2A and 2B for the baseline assessment.

METHODS:

The purpose of the monitoring is to verify that the *Lyngbya* (*Microseira wollei*), other filamentous algae, and flocculent organic substrate has been sufficiently removed to support *Vallisneria americana* restoration, colonization, and survival. Johnson Engineering Senior Aquatic Ecologist, assisted by an Environmental Technician II collected baseline core samples from the four unrestored areas in a stratified pattern throughout with the sample locations evenly distributed throughout Phases 2A and 2B.

Core samples from the benthos were collected using a customized vacuum core sampler developed by Florida Gulf Coast University for limnological studies and characterizing sediment types. The core sampler consists of a 3.1 meter-long section of 3.8 cm diameter schedule 40 PVC pipe, with a one-way ball valve, rubber coupler, and 7.6 diameter x 0.75 meter clear Plexiglas™ cylinder at the base for collecting and viewing benthic samples (**Figure 3**). Additional extensions may be added to access deeper canal sites as needed.

Figure 3. Photograph of the core sampling device used.

Sediment cores were removed from the PVC extension and photographed against a white board with location and sample number for archival and later comparison with post-restoration sediment profiles. Flocculent (floc) unconsolidated organic materials were measured on the surface of sediments. Consolidated sediments were also measured in depth and categorized as floc (including live and dead *Lyngbya*), mud, sandy mud, sandy clay, shell, and peat. The focus is on the upper layer of flocculent material along with *Lyngbya* and unconsolidated organics which is unsuitable habitat for survival and growth of *Vallisneria americana*. Baseline substrate samples were GPS located and are presented on aerial map in **Figure 2**.

RESULTS:

The following are the results of the pre-restoration (baseline) core samples collected during Phase 2A in August 2019. Canal 2A1 sampling was initiated at the northern end and continued south and to the east. Water depths were relatively inconsistent, ranging from 2.0 to 5.0 meters with an average of 2.98 meters (**Table 1**). Floc depths ranged from 1.3 to 5.1 cm deep with an average of 3.0 cm. At four of the sampling sites in Canal 2A1, there were deep deposits of mud ranging from approximately 7.6 to 10.2 cm in depth. At three other sampling sites in Canal 2A1 the floc transitioned into a layer of sandy mud that ranged from approximately 14.0 to 22.9 cm. Sample site 2A-3 was the only site in Phase 2A that had a layer of sandy clay, which totaled 16.5 cm. Core sample depths ranged from 15.3 to 29.2 cm. At sample site 2A-10 the lower section of the core sample contained a 14.0 cm layer of peat. Peat forms when plant material does not fully decay because of acidic or anaerobic conditions like in a bog or swamp. These peat deposits may be remnants of historic habitat conditions prior to human development and excavation of canals. Photographs of core samples from Canal 2A1 are included in **Appendix A**.

Table 1. Baseline Results of Core Samples of Phase 2A collected on August 5, 2019.

Phase/Station: 2A		Sampler Initials: DWC				Date: 8/5/2019				
King's Bay Core Sample Locations				Core Sample Constituents in cm (top to bottom).						
Sample #	Latitude	Longitude	Depth (m)	Floc	Mud	Sand/Mud	Sand/Clay	Shell	Peat	Overall (cm)
2A-1	28.88978347	-82.59511388	5.00	3.8	10.2	15.2				29.20
2A-2	28.88922987	-82.59538075	3.00	2.5	10.2	12.7				25.40
2A-3	28.88905976	-82.59486829	2.50	2.5	0.0		16.5			19.00
2A-4	28.88868602	-82.59415745	3.00	1.3	0.0	19.1				20.00
2A-5	28.88867233	-82.59365196	3.00	3.8	7.6	15.2				26.60
2A-6	28.8831861	-82.59317078	3.00	1.3	0.0	22.9				24.20
2A-7	28.8881292	-82.59257055	3.00	3.8	10.2	12.7				26.70
2A-8	28.88812334	-82.59190331	2.80	4.5	7.0	10.2				21.70
2A-9	28.88787717	-82.59160686	2.50	5.1	0.0				14.0	19.10
2A-10	28.88791872	-82.59135222	2.00	1.3	0.0	14.0				15.30

Ten core sampling sites where used for Phase 2B. Sampling sites 2B-1 through 2B-5 (located in Area 2B2) start at the southern border and work their way around. Sampling sites 2B-6 and 2B-7 were located in Area 2B3 with 2B-6 representing the northern portion and 2B-7 the southern portion. Sampling sites 2B-8 through 2B-10 (located in Area 2B-4), start at the southern border and work their way around as well. Phase 2B had water depths ranging from 1.75 to 3.50 meters with an average depth of 2.48 meters. The floc layer in Phase 2B ranged in depth from 1.3 cm within Area 2B3 up to 14.0 cm in Area 2B2. Average floc depths were 6.2 cm but were inconsistent in each area with exception to Area 2B-4 which ranged from 5.1 to 7.6 cm.

Table 2. Baseline Results of Core Samples of Phase 2B collected on August 6, 2019.

Phase/Station: 2B			Sampler Initials: DWC			Date: 8/6/2019				
King's Bay Core Sample Locations				Core Sample Constituents in cm (top to bottom).						
Sample #	Latitude	Longitude	Depth (m)	Floc	Mud	Sand/Mud	Sand/Clay	Shell		Overall (cm)
2B-1a	28.88972263	-82.59716034	1.75	2.5	7.6			3.8		13.9
2B-1b	29.88972263	-81.59716034	1.75	5.1	11.4	21.6				38.1
2B-2	28.88988836	-82.5963024	2.75	7.6	12.7	22.9				43.2
2B-3	28.89016163	-82.59600805	2.50	6.4	12.7	25.4				44.5
2B-4	28.89023451	-82.59637756	3.50	14.0	5.1	7.6				26.7
2B-5	28.88989898	-82.59695467	2.00	6.4	7.6		11.4			25.4
2B-6	28.88887366	-82.59693243	2.00	5.1	10.2		25.4			40.7
2B-7	28.88855178	-82.59692838	2.50	1.3		6.4	15.2			22.9
2B-8	28.88808609	-82.59599445	2.50	7.6	11.4		19.1			38.1
2B-9	28.88831211	-82.59565136	3.00	7.6	14.0		19.1			40.7
2B-10	28.88832561	-8159609556	3.00	5.1	8.9		21.6			35.6

DISCUSSION:

Although Canal 2A-1 water depths were inconsistent, the floc depth and deep deposits of mud, sandy mud, or sandy clay were relatively consistent throughout. The suitability of Canal 2A-1 for *Vallisneria americana* establishment will depend on restoring suitable sediment conditions. Restoration areas of Phase 2B were much more variable with the water and floc depths. Additionally, the average floc depth for Phase 2B was 3.2 cm deeper than that of Phase 2A in Canal 2A-1. This is likely due to the proximity of Phase 2A to already previously restored areas (Phase 1B) and that the Phase 2A canal is open which allows for a flushing affect from tidal exchange and from freshwater discharge from Three Sisters Springs that hinder the development of the floc layer. According to conversations with Sea and Shoreline LLC (contractor for restoration activities), the restoration will begin in Area 2B2 then proceed to Canal 6, Canal 2A, followed by Areas 2B3 and 2B4. Post-restoration core sampling will be conducted when de-mucking is complete and a Final Report will be prepared comparing pre and post-restoration core sampling results.

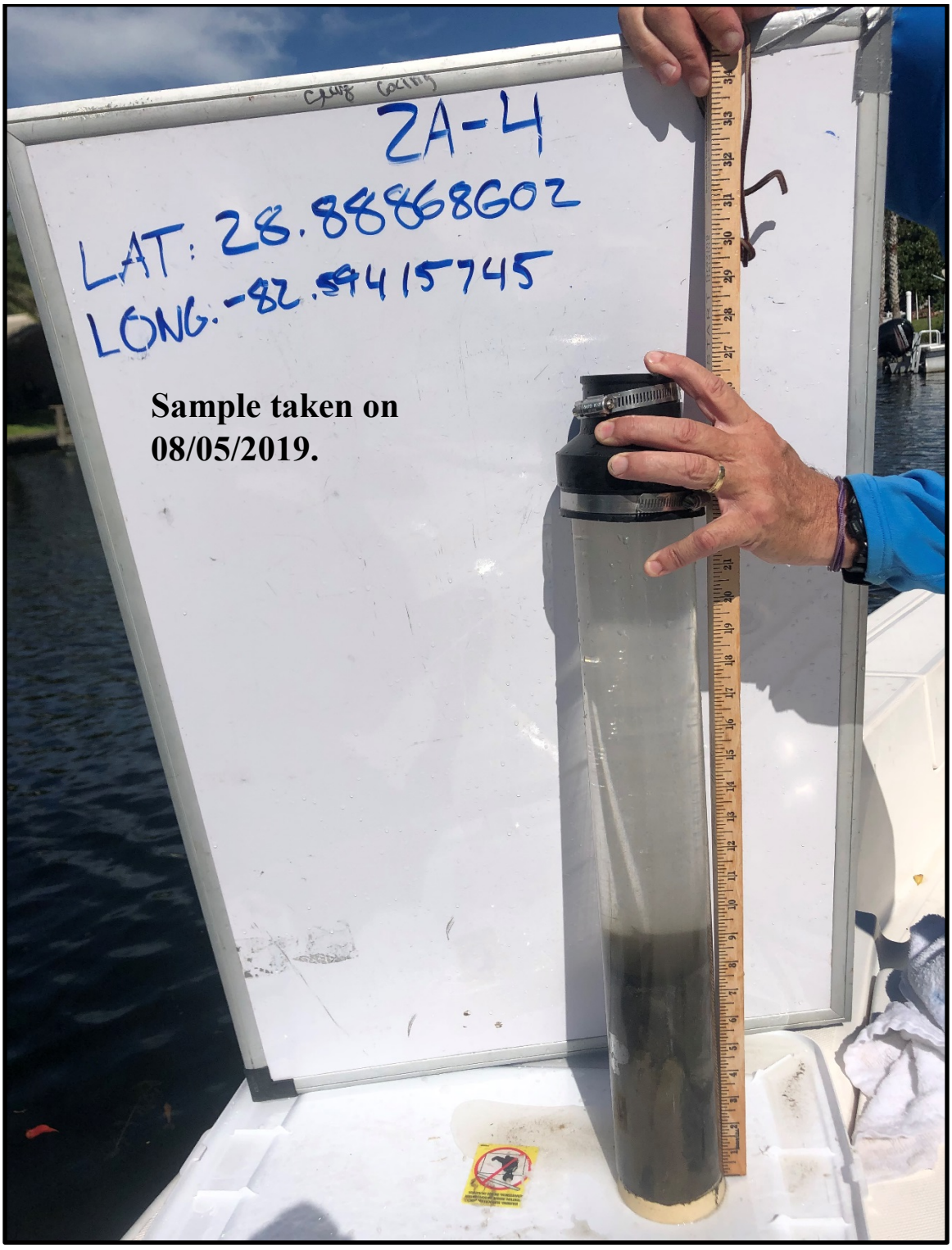
APPENDIX A

Photo Documentation

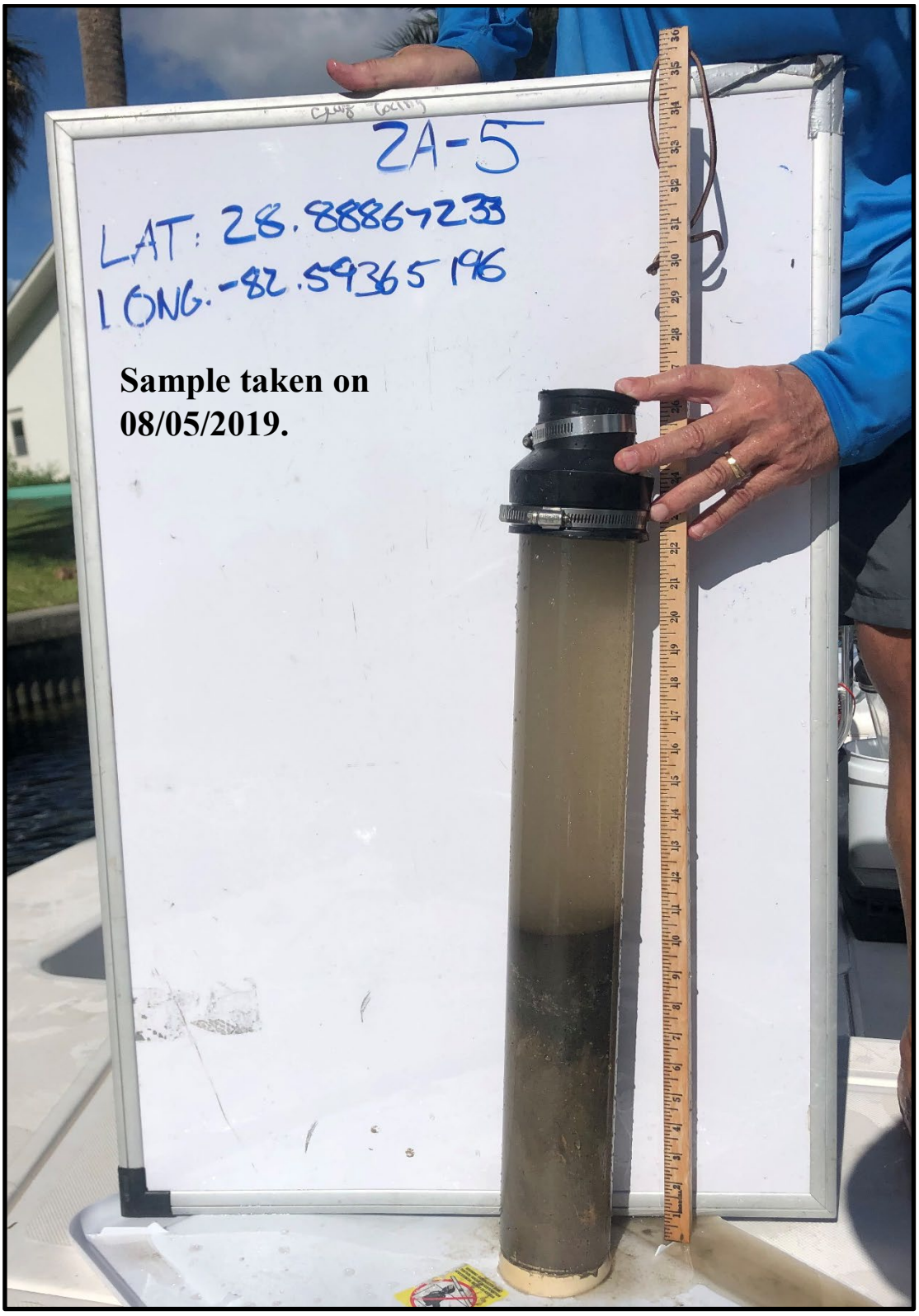
Phase 2A (Canal 2A1) Site 2A-1 - 3.8 cm of floc over 10.2 cm of mud over 15.2 cm of sandy mud.

Phase 2A (Canal 2A1) Site 2A-2 – 2.5 cm of floc over 10.2 cm of mud over 12.7 cm of sandy mud.

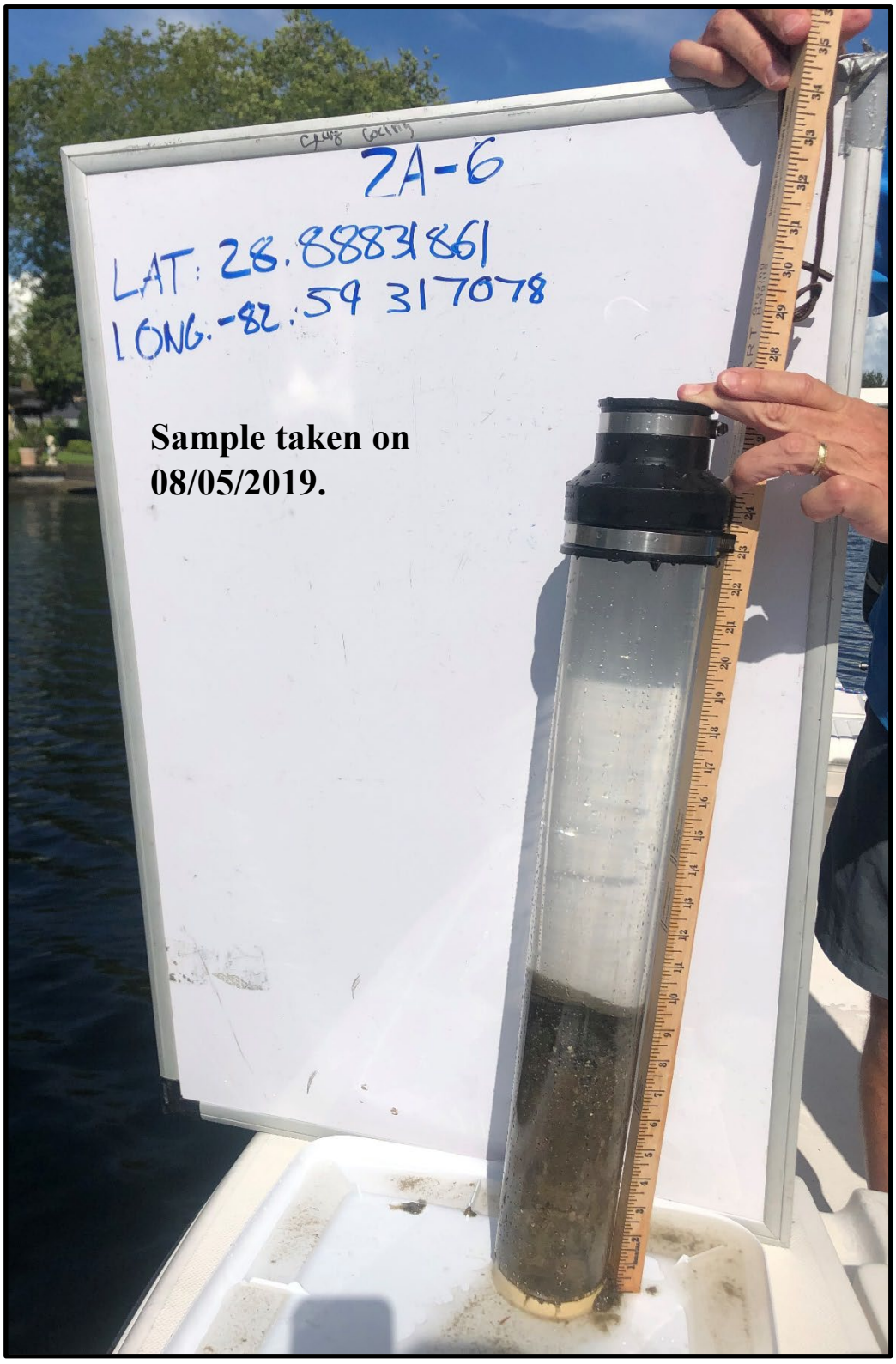
Phase 2A (Canal 2A1) Site 2A-3 – 2.5 cm of floc over 16.5 cm of sandy clay.



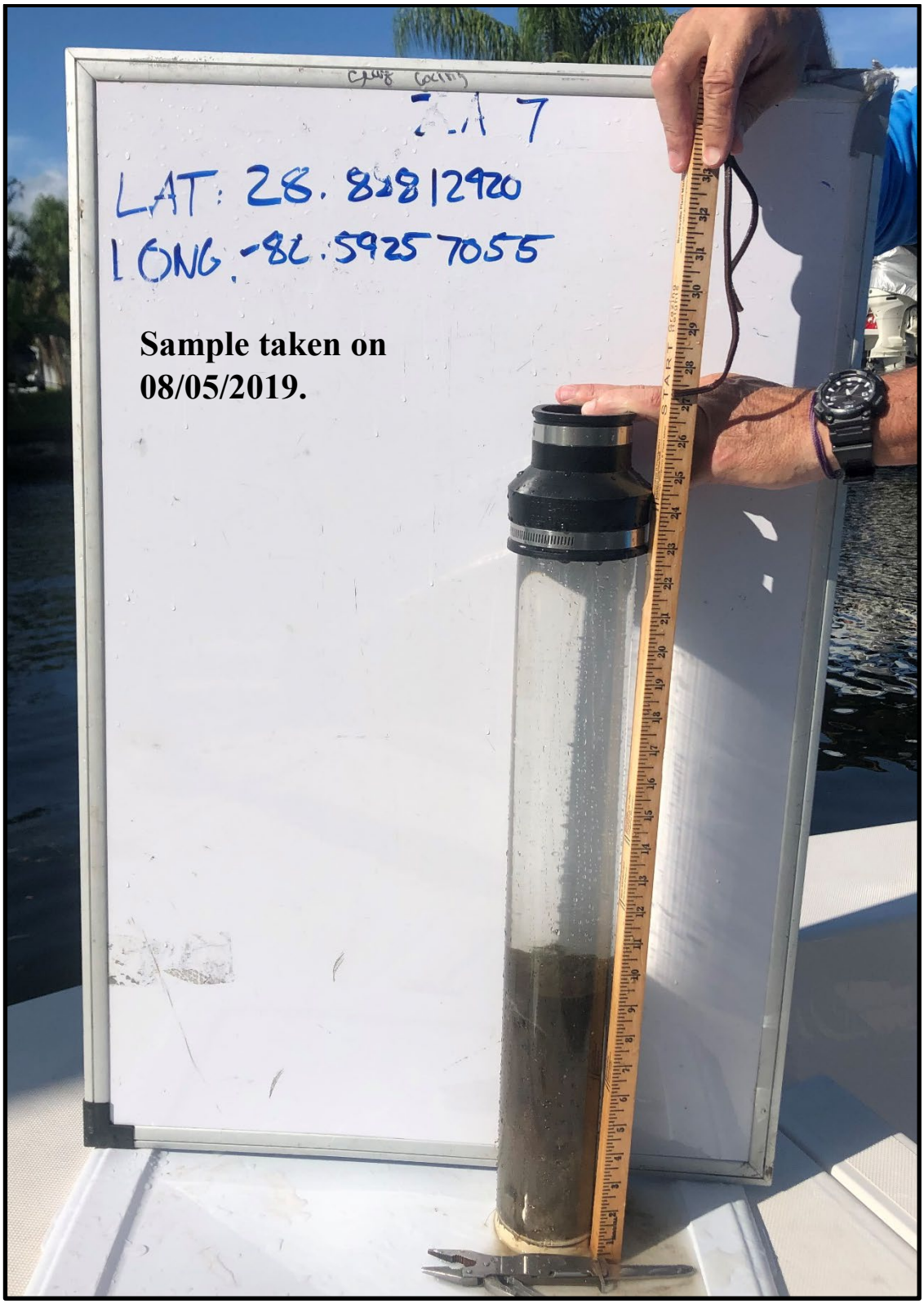
Phase 2A (Canal 2A1) Site 2A-4 – 1.3 cm of floc over 19.1 cm of sandy mud.



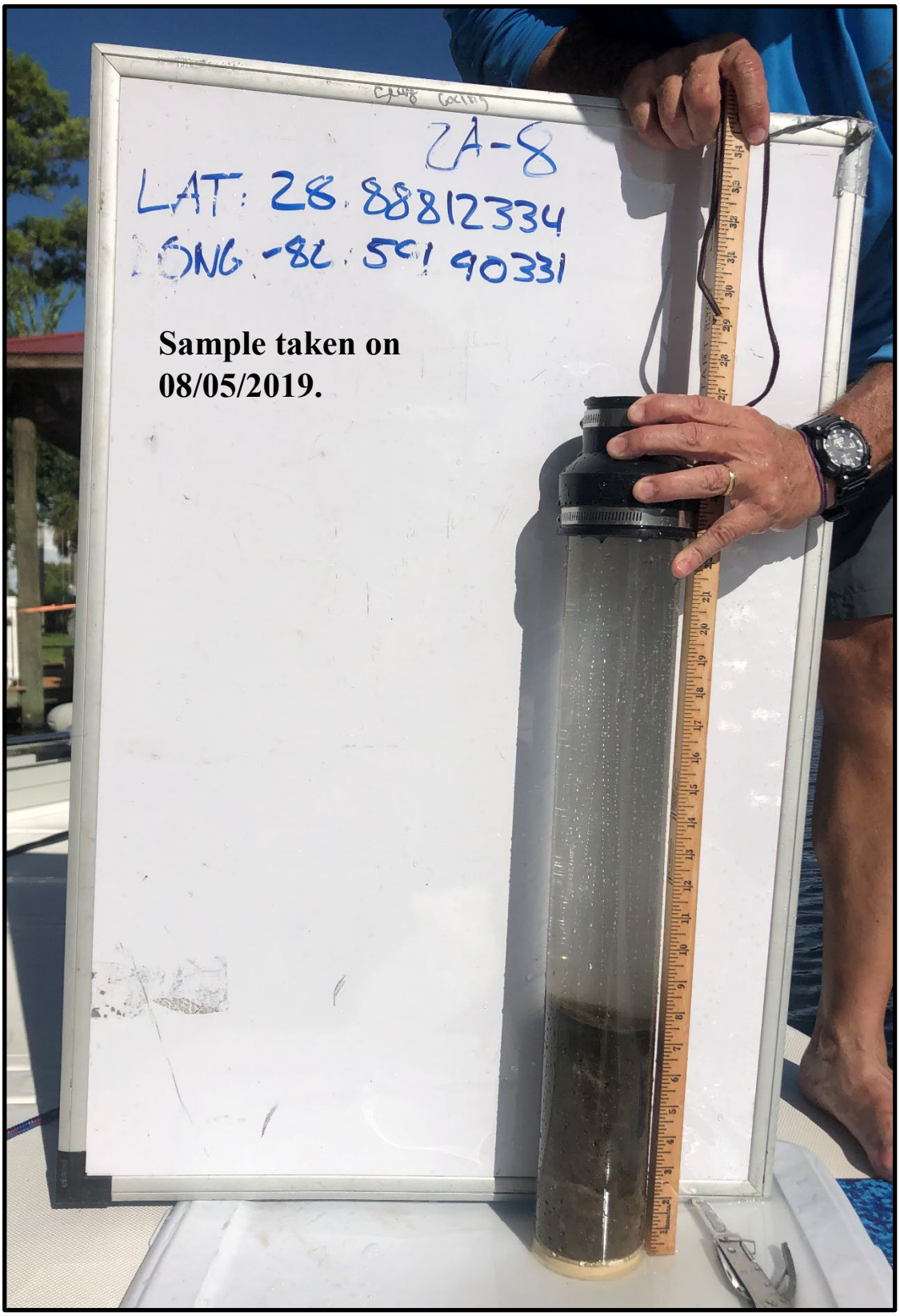
Phase 2A (Canal 2A1) Site 2A-5 – 3.8 cm of floc over 7.6 cm of mud over 15.2 cm of sandy mud.



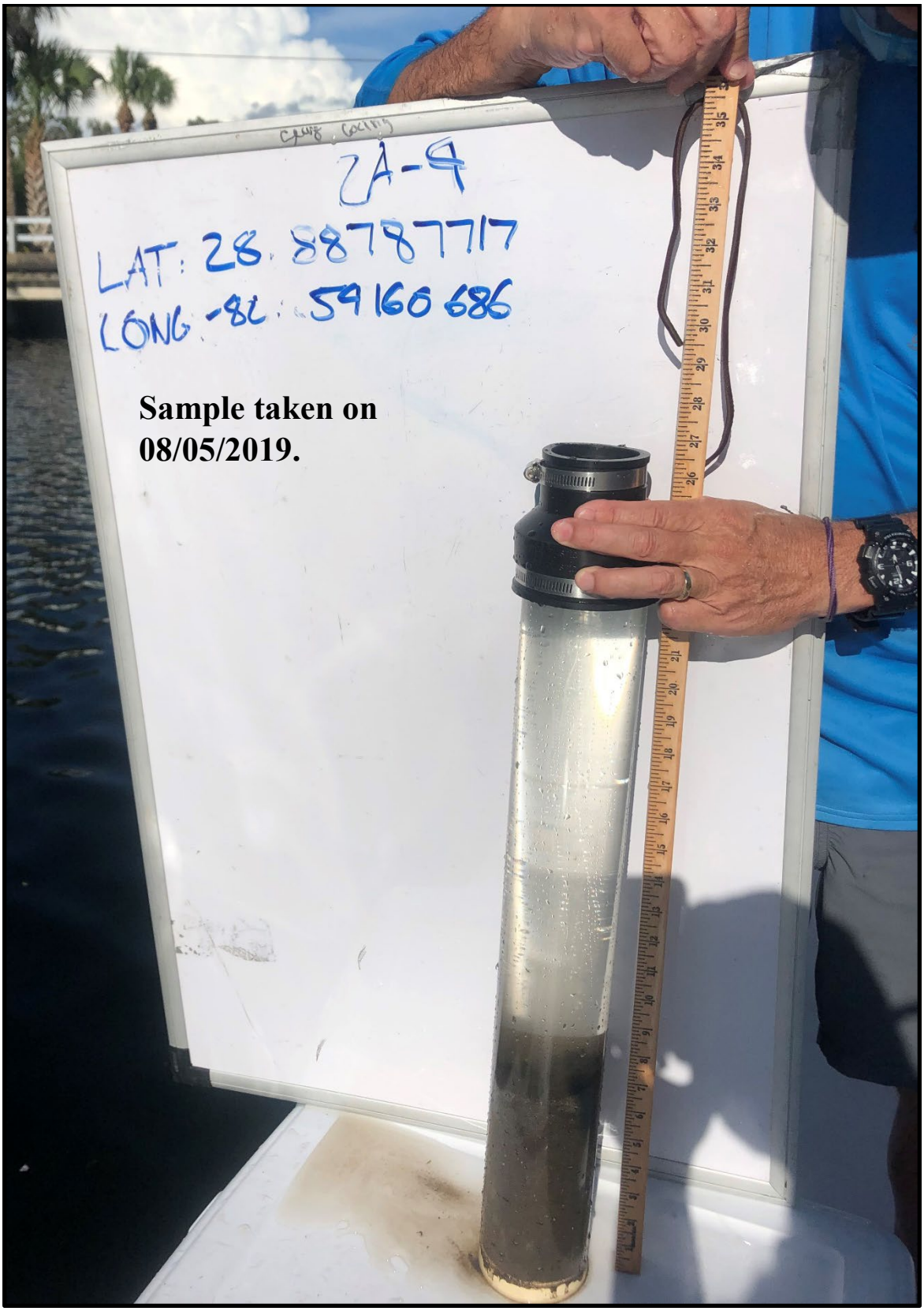
Phase 2A (Canal 2A1) Site 2A-6 – 1.3 cm of floc over 22.9 cm of sandy mud.



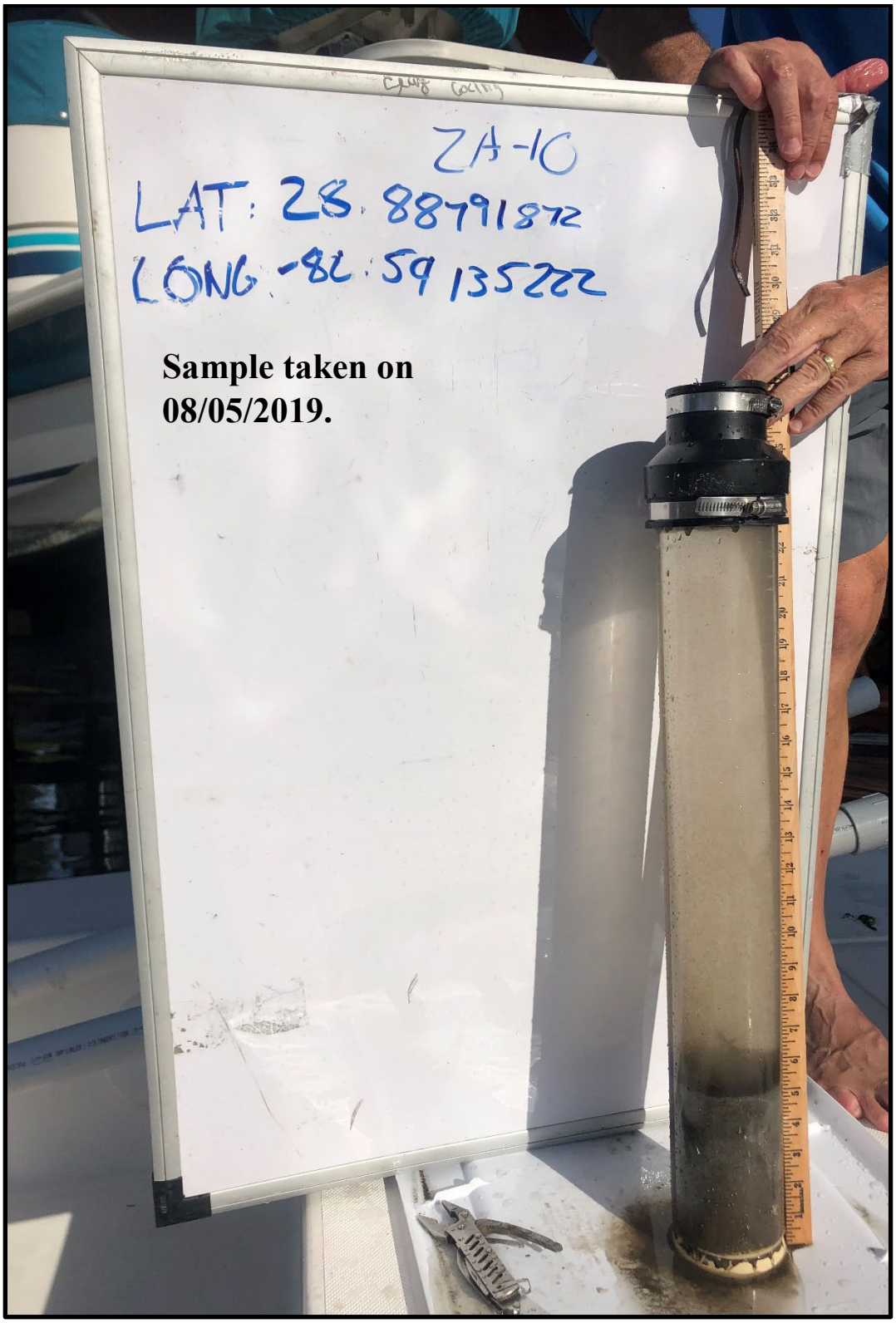
Phase 2A (Canal 2A1) Site 2A-7 – 3.8 cm of floc over 10.2 cm of mud over 12.7 cm of sandy mud.



Phase 2A (Canal 2A1) Site 2A-8 – 4.5 cm of floc over 7.0 cm of mud over 10.2 cm of sandy mud.

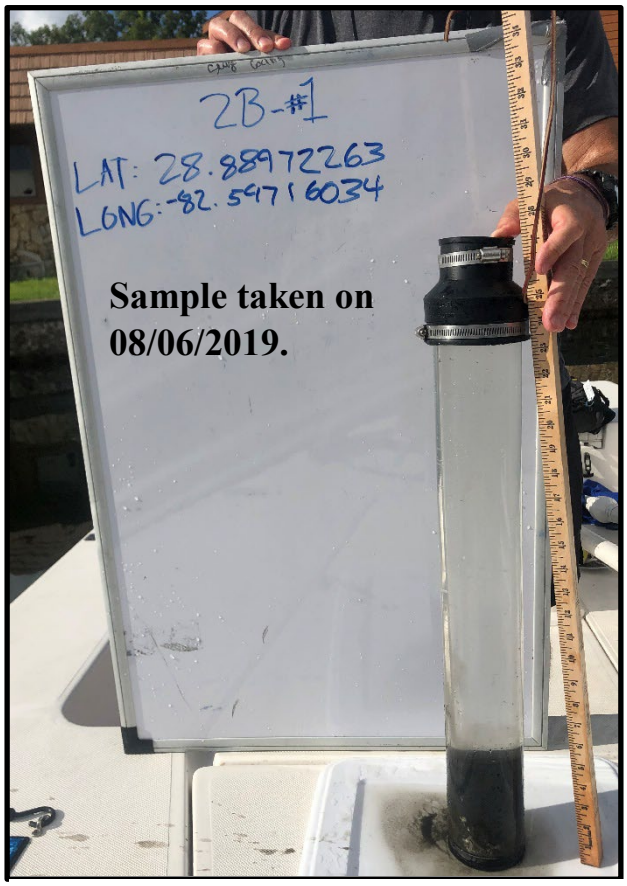


Phase 2A (Canal 2A1) Site 2A-9 – 5.1 cm of floc over 14 cm of peat.

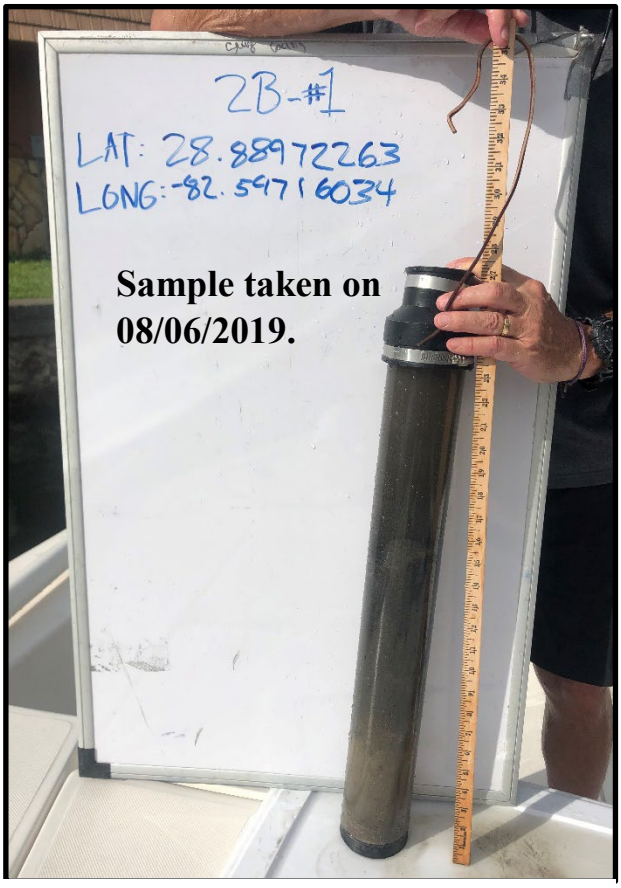


Phase 2A (Canal 2A1) Site 2A-10 – 1.3 cm of floc over 14.0 cm of sandy mud.

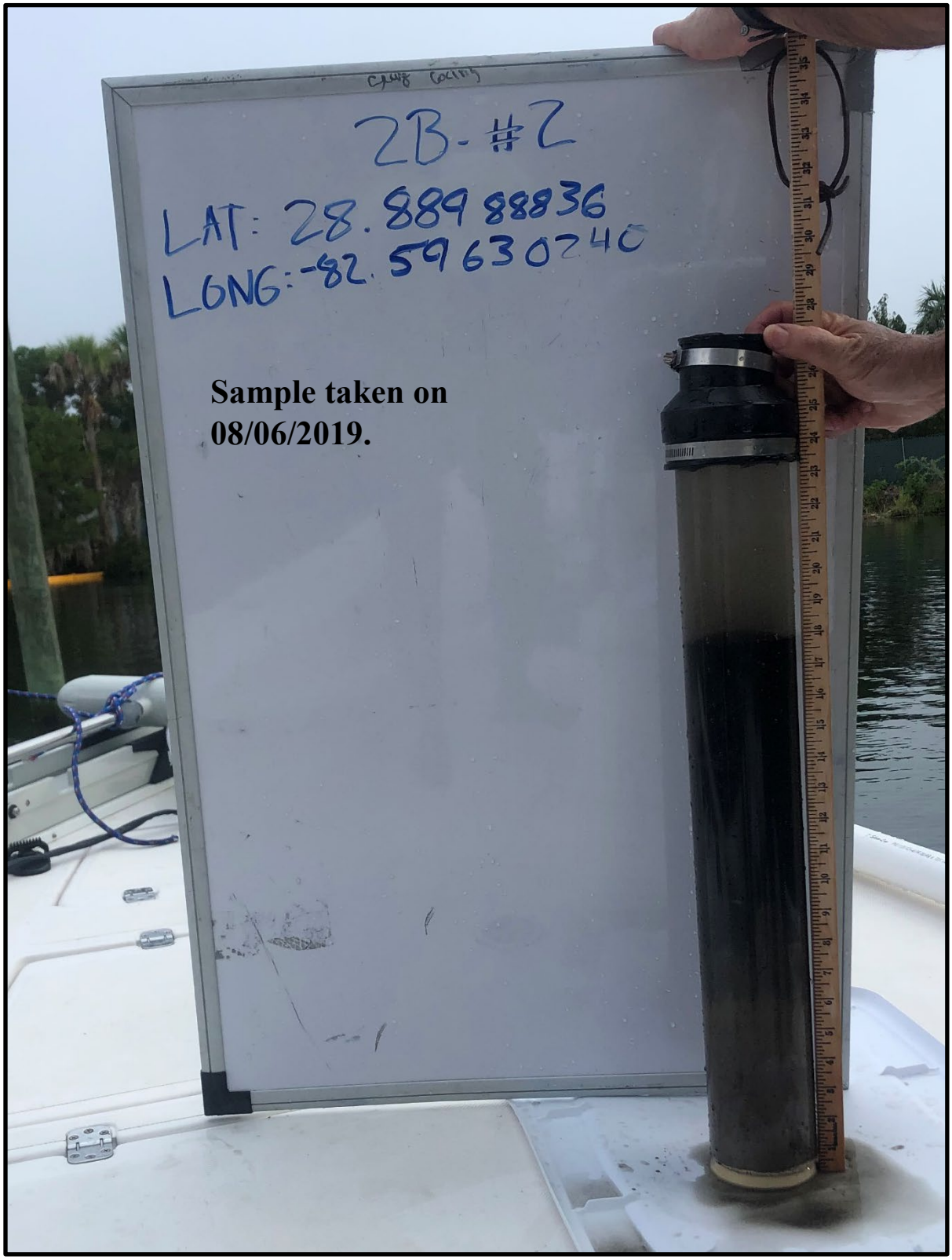
Phase 2B (Canal 2B2) Site 2B-1a – 2.5 cm of floc over 7.6 cm of mud over 3.8 cm of shell.



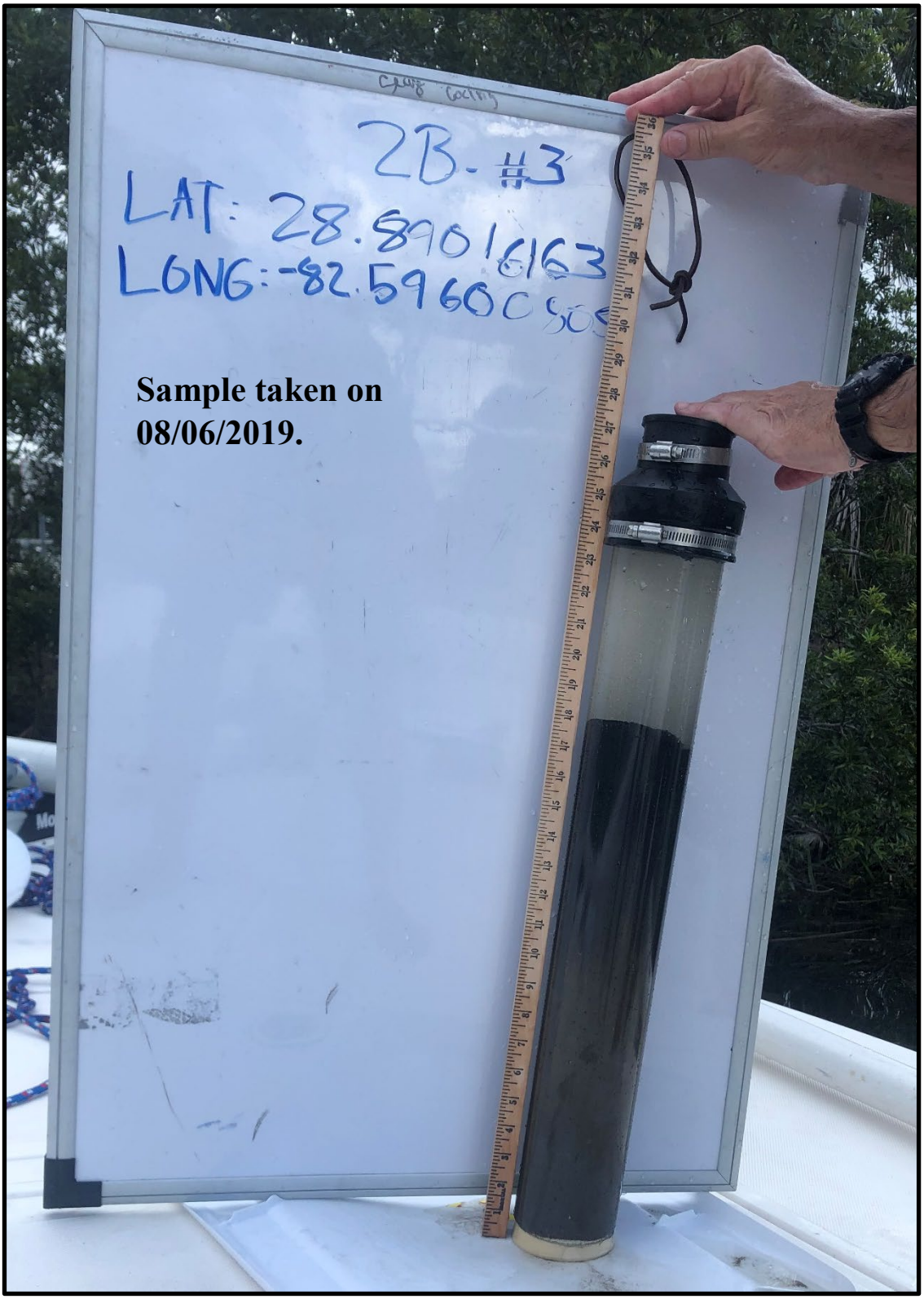
Phase 2B (Canal 2B2) Site 2B-1b – 5.1 cm of floc over 11.4 cm of mud over 21.6 cm of sandy mud.



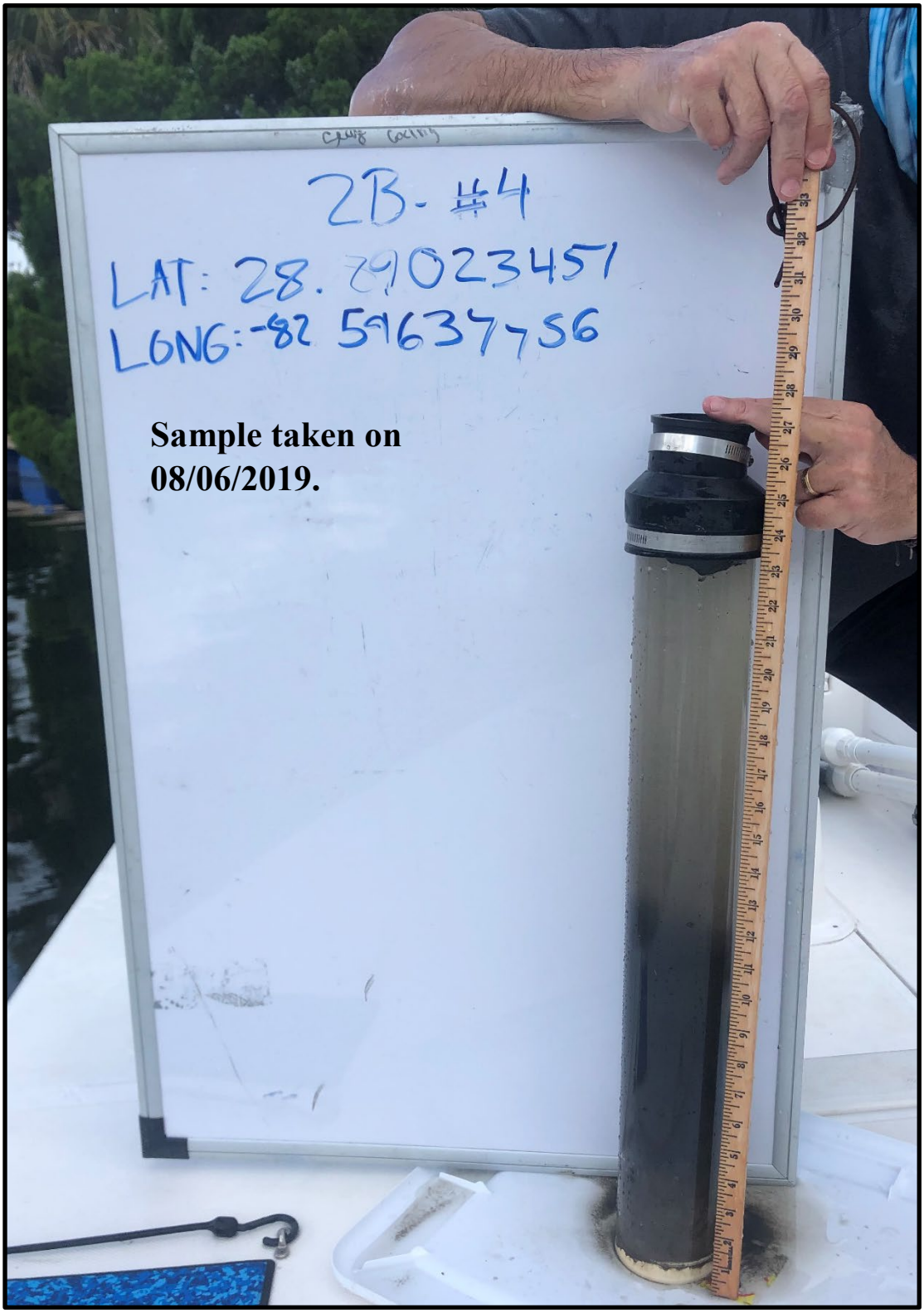
Two samples taken at same location showcasing the inconsistency recorded throughout Canal 2B-2



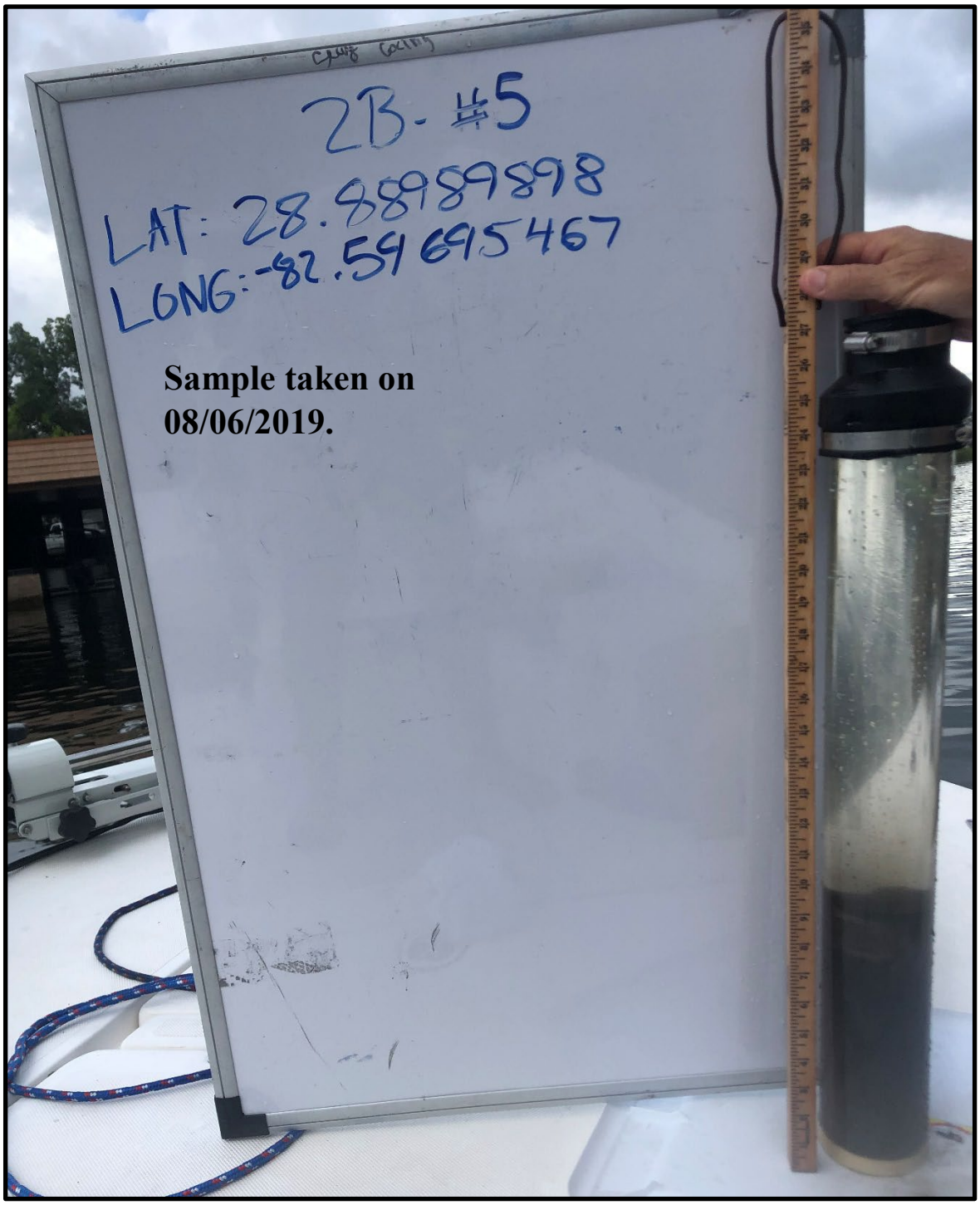
Phase 2B (Canal 2B2) Site 2B-2 – 7.6 cm of floc over 12.7 cm of mud over 22.9 cm of sandy mud.



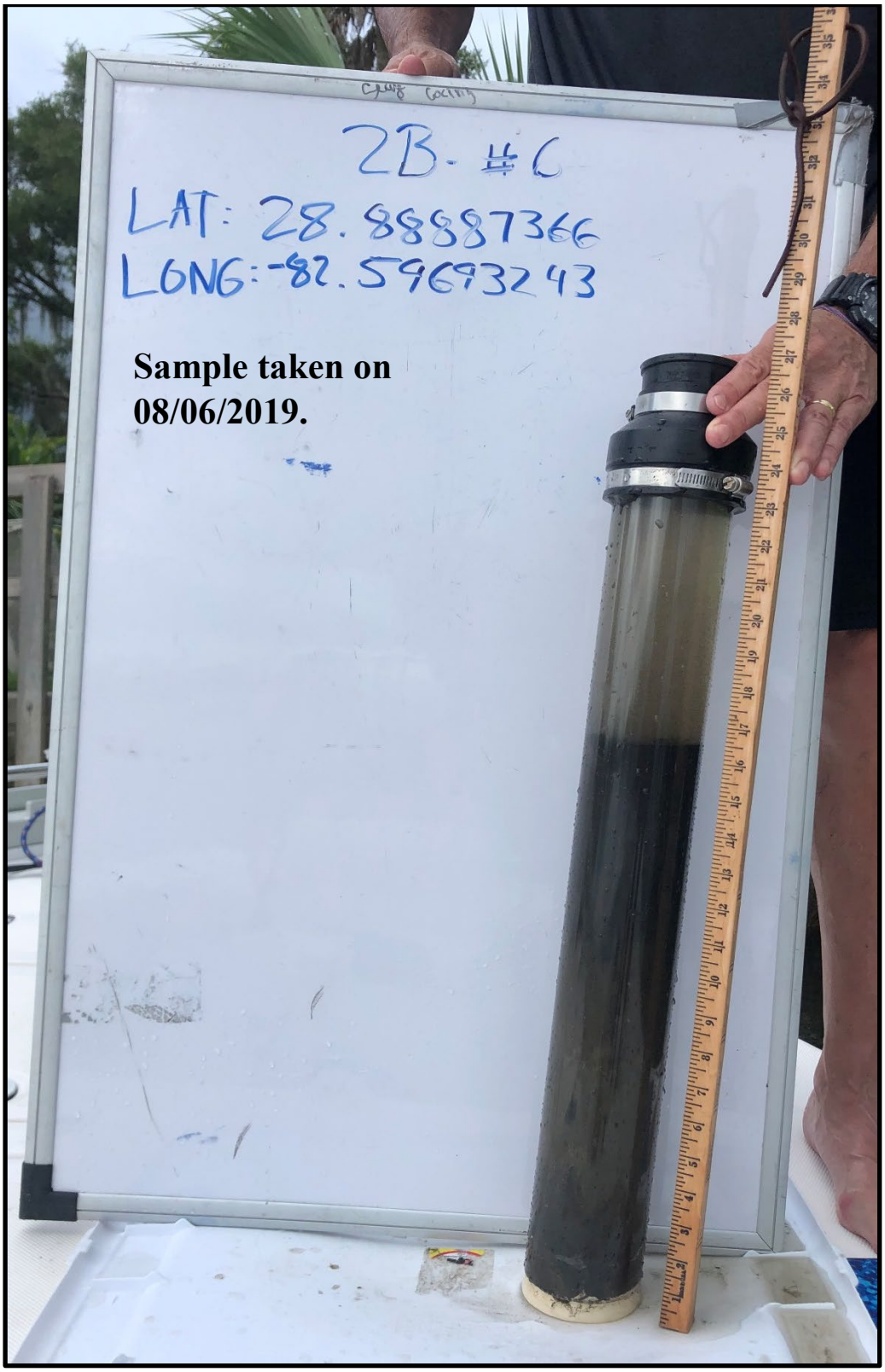
Phase 2B (Canal 2B2) Site 2B-3 – 6.4 cm of floc over 12.7 cm of mud over 25.4 cm of sandy mud.



Phase 2B (Canal 2B2) Site 2B-4 –14.0 cm of floc over 5.1 cm of mud over 7.6 cm of sandy mud.



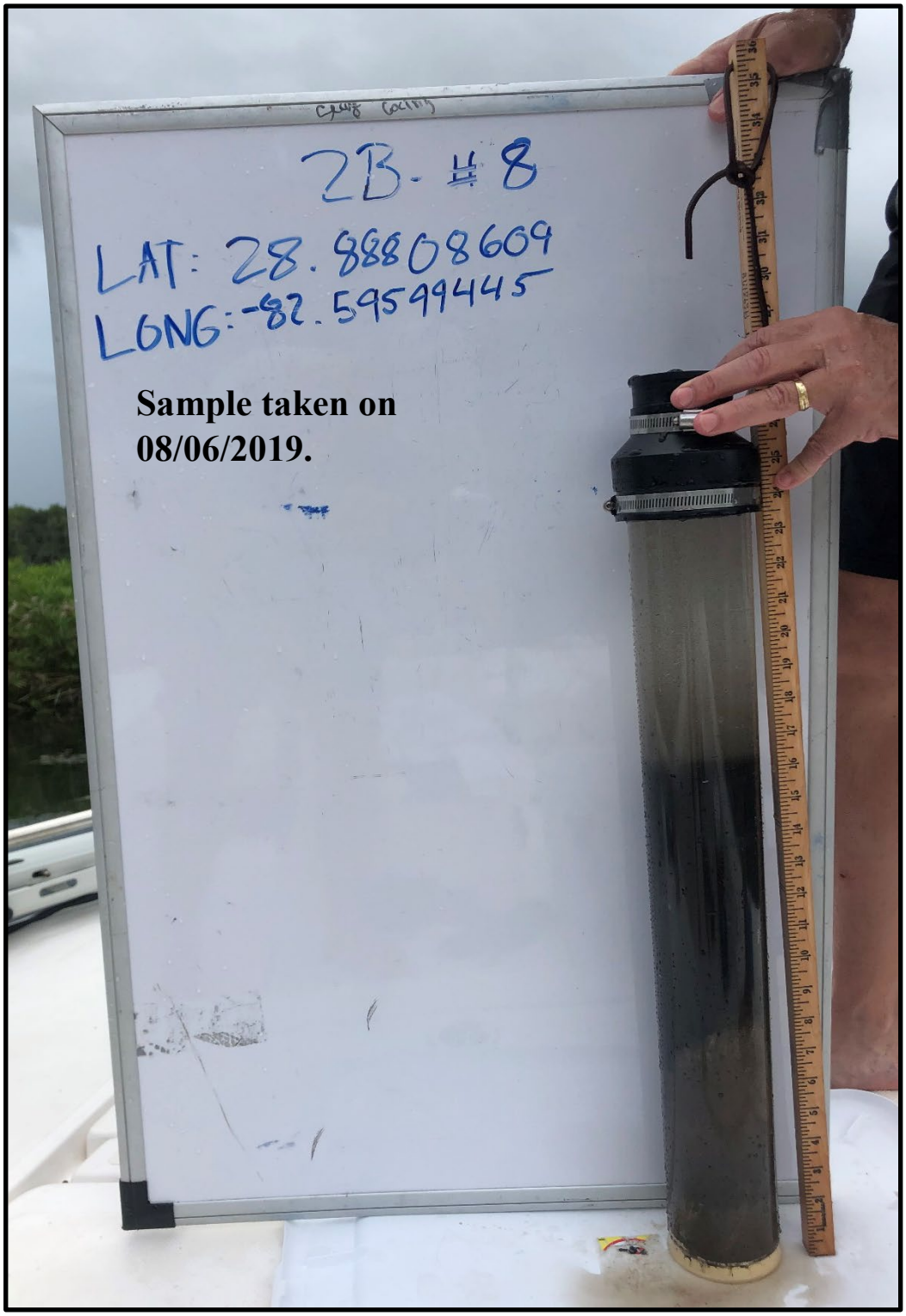
Phase 2B (Canal 2B2) Site 2B-5 – 6.4 cm of floc over 7.6 cm of mud over 11.4 cm of sandy clay.



Phase 2B (Canal 2B3) Site 2B-6 – 5.1 cm of floc over 10.2 cm of mud over 25.4 cm of sandy clay.

Phase 2B (Canal 2B3) Site 2B-7 – 1.3 cm of floc over 6.4 cm of sandy mud over 15.2 cm of sandy clay.

Close up view of sample 2B-7.



Phase 2B (Canal 2B4) Site 2B-8 – 7.6 cm of floc over 11.4 cm of mud over 19.1 cm of sandy clay.

Close up views of sample 2B-8

Phase 2B (Canal 2B4) Site 2B-9 – 7.6 cm of floc over 14.0 cm of mud over 19.1 cm of sandy clay.

Close up view of sample 2B-9.

Phase 2B (Canal 2B4) Site 2B-10 – 5.1 cm of floc over 8.9 cm of mud over 21.6 cm of sandy clay.

Close up view of sample 2B-10.