

CRANEY ISLAND MANAGEMENT STUDY
NORFOLK HARBOR, VIRGINIA

SUBSURFACE INVESTIGATION

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AUGUST 1980

SUMMARY

In January 1980, the Norfolk District, Corps of Engineers retained the services of the Waterways Experiment Station (WES), Corps of Engineers to develop a management plan for the Craney Island Disposal Area, Norfolk Harbor, Virginia. As part of that plan the Norfolk District supervised a two phase subsurface investigation. The first phase was to develop a preliminary soil/groundwater profile of the southwest end of the island and supply WES with samples for a more detailed analysis. The second phase was to perform a preliminary analysis to locate sources of sand as potential borrow material.

The general profile consists of about 18 to 23 feet of dredge spoil overlying foundation river sediments. The spoil consists of highly plastic silty clay. The sediments consist of highly plastic organic silty clay with shell fragments. The groundwater table is at ground elevation at the drilling site, but is very irregular throughout the entire disposal area.

Five areas within the island were investigated as potential borrow sources. Four of these areas have suitable surface material of sufficient quantity to be considered potential borrow sources. The material is primarily silty sand and there is an estimated total of 440,000 cubic yards of material available from these four areas.

Overall, the first phase investigation was not as successful as planned. Additional information may be required to better define groundwater levels and foundation elevations. The estimated borrow source quantities are based on preliminary information. The present estimates were based on a May 1980 survey and project operations have already altered the area topography.

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SUBSURFACE INVESTIGATION
CRANEY ISLAND DISPOSAL MANAGEMENT STUDY
NORFOLK HARBOR, VIRGINIA

1. **INTRODUCTION:** In January 1980, the Norfolk District, Corps of Engineers, Norfolk, Virginia retained the services of the Waterways Experiment Station (WES), Corps of Engineers, Vicksburg, Mississippi to develop a management plan for the Craney Island Disposal Area, Norfolk Harbor, Virginia. The plan is required to assure the most effective use of the containment in future years.

In April 1980 the Norfolk District supervised a Phase I subsurface investigation as part of the management study. The investigation was conducted by Atec Associates of Virginia, Inc. The scope of work was threefold:

- a. To sample soft dredge spoil contained within the southwest end of the Craney Island project and the underlying foundation material, and to install piezometers to establish watertable levels.
- b. To perform laboratory soil identification tests for sample classification.
- c. To ship samples to WES.

The purpose was to develop a preliminary soil/groundwater profile and supply WES with samples for a more detailed analysis. Also, as a result of the unique drilling procedure for Phase I, WES requested a documentation of the exploration program.

In June 1980, the district supervised a Phase II subsurface investigation. The investigation was conducted by McCallum Inspection Co. The scope of work was twofold:

- a. To sample known sandy dredge spoil deposits within the containment.
- b. To perform laboratory soil identification tests for sample classification.

The purpose was to perform a preliminary analysis to locate sources of sand as a potential borrow material.

In August 1980, the district installed two additional piezometers to supplement the Phase I investigation. The original investigation failed to adequately define the groundwater conditions. The extra piezometers were needed to better delineate the area watertable.

2. SITE DESCRIPTION:

2.1 General Geology: Craney Island is located within the outer limits of the coastal plan physiographic province. Craney Island consists of fill material overlying the Sandbridge Foundation and the

Norfolk Foundation in areas that the Sandbridge Foundation has been eroded. Both formations are of late Pleistocene age. Sediments of the Sandbridge Formation are fine to coarse sands and interpreted as having been deposited in a estuarine beach environment. The Norfolk Formation consists of silty sands and clayey sands, and believed to have been deposited in brackish-marine and fluvial-estuarine environments.

As per a July 1979 report by Dames & Moore, prepared for the Virginia Port Authority, geophysical studies by others uncovered an ancient river valley filled with soft sediments to the northwest of the dredge disposal area. Extrapolations have shown that this river valley probably passes diagonally from the northwest to the southeast through the dredge disposal area. This old river erosion channel, probably created during the Post-Miocene period of low ocean levels, is now filled with recent deposits of soft and highly plastic clays. The thickness of these soft river valley deposits ranges from a few feet, near the south end of the disposal area, to over a hundred feet toward the northern end of the site.

2.2 Project Site: The Crane Island Disposal Area is located in Norfolk Harbor north of Crane Island, Portsmouth, Virginia. The project consists of a 2,500 acre dredged spoil disposal site confined by dikes. A vicinity and project location maps are shown on Plate A-1, Appendix A.

3. SUBSURFACE INVESTIGATION: Soil samples were classified according to the "Unified Soil Classification System" and described according to the inspector's visual interpretation of Burmister's Method of material proportions. Elevations shown on the logs and referenced in this report are based on CE low water datum. This datum is 1.50 feet below Sea Level Datum of 1929, 1953 adjustment, and developed by stereo-photogrammetric methods from air photographs flown during March 1980. Boring locations are shown on Plate A-2, Appendix A. Boring logs are provided in Appendix B.

3.1 Phase I: The initial exploration program called for six borings to be drilled to 36 feet or approximately 10 feet into foundation materials. Only four borings, designated DH-1A thru 4A, were accomplished. The holes were advanced to various depths by an Acker Stationary Piston Sampler and 4-inch I.D. hollow stem auger. Continuous 24-inch samples were taken with a 3-inch O.D., 30 inch thin wall "shelby" tube. One and a quarter inch I.D. PVC pipe with a standard slotted well point were installed in each hole to facilitate groundwater readings.

3.1.1 Soil Profile: The general profile consisted of about 18 to 23 feet of dredge spoil overlying river sediments. The spoil was essentially a saturated medium to high plastic, odorous silty clay (CL, CH).

Only in borings DH-2A and 3A could the foundation material be identified by either visual observation of samples and/or by drilling resistance. In boring DH-2A, drilled from Elevation (EL)

+10.5 feet mean low water to EL-19.5 (30 feet in depth), sampling became stiff at about EL-12.5 (23.0 feet). The stiff material consisted of high plastic, organic, silty clay (CH) with shell fragments. The fragments are often indicative of area river sediments. In DH-3A drilled from EL +10.7 to EL-7.3 (18.0 feet) sampling became stiff at EL -7.3 (18.0 feet). However, the material revealed no apparent change from the dredge spoil down to EL-9.8 (20.5 feet). At EL-9.8 the material changed to a non-plastic sand (SP). In boring DH-1A, drilled from EL+12.6 to EL-23.6 (36.0 feet), and boring DH-4A, drilled from EL+10.8 to EL-13.1 (24.0 feet) the foundation material was not discernable by either drilling or identification.

3.1.2 Groundwater: Open-standpipe piezometers with slotted well screens were installed in all four holes. Tip elevations in DH-1A and 2A were set in apparent or possible foundation materials at EL -22.0 (34.5) and EL -18.0 (28.5), respectively. Tip elevations in DH-3A and 4A were set in dredge spoil below sea level at EL -5.8 (16.5) and EL -5.6 (16.5), respectively.

For various reasons, as explained in Paragraph 5.6.10, these four piezometers were not functional. Therefore, two additional piezometers were installed to supplement the original set. However, these additional piezometers were installed four months after the original piezometers. The original piezometers were installed in April. Shortly thereafter the area was covered with pumped dredge spoil to about EL 15.5+ making the site inaccessible. It was not until August that the area had sufficiently dried enough to become accessible.

At that time, the areas by DH-2A, 3A, and 4A were probed to 20 feet with a pipe. The material was very soft and saturated. Only the top few inches were dessicated and crusted. Piezometers were offset from DH-3A and 4A because those areas were solid enough to work in. The area around DH-2A and DH-1A were still wet and considered to precarious to work in.

One piezometer was offset approximately 25 feet south of DH-3A to EL 5.7. Another was offset about 5 feet northeast of DH-4A to EL 0.5. Both holes were bailed and read 24 hours later. The waterlevels in both holes were at ground level or EL 15.5+. The offset holes are logged on the logs for DH-3A and 4A, respectively.

However, this does not agree with pass exploration in the immediate area. Borings CI 3, 17, 19 and 20 performed in 1971 indicate a watertable at about EL +7.0. Borings logs for these holes are provided in Appendix B and their locations are shown on Plate A-2, Appendix A.

A total of nineteen holes were drilled for the Phase II investigation. Groundwater was encountered in these holes at elevations ranging from EL 3.2 to 12.5.

Phase I and II, investigations, as past investigations, proved spoil conditions are extremely varied. The watertable in the area of the Phase I investigation is at the groundlevel due to the influx of the recently deposited dredge spoil.

3.2 Phase II Subsurface Investigation: Five different areas were investigated as a potential borrow source for sand. The areas are designated A thru E and are shown on Plate A-2. A total of 19 borings designated of DH-1 thru 19 were drilled to a maximum depth of 16 feet to sample the various areas. The holes were advanced by a 2-inch O.D. splitspoon sampler and 4-inch I.D. hollow stem auger.

3.2.1 Area A, Northwest Corner: Area A is located in the northwest corner of Crane Island. This area is already an active borrow pit. Two borings designated DH-1 and 2 were drilled to 16 feet to provide additional information in the area. Boring DH-1 and 2 indicated fine sands (SM, SP-SM) to 7.0 feet and 4.0 feet, respectively. Underlying this cover material the soil becomes interlayered with zones of organic fines (OH) and sands (SC, SP-SM). The surface sands are considered to be an excellent to good construction material. The underlying intermittent zones are a mixture of good to unsatisfactorily material and would be difficult to segregate during excavation. A watertable was not encountered. There is an estimated 100,000 cubic yards of suitable surface sand in this area.

3.2.2 Area B, Northeast Corner: Area B is located in the northeast corner of the island. Three borings designated DH-3, 4 and 11 were drilled in this area. Borings DH-3 and 4 were advanced to 16 feet. Boring DH-11 was advanced to 10 feet. These borings encountered 2 to 4 feet of silty sands (SP, SP-SM). The surface sands are considered to be an excellent to good construction material. The underlying zones are a mixture of good to unsatisfactory material and would be difficult to segregate during excavation. A watertable is encountered at about 12 feet or EL 5. There is an estimated 5,000 cubic yards of suitable surface sand in this area.

3.2.3 Area C, North Spur Levee: Area C is located around the north spur levee about 1,000 feet due west from the east levee. This area is also an active borrow pit. Six borings designated DH-5 thru 10 were drilled to 16.0 feet to investigate this area. Borings DH-6 thru 10 encountered sands (SP, SC, SM, SP-SC) to an average depth of 10 feet. Underlying this material the sand became interlayered with organic clays and silts (OH), or lensed with clay. Boring DH-5 encountered sands (SP) with traces of organics and clay lenses to full depth of 16 feet. The overlying sands are excellent to good construction material. The interlayered materials are a mixture of good to unsatisfactory material and would be difficult to segregate during excavation. The watertable was encountered at about 12 feet or EL 12. There is an estimated 200,000 cubic yards of suitable surface material in this area.

3.2.4 Area D, Inside East Levee: Area D is located inside the east levee just south of the north spur levee. Four borings designated DH-12 thru 14, and 19 were drilled to 16 feet to investigate this area. These borings encountered 6.5 to 12 feet of sands (SP, SP-SC, SP-SM) or to an average depth of 9 feet. Underlying this material the sands become interlayered with organic clay and silts (OH). The overlying sands are excellent to good construction materials. The interlayered soils are a mixture of good to unsatisfactory material and would be difficult to segregate during excavation. The watertable was encountered at about 12 feet or EL 6. There is an estimated 80,000 cubic yards of suitable surface material in this area.

3.2.5 Area E, Southeast Corner: Area E is located in the southeast corner of the island. This area is presently used to store junk. Four borings designated DH-15 thru 18 were drilled to 16 feet to investigate the area. The borings encountered 3 to 9 feet of sands (SM, SP) with traces of clay lenses. The average depth of material was 6.5 feet. Underlying this cover material the sand became interlayered with organic soils (OH) and clay lenses (SC, CH). The overlying sands are excellent to good construction material. The interlayered soils range from good to unsatisfactory and would be difficult to segregate during excavation. The watertable was encountered as shallow as 10 feet or EL 12. There is an estimated 60,000 cubic yards of suitable surface material in this area.

4. LAB TESTING: For Phase I, moisture contents, Atterberg limits, and gradation analyses (Wash No. 200) were conducted by Atec Associates to confirm the inspector's visual classification. For Phase II, gradation analyses were performed by the Norfolk District to determine grain size distributions of potential borrow material. All test results are indicated on the logs and are provided in Appendix C.

5. PHASE I EXPLORATION REPORT: The Phase I exploration program was a unique experience for the Norfolk District. It was the first time continuous undisturbed samples were ever taken from a barge. The following is a documentation of that program including a breakdown of particular problems encountered.

5.1 Site Access: The borings proposed to sample dredge spoil were located within the containment area. The existing terrain was too soft to operate a drill rig without providing some means of support. Craney Island maintenance personnel flooded the containment to provide a pool to facilitate mobilization by barge. A layout of the drilling operation and appurtenances is shown on Plate A-3, Appendix A.

5.2 Mobilization: Mobilization was a 3 phase operation; placement of the barge and drilling rig within the containment, movement within the containment, and stabilization of the drilling platform during operation. The essential equipment involved with this operation was a skid rig, blocking, barge, crane, anchors, skiffs, and outboard motors.

A Lorain 25 ton crane was used to lift the barge into the containment area and to lift the rig onto the barge. Several 4 by 12 inch, 6 foot long timbers served as blocking to elevate the rig about 1 foot off the barge to provide a better working elevation. The rig was secured by chains and ropes fastened to hooks welded to the barge. It took one man to operate the crane. It took two additional men to guide the barge and rig during lifting, to place blocking and to secure the rig to the barge.

The barge was made of steel and the deck measured 25 feet by 12 feet. The hull tapers to a 14 by 12 foot bottom and is 3 feet high. When empty the barge had a 12 inch draft. When loaded with all drilling equipment and personnel it sat 18 inches in the water. A 12 inch hole was cut through the barge and located at 9 feet from one end just off the centerline.

To provide movement within the water the barge was equipped with an Evinrude 25 hp motor with a 24 inch shaft. This was suitable and could easily move the boat at about 5 to 10 mph. Steering and turning were not a problem when the winds were mild (5-10 mph). However, the set up had a rather large turning radius. To assist movement during windy days and reduce the turning radius, a skiff was moored to one side of the barge. The skiff was equipped with a 24 hp outboard motor. The skiff was used to work against the wind and to maneuver the barge in tight areas. One man was necessary to operate the outboard on the barge, a second on the skiff, a third man coordinated and directed the activities. Sometimes it was necessary to switch the skiff from one side of the barge to another during movement. A fourth man was available and was used to release and secure mooring lines when switching the skiff.

The barge was stabilized in the water by using 75 to 100 pound mud anchors, one located at each corner and secured by 1/2-inch, 100 foot long hemp line. Hemp rope was used, because of its limited stretch characteristics. Nylon rope, for example, stretches as much as 9 percent and would have resulted in too much play.

To anchor the barge, the outboard on the barge was cut and one anchor was dropped from the barge to stop the forward motion. The remaining anchors were placed by ferring the anchors with the skiff to selected points. The outboard was started up on the barge to control barge movements while placing the anchors. After all four anchors were placed each line was tightened and adjusted until slack was taken up. It took four men to do this operation. One man supervised, one man handled the outboard on the barge, and two men worked on the skiff. The supervisor assisted the skiff crew when transferring the anchors from the barge to the skiff. The anchors were set so that they could be flipped off the boat by one man. Then the supervisor tightened the lines, while the rest of the workmen proceeded to there respective drilling assignments.

Demobilizing off the hole consisted of using the cathod on the drill rig to drag in the anchors. While one man operated the cathod, at least three men assisted in lifting the anchor out of the water. One man was needed to make sure the mudflap on the anchor did not catch beneath the barge and the other two lifted the anchor to the deck. After all four anchors were pulled, and the barge underway, all lines were collected and anchors replaced on there respected corners ready for the next hole. Floats were used to locate anchors in the water.

5.3 Drilling Operation: The drilling operation consisted of sampling and installing piezometers. The equipment used was CME-45 skid rig, 4-inch I.D. hollow stem flight auger for casing, a piston sampler, wash bit, and Acker 3 inch O.D. thin wall tubes. A layout of the working platform is shown on Plate A-4, Appendix A. A pictorial sequence is provided in Appendix D. Photo 10 shows the barge set upon on a hole. Holes were advanced by taking continuous undisturbed samples with the piston sampler and then casing with the hollow stem auger. Washing was used to clean out the casing where necessary as shown in Photo 1. The wash bit shown in Photo 2 was patented by the head driller Eugene Jones. As one man handled the drill rig a second man handled augers and other support equipment. A third man was kept busy cleaning and assembling the piston sampler apparatus, Photo 3. An assembled piston head is shown in Photo 4. The top of the piston rod was equipped with a eye hook. The sampler was lowered in the hole. A pulling iron was used to lock the rod into place. The overhead pulling cable was attached to the piston rod hook. The tube was then either pushed by hand when in the soft dredge material, Photo 5, or by chuck when in the stiffer foundation material. However, when sampling the soft dredge material, the sampler often sank under its own weight and it was a question of preventing the rod from going more than the required 24 inches. The sample was withdrawn, capped, and set on the deck, Photos 7 and 8. A chain clamp was used to remove the tube, Photo 6. The sample was then turned over to a fourth person who cleaned, capped, labeled and stored the sample. In the meantime the drilling crew was proceeding to take the next sample. A wooden rack shown in Photo 9 was used to keep samples upright. The wet rag shown on the tube was necessary to cover the holes at the top to prevent the wind from drying out the top of the sample. When three to five samples were accumulated, then they were transferred to the shore. On the average, one tube was taken every 15 to 20 minutes. This is based on holes to 30 feet. Deeper holes, say 40 to 50 feet, would slow that average down to 2 to 3 per hour. A fifth man used as a go-for between the drilling operation, the office and the place where samples were sealed, picked up the samples, secured them in the boat ferried them to shore, transfer the samples to a truck and transported them to the area set up for preparing the samples.

Materials used to construct the piezometers were 1-1/4 inch PVC pipe, 2 foot standard slotted PVC well screen, caps, industrial sand, bentonite pellets, and floats. Specifications required the bottom of the hole to be cleaned and to have sand placed into the hole as the casing was pulled to the proposed tip elevation. The hole was cleaned by washing and sand was placed by pouring it thru a funnel and then allowed to settle. Soundings were taken to check depth. The length of the piezometer was based on setting the cap below the bottom of the barge to facilitate moving off the hole. The piezometer was dropped down the casing and allowed to sink. Then annular sand was placed, and the casing pulled. A float was set next to the piezometer before moving off to mark the piezometer location. Setting the piezometer took one hour and could easily be done by one person.

5.4 Sample Preparation: The work involved with sealing a sample involved the following; taking a disturbed sample for soil identification tests, cleaning out the ends, sealing, taping, dipping, and relabeling. A sheltered area was set up to prepare the samples as shown on Photos 11 and 12. New samples were temporarily stored upright against the back wall. None are shown in the photographs. When each sample was being prepared, the bottoms were first sealed. Then prior to sealing the tops the extra length of tube was cut off. The vertical clamping device shown in the center of the photographs was used to secure tubes during cutting. The pipe cutter used is shown hanging on the wooden column in the right of the photographs. The rack shown on the right is where all sealing was done. A propane burner shown by the pipe cutter on the column was used to melt wax. A non-shrinking petroleum base wax was used to seal the tubes. Sealed tubes were stored upright in the rack as shown on the left in Photo 11. It took one man to do the job and it took 15 minutes per tube. Usually 4 to 5 tubes were done at one time.

When the entire job was completed, all the samples were transported to the district in a horizontal position and protected from vibration. At the district the samples were packaged in wooden boxes. Two boxes were packed with 53 samples. Styrofoam peanuts were placed in the bottom of the box. Then five tubes were layed horizontally on the packing material and covered with more styrofoam. The next layer consisting of four tubes, more packing, five tubes, etc. The samples were air freighted to WES, laying in a horizontal position. The crates were hand crafted in the district.

5.5 Time and Personnel: For a job of this size with the equipment necessary, it would take approximately two and half days for mobilization and demobilization. One day would be needed to deliver drilling and support equipment, and become familiar with the operation and the site. A half of a day would be needed for mobilizing the actual drilling operation. Another day would be needed for demobilizing and moving off the site.

Movement from hole to hole, assuming about 1000 feet apart, would take about one hour. The time includes from moving off of one hole to setting up and be ready to drill on the next hole. Most of the time is spent pulling and dropping anchors.

Required personnel for this type of operation is six people. Five would be minimal, three drillers, one man logging and one man sealing tubes. The labor demand is high because of special treatment required for undisturbed samples, and transportation and handling problems associated with undisturbed samples on a water job. A sixth man would be beneficial serving as go-for between the working platform, sample sealing operation and the office. The extra man essentially handles duties that would otherwise interrupt the other workers.

One important item was that each worker had assigned responsibilities. The results were each worker did not need much further direction, there was very little overlap, each felt part of the operation, and the procedure went smoothly once each understood their duties.

One other item is that one man be responsible for coordinating the operation. In this operation the government inspector acted as the overall coordinator of the operation. He answered questions, and provided direction during mobilization and demobilization.

5.6 Problems Encountered: This drilling operation was plagued with many problems familiar with first time adventures. Some problems could have been averted with more thought and assertiveness, others only experience could teach.

This venture was coordinated between three separate operations, the support at Craney Island, district personnel assisting the driller, and the contractor's drilling plant and crew. There were no problems at all bringing all three elements and associated equipment and supplies to the site.

5.6.1 Coordination: The first major problem was that the project coordinator was not thoroughly familiar with all the crews capabilities, and often whether advice was advisable. The immediate results were confusion and delays because the coordinator was sometimes ill advised and often hesitant to step into others domain to provide overall direction. This discontinued with increase familiarity with the crews and the operational procedures.

5.6.2 Mobilization: Launching the barge was a problem. Craney Island personnel dammed the sluices to provide sufficient draft within the containment. A pool of no less than 18 inches and comfortably 24 inches was to need to float the barge loaded down. It was advised to launch the barge by the second sluice. The second sluice soundings showed a marginal pool but was decided after some discussion to launch at that point. It proved to be too shallow, for a loaded barge and

got stuck in the mud. The barge was unloaded. A second launching area was constructed between the first and second sluice. Craney Island people had dredged, by drag bucket, a small six foot deep harbor for launching. The empty barge was powered over to the new sit, reloaded and moved off with no problem. The relaunching caused a one-day delay.

5.6.3 Drilling Crew: A new inexperienced drill crew was a problem. The members were not familiar with each other and with taking piston samples. The head driller was very knowledgeable, but physically handicapped and limited as to the amount of manual labor he could perform. He trained the other members and it took one whole day to learn to work together. This resulted in an overall delay of about one day.

5.6.4 Anchorage: Stabilizing the barge during drilling was a problem. Mud anchors were recommended and were used against better judgement, because they were the only practical alternative for the given set-up. A spud system was preferable, but required a set-up to set and pull spuds which was not available. The anchors worked fine until winds exceeded 10 miles/hour. The barge would shift enough to deflect the auger making it difficult to push tubes without hitting the side of the casing and eventually getting hung-up. When the wind exceeded 15 miles/hour work had to be terminated due to too much rocking of the barge.

5.6.5 Piston Sampler: Removing the tube from the piston sampler was a problem. Part of the problem was that the top of the inside of the Acker tubes was partially painted causing a binding action. The other part was the suction. It was necessary to remove the tube by using a chain clamp, Photo 6. The operation required three people; one to use the clamp, a second to hold the cap on the bottom of the sample to avoid losing the sample after breaking the vacuum, a third to hoist and hold the drilling rod in the air as the tube is removed.

5.6.6 Sample Disturbance: The samples were subjected to much disturbance. When removing the tube from the piston sampler, the person holding the cap at the bottom could feel the sample rise slightly and then drop as in a heaving or breathing action. Also, as samples were stored on the barge waiting for transportation to shore, they were subjected to vibration caused by operating the rig on the barge. Finally, there was the usual disturbance associated with transporting samples from barge to skiff, skiff to truck, truck to the sealing work area.

5.6.7 Limited Drilling: As explained with the anchorage, the depth of holes were governed by the weather conditions. Excessive winds would cause the barge to shift, deflect the casing and restrict the drilling depth. Twenty to twenty-five feet was the maximum depth before problems inhibited and/or terminated drilling.

5.6.8 Sealing Samples: Originally, it was planned to set up the sealing operation on shore to minimize the transportation of samples. However, the time involved with sealing a continuous supply of samples was underestimated. Also, the selected work area was open and the wind inhibited the operation by blowing sand all around. Therefore, a sheltered place was used.

Another unexpected problem was gas in the samples. The bottom of the tube was cleaned and sealed with wax. Then the top was cleaned out and then covered with about an inch of wax. It was discovered when the first group of samples were ready for tapping, gas was percolating through the top seals along the tube-wax contact. This was never before encountered by district geotechnical personnel. Much time and various efforts were employed to properly seal the tubes. One effort was even to completely fill the top of the tube in some cases with several inches of wax which was ineffective. What eventually was done was to cut the excess tube off the top and clean and treat the top as the bottom. It worked. No more gas escaped and no problems were reported by WES when samples were reopened for testing. There is no explanation as to why this method worked and probably is no guarantee. The gas must still migrate to the top, but how this type seal prevented it from escaping is unknown. Also, these tubes were subjected to no more than 1-1/2 months of storage. What effect longterm storage will have on the seals is unknown. As long as there is gas generating, it is difficult to assess if the tube seal can "explode" and what effect gas has on sample disturbance.

5.6.9 Lost Samples: Samples were lost in borings DH-1A and 3A at sea level. The reason for losing the sample is unknown. The holes were cleaned out, water kept in the hole and no other problems were encountered after that depth. The only other time washing was required was DH-2A when refusal was encountered at 19.8 foot. The washed material revealed no clues for the refusal and there is no explanation.

5.6.10 Installation of Piezometer: The problem with the piezometer was that the tops had to be set below the bottom of the barge in order to be able to move the barge off the hole. A system was devised where the length of the pipe was calculated that would be necessary to extend above the mudline, but be below the barge. The piezometer was dropped down the casing, allowed to sink, annular sand placed, and casing pulled. Finally a stake with a float tied to it was set through the well in the barge, pushed below the bottom of the barge, and left to float.

The problem encountered in the first hole, DH-1A, was when the barge moved off the hole, the well snagged the float pulling it and the stake along. Consequently, there was no marker locating the piezometer and the piezometer was technically considered lost. On the second hole, DH-2A, it was made sure the float was tucked under the barge before moving off. However, this time the bottom of the barge

snagged the float and again dislodged the stake. As in the first case, the second piezometer was also considered lost. On the third hole, DH-3A, a shelby tube was used in lieu of a stake. The tube proved to be sufficiently set in the mud and the float and tube remained in place. The tube also worked in the fourth hole.

After the drilling was completed two men in a skiff went out to locate the top of the piezometers. Efforts were first directed toward locating the lost piezometers. The piezometer in DH-2A was definitely located and the one in DH-1A may have been located. However, the top of piezometers were set too deep. The tops were about 1 to 1-1/2 feet below the mudline and just beyond the reach of a man stretching from the skiff. It was unsafe to go into the water because of the very soft mud bottom and no attempts were made to enter the water. The piezometer in DH-3A was easily located, but again the top could not be reached from the skiff.

At the same time the crew was locating the piezometers, dredge spoil was being pumped into the immediate area and a mudwave was quickly (several feet per day) migrating into the drilling area. The mudwave had already begun to envelope DH-4A and the skiff could not maneuver within the developing blanket of mud, and attempts to reach DH-4A were abandoned.

The mudwave within a few days had enveloped the entire drilling area is now inaccessible by skiff or conventional transportation. The results are four piezometers are buried under 4 to 5 feet of unconsolidated mud. Each piezometer location was staked and is known.

5.7 Contract: The subsurface investigation which included exploration, laboratory analysis and engineering was negotiated. The contract specifications and negotiated prices are included in Appendix E.

5.8 Evaluation: The drilling operation was expensive and a simpler system could be devised with more experience. However, the continuous undisturbed sampling was a time consuming job that required a high degree of labor to maintain a smooth operation.

A six man crew proved to be an optimum number of personnel. However, it is essential to use a drilling crew experienced with piston sampling and waterborne mobilization. On the job training proved to be very costly and time consuming.

The CME-45 rig was too heavy for the limited depths drilled. A rig of this size is not needed to sample the soft dredge material. It may have been necessary to sample the stiff foundation material.

The 25 by 12 foot barge deck was an optimum area for a working platform, any less would have cramped the operation, and a larger one was not needed.

The stabilization method was unsuitable, time consuming, and very cumbersome. The anchors did the job for ideal conditions, but were otherwise ineffective. This portion of the operation is one area that can be greatly improved upon. A spud system is recommended in lieu of anchors.

The method to locate the piezometers worked. However, this is another aspect of the job that can be greatly improved.

A further note, instead of using pellets to seal off piezometer well points, the head driller recommended a more effective procedure. First, pull the casing to the desired elevation, then backfill with sand, lower a tube in the annular space between the piezometer riser and casing, and pump driller's mud around the riser to seal the well point. The pellets are a hit and miss procedure, where sealing with mud is more consistent.

6. CONCLUSIONS:

6.1 Phase I: The purpose was to develop preliminary soil/groundwater profiles of the southeast end of the island and supply WES with samples for a more detailed analysis. The profile was not that well developed. In two of the borings the foundation materials were not discernable by either drilling or visual identification. Also, the groundwater table was not clearly defined. The original intention was to determine if there was a perched table as well as a table at sea level. However, the investigation failed to adequately delineate what the groundwater conditions were. The only functional piezometers indicated the watertable to be at the existing ground elevation. Also Phase II borings indicated that the watertable was highly irregular throughout the island.

If further delineation of the foundation elevation and groundwater levels are required, this can be accomplished with minimal effort. The area of the Phase I drilling is for the most part now drained and accessible by foot. Pipe borings to locate stiff foundation materials can easily be performed to 30 feet. About three borings can be performed every hour by a two man crew. Also, additional piezometers can easily be placed to about sea level to check for a perched watertable. About one piezometer can be installed every hour by a two man crew. It is important to note this work must be accomplished prior to the rainy winter season which again will flood the site and make it inaccessible. If there is sufficient funds at the completion of this report the Geotechnical Engineering Section plans to proceed with additional borings and install extra piezometers. Efforts will also include uncovering the buried piezometers installed in holes DH-1A thru 4A. Any additional work will be forwarded in a supplementary report.

6.2 Phase II: The purpose of the Phase II investigation was to perform a preliminary analysis to locate sources of sand within the containment as a potential borrow material. Area A is already a

productive borrow pit. Area C is presently being developed as a borrow pit. The investigation revealed that the surface material in these areas is a suitable construction material. There is an estimated 100,000 cubic yards available in Area A and 200,000 cubic yards in Area C. The surface material in Areas D and E is also suitable. There is an estimated 80,000 cubic yards in Area D and 60,000 cubic yards in Area E. The material in these four areas is of sufficient quantity to warrant consideration as a suitable source of borrow. There is a total estimated 440,000 cubic yards available from these four areas.

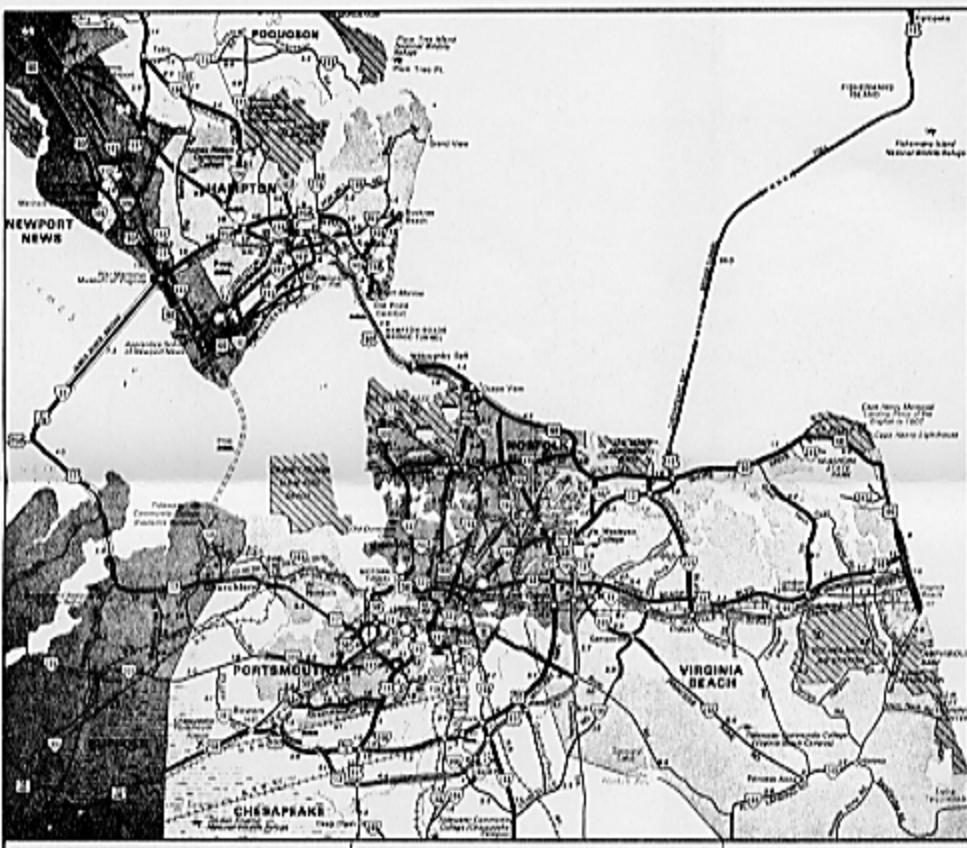
The surface material in Area B is suitable. However, there is only an estimated quantity of 5,000 cubic yards. This area is not as an attractive area to develop as the other four due to its lower quantity of suitable material.

The estimated quantities for these areas are based on preliminary information and are considered approximate. Also, it must be further noted that the face of Craney Island is constantly changing. The present operations of disposal and excavation have already altered the topography shown on Plate A-2 which these estimates were based on.

It further delineated the foundation and groundwater levels and determined the amount of water that can be expected to be available for the most part of the year. The investigation also showed that the foundation material is of a suitable quality and that the groundwater level is generally high throughout the island. The investigation also showed that the foundation material is of a suitable quality and that the groundwater level is generally high throughout the island. The investigation also showed that the foundation material is of a suitable quality and that the groundwater level is generally high throughout the island.

The purpose of the Phase II investigation was to determine the suitability of the areas for disposal and excavation. The investigation also showed that the foundation material is of a suitable quality and that the groundwater level is generally high throughout the island.

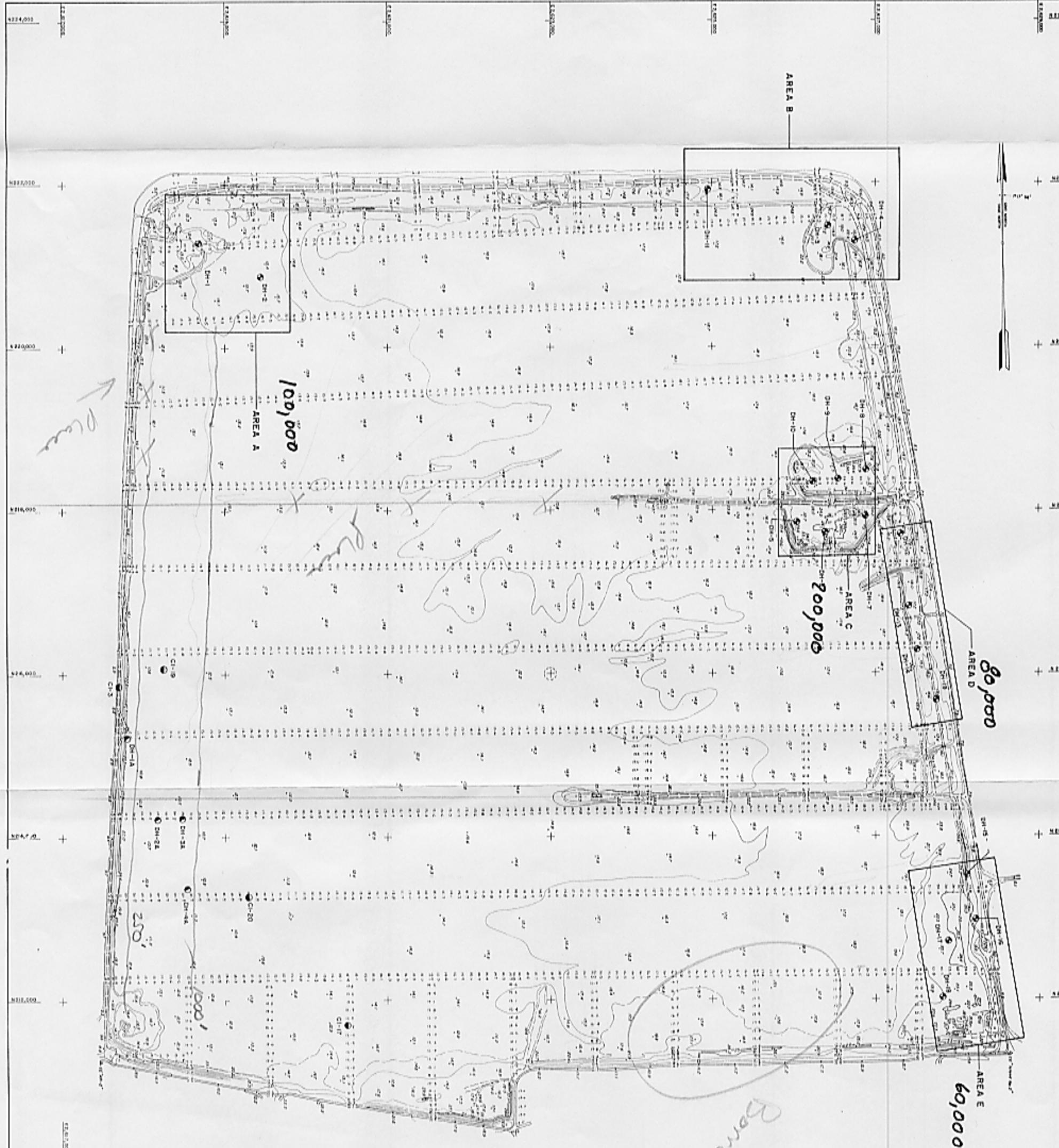
APPENDIX A: DRAWINGS



-VICINITY MAP-



NORFOLK HARBOR, VIRGINIA
**CRANEY ISLAND
 MANAGEMENT STUDY**
 PROJECT LOCATION MAP



- LEGEND**
- PHASE I BORING LOCATIONS
 - PHASE II BORING LOCATIONS
 - 12TH BORING LOCATIONS

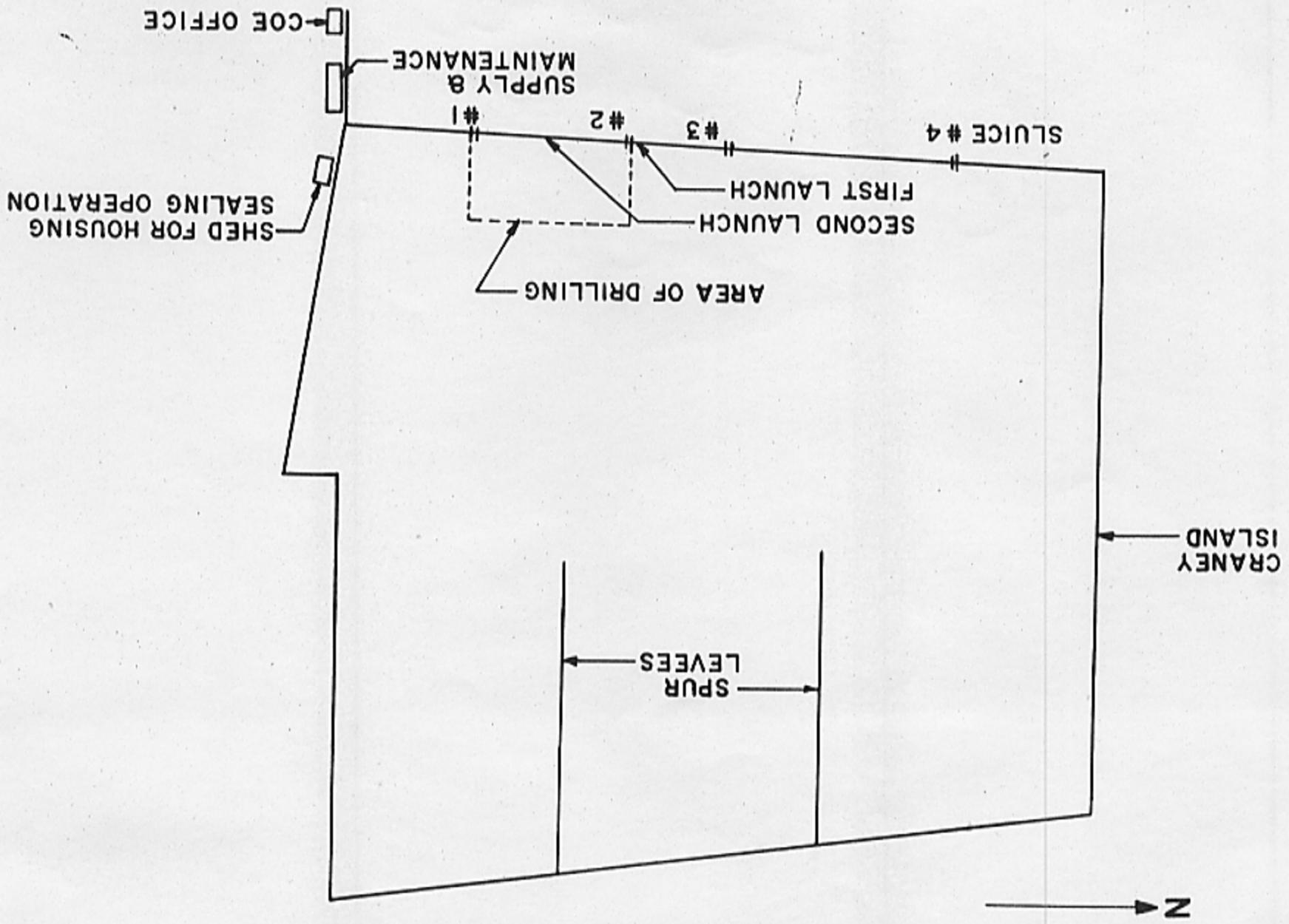
NOTES

CONDUCTED ON 1/24/80 IN THE VICINITY OF THE VARIOUS BARRAGE DAMS. BORING LOCATIONS WERE DETERMINED BY VISUAL INSPECTION AND PHOTO AERIAL PHOTOGRAPHY. MEAN ELEVATION OF TIDE 2.8 FEET BASED ON NAD 83 DATUM. ELEVATIONS ARE IN FEET REFERRED TO CE LOW WATER CORNER WITH A 1.50 FEET HIGH TIDE CORNER OF 1985. 1985 ELEVATION, AND WERE DETERMINED BY PHOTO-INTERPRETATION OF AERIAL PHOTOGRAPHS TAKEN FROM APRIL 1980. BORING LOCATIONS - CE (TIDE) AND CE (LOW WATER) AND CE (TIDE) AND CE (LOW WATER).

<p>DEPARTMENT OF THE ARMY NORFOLK DISTRICT, CORPS OF ENGINEERS NORFOLK, VIRGINIA</p>	
<p>CRANEY ISLAND MANAGEMENT STUDY PHASE I AND II BORING LOCATION PLAN</p>	
PROJECT	CRANEY ISLAND MANAGEMENT STUDY
DATE	23 APR 1980 FILE NO. W-10-1
SCALE	AS SHOWN
BY	W. J. BROWN
CHECKED	W. J. BROWN
APPROVED	W. J. BROWN
DATE	23 APR 1980

CRANEY ISLAND
MANAGEMENT STUDY
LAYOUT OF DRILLING OPERATION
PLATE A-3

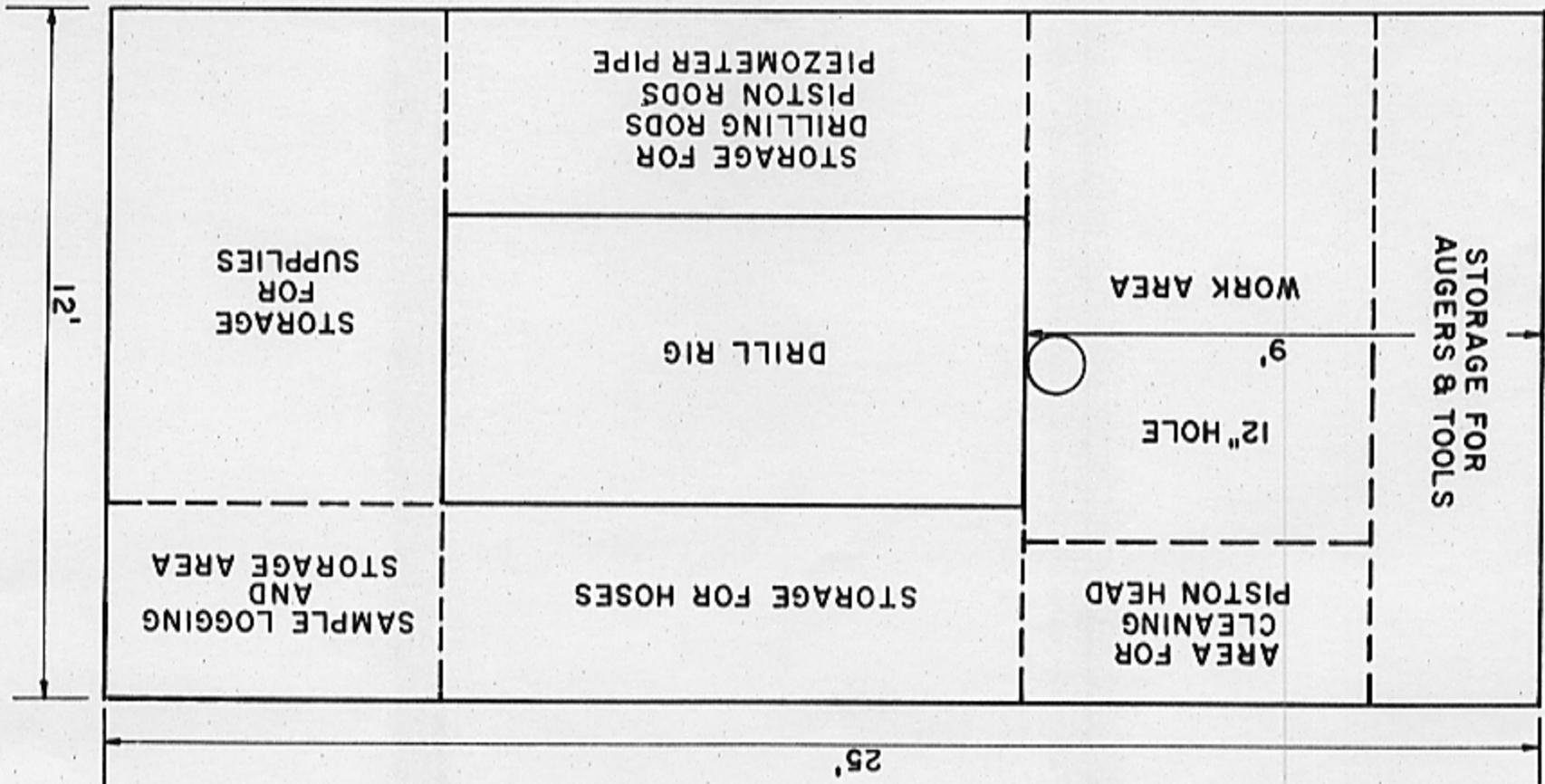
NOT TO
SCALE



CRANEY ISLAND
 MANAGEMENT STUDY
 LAYOUT OF WORKING PLATFORM
 PLATE A-4

SCALE: 1" = 30'

NOTE: ONE ANCHOR WAS KEPT
 AT EACH CORNER.



APPENDIX B: BORING LOGS

BORING NOTES

1. Borings DH-1A through 4A and DH-1 through 19 were drilled as part of the Craney Island Management Study. Borings CI-3, 17, 19, and 20 were drilled for a past study and are included in this report as supplemental data.
2. The soil was classified according to the "Unified Soil Classification System" (ML, CL, GP, etc) and described according to the "Burmister's Method of Material Proportions."
3. Borings DH-1 through 19 and CI-3, 17, 19 and 20 were advanced with a 2-inch O.D. splitspoon sampler and 4-inch I.D. hollow stem auger. The blow column indicates the number of blows required to drive a 2-inch O.D. split spoon sampler 6 inches, unless otherwise noted, into undisturbed soil with a 140 lb. hammer falling 30 inches. The standard penetration "N" value is the sum of the second and third 6-inch drives, i.e. 6, 4, 5, 3; N=9.
4. Borings DH-1A and 4A were advanced with an Acker Stationary Piston Sampler and a 4-inch I.D. hollow stem auger. The remarks column indicates depth of samples. Samples were taken with a 3-inch O.D. thin wall "Shelby" tube. Estimated consistencies (med., stiff, soft, etc.) are from Terzaghi & Peck "Soil Mechanics in Engineering Practice." Estimated blow counts, noted in the remarks column, are based upon a field test derived by the Norfolk District.
5. All elevations and locations are approximate.
6. For location of borings, see attached drawings.
7. Dates shown on logs are completion dates.
8. Samples are stored at the Waterways Experiment Station, Corps of Engineers.
9. Abbreviations:

blk	- black	gry	- gray
BOH	- Bottom of Hole	hi	- high (ly)
brn	- brown	lt	- light
crs	- coarse	&	- and
dk	- dark	L.L.	- Liquid Limit
fdn	- foundation	MLW	- Mean Low Water
fn	- fine	med	- medium
frag	- fragments (fragmented)	o/c	- on completion

occ - occasional
org - organic
P.I. - Plastic Index
piez - piezometer
plas - plastic
sat - saturated

thk - thick
tr - trace
vy - very
W - moisture content
w/ - with
w/d - with depth

W O/C = Water on Completion - the water level in an uncased hole, unless otherwise noted, at completion.

W @ 24 hrs = Water at 24 hours - the water level in an uncased hole, unless otherwise noted, 24 hours after completion.

DRILLING LOG		DIVISION		INSTALLATION		SHEET			
NAD		NAD		NAD		1			
1. PROJECT CRANEY ISLAND MNGT STUDY NORFOLK HARBOR, VIRGINIA				10. SIZE AND TYPE OF BIT 3" O.D. SHELBY TUBE				OF 1 SHEETS	
2. LOCATION (Coordinates or Address) N215.240 E2.617.790				11. DAYUM FOR ELEVATION SHOWN (FSM or MSL)					
3. DRILLING AGENCY ATEC ASSOCIATES				12. CE LOW WATER DATUM CME-45					
4. HOLE NO. (As shown on drilling title and title sheet) DH-1A				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN				0	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES				32	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER NO RECORD					
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED 9 APR 80				COMPLETED 10 APR 80	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE 12.5 ±					
9. TOTAL DEPTH OF HOLE 36.0'				18. TOTAL CORE RECOVERY FOR SOILING				%	
				19. SIGNATURE OF INSPECTOR <i>David A. ...</i>					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE RECOVERY NO.	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of penetration, etc., if applicable)	NOTES		
12.5	0	c	(CH) Silty CLAY, high plastic, odorous	1-1	0.0 - 2.0				
				1-2	2.0 - 4.0				
				1-3	4.0 - 6.0				
				1-4	6.0 - 8.0				
				1-5	8.0 - 10.0				
				1-6	10.0 - 12.0				
				1-7	12.0 - 14.0	Loft Sample 1-7: Washed from 12.0 to 14.0			
				1-8	14.0 - 16.0				
				1-9	16.0 - 18.0				
				1-10	18.0 - 20.0				
				1-11	20.0 - 22.0				
				1-12	22.0 - 24.0				
				1-13	24.0 - 26.0				
				1-14	26.0 - 28.0				
				1-15	28.0 - 30.0				
				1-16	30.0 - 32.0				
					32.0 - 36.0	Augered and washed to 36.0'. Back-filled w/same to 34.5'. Set pipe. at 34.5'			
-22.0	34.5'		Well Tip						
-23.5	36		BOH						
				NOTE 1: Piez not functional. No water-levels recorded.					

DRILLING LOG		DIVISION NAO		INSTALLATION NAO		SHEET 1 OF 1 SHEETS	
1. PROJECT CRANEY ISLAND MNGT STUDY NORFOLK HARBOR, VIRGINIA							
2. LOCATION (Coordinates or Address) N 214,250 E2, 618,470							
3. DRILLING AGENCY ATEC ASSOCIATES							
4. HOLE NO. (As shown on drawing title and log number) DH-3A							
5. NAME OF DRILLER							
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.							
7. THICKNESS OF OVERBURDEN							
8. DEPTH DRILLED INTO ROCK							
9. TOTAL DEPTH OF HOLE 22.5							
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Described)	3 CORE RECOV. NO.	BOX OR SAMPLE NO.	MARKS (Disturbance, water loss, depth of DEPTHS, etc., if signs NOTES)	
10.7	0		(CH) Silty CLAY, high plastic, odorous	M=222	3-1	0.0 - 2.0	
				M=192 LI=134 PI=85	3-2	2.0 - 4.0	
				M=152	3-3	4.0 - 6.0	Sample not pushed v. well
			(CL) Silty CLAY, med plastic, odorous	M=164	3-4	6.0 - 8.0	
				M=69 LI=39 PI=18	3-5	8.0 - 10.0	
					3-6	10.0 - 12.0	Lost sample 6. Washed from 10.0 to 12.5
				M=129	3-7	12.0 - 12.5	Overwashed
				M=159 LI=130 PI=89	3-8	14.5 - 16.5	
			Well Tip	M=148	3-9	16.5 - 18.5	Stiff @ 18.0
			(CH) Silty CLAY, high plastic. Fdn. material?	M=115 LI=99 PI=69	3-10	18.5 - 20.5	
			(SP) SAND, non plastic	M= 23	3-11	20.5 - 22.5	Bad sample. See Note 1
			BOH				NOTE 1: Hole terminated Casing at an angle due to shift in wind. Tube hitting side of casing. Pulled casing to 18.0 and backfilled w/sand and set piez. at 16.5'.
							NOTE 2: Piez. not functional. No waterlevels recorded.
							NOTE 3: In late April the area was covered with up to 5 feet of dredge spoil. On 8 Aug 80, an open stand pipe piezometer was offset 25 feet south of DH-3A to tip elevation +5.7'. The hole was bailed and the water- level recorded 24 hours later. The waterlevel was at ground level or elevation 15.5'

18. TOTAL CORE RECOVERY FOR SOILING
19. SIGNATURE OF INSPECTOR
Paul J. Kelly

16. DATE HOLE STARTED 11 APR 80 COMPLETED 12 APR 80

15. ELEVATION GROUND WATER SEE NOTE # 5

14. TOTAL NUMBER CORE BOXES 11

13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 11

12. MANUFACTURER'S DESIGNATION OF DRILL

11. DATUM FOR ELEVATION SHOWN (FSM OR MSL)

10. SIZE AND TYPE OF BIT 3" O.D. Shelby Tube

DRILLING LOG		DIVISION	NAD	INSTALLATION	SHEET	OF	SHEETS
1. PROJECT Craney Island Management Study		NAD		NAO		1	
2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT 2" OD Split Spade					
3. DRILLING AGENCY N 221270 F 7 618 660 McCallum Drilling		11. DATUM FOR ELEVATION SHOWN (FSD or MSL) CE LOW WATER DATUM					
4. MOLE NO. (As shown on drawing title and file number)		12. MANUFACTURER'S DESIGNATION OF DRILL CME 45					
5. NAME OF DRILLER Floyd Downing		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 8					
6. DIRECTION OF MOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		14. TOTAL NUMBER CORE BOXES					
7. THICKNESS OF OVERBURDEN		15. ELEVATION GROUND WATER NO RECORD					
8. DEPTH DRILLED INTO ROCK		16. DATE MOLE STARTED 4 JUNE 80 COMPLETED 4 JUNE 80					
9. TOTAL DEPTH OF HOLE 14.0'		17. ELEVATION TOP OF MOLE 14.0					
18. SIGNATURE OF INSPECTOR Matthew I Byrne		19. TOTAL CORE RECOVERY FOR BORING					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	No. 200 BOX OR SAMPLE NO.	DEPTH	REMARKS (Drilling slurry, water loss, depth of weathering, etc., if significant)	BLOWS/FO'
14.0	0.0		(SM) vy. fn. SAND, non plas., little shell frags., lit. org. (roots), lit. cinder block, gray	1	0-2		2-2-3-3
12.0	2.0		(SP-SM) vy fn. fn. SAND, non plas., lit. shell, moist, tr. org., tr. hi. plas. CLAY	2	2-4		3-2-2-1
10.0	4.0		(SP-SM) fn. SAND, non plas., tr. shell, tr. org., moist, brn. - gray	7	4-6		3-1-3-3
8.0	6.0		(SP-SM) vy. fn. SAND, non plas., tr. shell, gray				
7.0	7.0		(OH) organic SILT & hi. plas. CLAY blk., moist, soft, tr. plant fibers	4	6-8		4-4-1-1
6.0	8.0		(SC) fn. SAND & hi. plas CLAY, moist, gray				
4.5	9.5		(SP-SM) vy fn SAND, non plas., gray	14	8-10		1-4-1-0
4.0	10.0		(SP-SM) fn. SAND, non plas., wet, lit. shell, tr. crs. sand, tr. hi. plas. CLAY in lenses, brn. & gray	6	10-12		1-0-1-2
2.0	12.0		fn. SAND, non plas. lit med, wet, brn. & gray. tr. shell, tr. pea GRAVEL	7	12-14		2-1-2-1
-2.0	16.0		BOH @ 16' .0 Groundwater not recorded due to inspector oversight	8	14-16		7-8-9-13

DRILLING LOG		DIVISION	INSTALLATION	SHEET 1			
PROJECT		KAD	NAO	OF 1 SHEETS			
1. PROJECT Craney Island Management Study							
2. LOCATION (Coordinates or Ties) N220,870 E2,619,450							
3. DRILLING AGENCY McCallum Drilling							
4. HOLE NO. (As shown on drawing title and file number) DH-2							
5. NAME OF DRILLER Floyd Downing							
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.							
7. THICKNESS OF OVERBURDEN							
8. DEPTH DRILLED INTO ROCK							
9. TOTAL DEPTH OF HOLE 16'-0"							
ELEVATION +	DEPTH 0-3'	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 BOX OR SAMPLE NO.	DEPTH	BLOWS/6"	
14.5	1.5		(SP)fn-med. SAND, non plas., lit. pea gravel 1.0' to 2.0'	2	0-2	1-2-2-3	
14.0	2.0		(SC)fn SAND & hi.plas. CLAY & shell mottle	3	2-4	3-3-3-2	
13.0	3.0		(SP)fn SAND, non plas, lit. shell, moist, dk. gray				
12.0	4.0		fn-med. SAND, tr. crs., non plas, tr. shell, tr. GRAVEL, brn.				
11.0	5.0		(OH)organic hi. plas. CLAY & SILT, sat., blk, tr. vy. fn SAND	3	4-6	1-0-1-3	
10.0	6.0		(SP-SC)mottled fn SAND & SAND & hi. plas. CLAY, light brn.				
9.0	7.0		(OH)organic hi. plas. CLAY & SILT, lit. vy. fn. SAND	4	6-8	3-1-1-1	
8.0	8.0		(SP)vy. fn-fn. SAND, non plas, tr. shell, gray				
7.5	8.5		(OH)organic hi. plas. CLAY & SILT, lit. vy. fn. SAND	5	8-10	3-1-0-1	
6.0	10.0		(SP)fn. SAND non plas, wet, grt	20			
4.5	11.5		(SM-SC)vy. fn. SAND w/occ. lenses of hi. plas. CLAY & SAND (SC), dk. gray	38	10-12	3-1-0-1	
4.0	12.0		(OH)org. CLAY & SILT hi. plas, sat. dk. gray				
2.0	14.0		(SM-SC)vy. fn. SAND non plas, lit. silt w/lenses of hi. plas. CLAY & SAND	7	12-14	1-0-0-1	
0.0	16.0		(OH)org. hi. plas. CLAY & SILT, soft, sat., dk. gray	8	14-16	1-1-0-1	
BOH @ 16'-0" cave in @ 6'-0" no v.o.c. recorded							

19. SIGNATURE OF INSPECTOR
M. Matthews

20. DATE
4 Jun 80

21. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN
8

22. DATE HOLE COMPLETED
4 Jun 80

23. ELEVATION TOP OF HOLE
+16.0

24. TOTAL CORE RECOVERY FOR BORING
5

25. REMARKS
(Drilling time, water loss, depth of weathering, etc., if significant)

DRILLING LOG		DIVISION		NAD		INSTALLATION		SHEET 1 OF 1 SHEETS	
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY		2. LOCATION (Coordinates or Street)		3. DRILLING AGENCY MCCALLUM DRILLING		4. HOLE NO. (As shown on drawing sheet and file number)		5. NAME OF DRILLER FLOYD DOWNING	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		9. TOTAL DEPTH OF HOLE		10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON	
11. DATUM FOR ELEVATION SHOWN (FSM or MSL)		12. MANUFACTURER'S DESIGNATION OF DRILL		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER	
16. DATE MOLE		17. ELEVATION TOP OF MOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR		20. REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	

ELEVATION +	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 (-) x	BOX OR SAMPLE NO.	DEPTH	REMARKS
15.5	0.0		(SP-SM) fn-crs. SAND, non plas., some shell, brn., gray, moist	5	1	0 - 2	BLONS/6 2-4-4-5
13.5	4.0		(OH) organic hi. plas. CLAY & SILT, sat., blk.		2	2 - 4	1-0-0-1
13.0	4.5		(SP) fn.-med. SAND non plas., moist, brn.		3	4 - 6	1-1-2-1
12.5	5.0		(OH) org. hi. plas. CLAY & SILT, sat., blk.		4	6 - 8	2-1-1-2
12.0	5.5		(SP) med.-crs. SAND, non plas., dk. gray		5	8 - 10	2-1-3-4
11.5	6.0		(SP) vy. fn. SAND, non plas.		6	10 - 12	1-1-1-1
10.0	7.5		(SP) med.-crs. SAND non plas, v/some shell wet		7		
9.5	8.0		2" the lense of (OH) @ 7.5				
7.5	10.0		(SM) vy. fn. SAND, non plas., wet, gray				
5.5	12.0		(SM-SC) med.-crs. SAND, non plas., v/lenses of hi. plas. org. CLAY & SAND dk. gray, wet, brn.				
4.5	13.0		(OH) org. hi. plas. CLAY & SILT, some shell, lit. crs. SAND sat., dk. gray				
3.2	14.5		(SM) vy. fn. SAND, non plas., wet, dk. gray				
1.5	16.0		(SP-SM) fn-crs. SAND, non plas., some shell, wet, blk. & brn.				
			BOH @ 16.10 W.O.C. @ 14.13 cave in @ 3'.0				

Signature: *Matthew T. Byrne*

DRILLING LOG		DIVISION		NAD		INSTALLATION		SHEET																															
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY		2. LOCATION (Coordinates or Station) N221300 E2626750		3. DRILLING AGENCY MCCALLUM DRILLING		4. HOLE NO. (As shown on drawing title and file number) DR-4		5. NAME OF DRILLER FLOYD DOWNING		6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		9. TOTAL DEPTH OF HOLE 16.0		10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON		11. DAY ON FOR ELEVATION SHOWN (FROM OR TO)		12. MANUFACTURER'S DESIGNATION OF DRILL CHE 45		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 8		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER W.O.C. 85.4		16. DATE HOLE STARTED 9 JUNE 80		17. ELEVATION TOP OF HOLE 18.0		18. SIGNATURE OF INSPECTOR <i>F. J. Byrne</i>		19. SIGNATURE OF INSPECTOR		20. TOTAL CORE RECOVERY FOR BORING	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 BOX OR SAMPLE NO. (-) 2	DEPTH	REMARKS (Drilling time, water, mud, etc., if significant)																																	
18.0	0.0		(SP) vy. fn. fn. SAND, non plas., moist, brn., lit, hi. plas. clay in lenses	1	0 - 2	BLWS/6 4-1-2-7																																	
16.0	2.0		fn.-med. SAND, non plas., moist, brn.	13	2 - 4	4-5-6-6																																	
15.0	3.0		fn.-med. SAND, some hi. plas. clay (SC) in lenses wet, brn. from 4.0 to 5.0, tr. hi. plas. CLAY & SAND in lenses (SC)	12	3 - 4	2-2-1-1																																	
13.0	5.0		fn.-med. SAND, tr. hi. plas. clay, some shell, wet, blk.	4	6 - 8	2-1-1-1																																	
11.0	7.0		(OH) org. CLAY & SILT, hi. plas., sat., blk. tr. vy. fn. SAND	5	8 - 10	wor-wor-1-1																																	
10.0	8.0		(SP) fn.-med. SAND tr. hi. plas. CLAY some shell, wet blk.	6	10 - 12	1-1-2-1																																	
9.2	8.8		vy. fn. SAND, non plas., wet, gray, lit, hi. plas. clay in lenses (OH)	7	12 - 14	3-10-9-7																																	
8.0	10.0		(OH) org. CLAY & SILT hi. plas., sat., blk, tr. shell lenses	8	14 - 16	8-5-5-8																																	
5.5	12.5		(SP) med. - crs. SAND, tr. hi. plas. CLAY, lit. shell, wet, brn.																																				
5.4	12.5																																						
2.0	16.0		BOH @ 16.0 WOC @ 12.6 cave in @ 4.5																																				

DRILLING LOG		DIVISION	INSTALLATION	SHEET OF SHEETS		
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY		NAD	NAO			
2. LOCATION (Coordinates or Station) N217860 E2626070				11. 2" OD SPLITSPOON CE LOW WATER DATUM		
3. DRILLING AGENCY MCCALLUM DRILLING				12. MANUFACTURER'S DESIGNATION OF DRILL CME 45		
4. HOLE NO. (As shown on drawing title and file number) DH-5				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 8 UNDISTURBED		
5. NAME OF DRILLER FLOYD DOWNING				14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER W.O.C. @ 1.9		
7. THICKNESS OF OVERBURDEN				16. DATE MOLE 6 JUNE 80		
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE + 23.0		
9. TOTAL DEPTH OF HOLE 16'-0"				18. TOTAL CORE RECOVERY FOR BORING 5		
10. SIGNATURE OF INSPECTOR <i>Matthew I Brink</i>				19. REMARKS (Drilling start, water base, depth of penetration, etc., if applicable)		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Descriptive)	#200 BOX OR SAMPLE NO. (-) %	DEPTH	BLOWS/6
23.0	0.0		(SP-SM) vy. fn.-fn. SAND, non plas.; moist, gray, lit shell frag.	1	0 - 2	1-2-2-4
19.4	3.6		fn.-cfs. SAND (SP), lit shell frag, wet, gray, tr organic hi plas fines (OH)	2	2 - 4	2-2-1-2
17.0	6.0		med.-cfs. SAND (SP) non plas, wet, gray	3	4 - 6	2-1-0-1
13.0	10.0		fn-med SAND (SP-SM), non plas., wet, gray	4	6 - 8	3-2-3-2
11.9	11.1		med.-cfs. SAND (SP), tr hi plas. clay, lit shell, wet, gray	5	8 - 10	4-2-1-0
11.0	12.0		med.-cfs. SAND (SP) non plas, wet, gray, w/occ. lense of SAND & hi. plas. CLAY (SC)	6	10 - 12	wob-2-2-3
9.0	14.0		fn-med SAND (SP) non plas, wet, gray	7	12 - 14	3-4-5-5
7.0	16.0		BOH @ 16.0 W.O.C. @ 11'.1	8	14 - 16	2-0-0-1

DRILLING LOG		DIVISION	INSTALLATION	SHEET	
1. PROJECT		NAO	NAO	1	
2. LOCATION (Coordinates or Station)		CRANEY ISLAND MANAGEMENT STUDY	10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON	OF 1 SHEETS	
3. DRILLING AGENCY		N2 17730 E2, 626, 420	11. DATUM FOR ELEVATION SHOWN (758M or ABL)		
4. HOLE NO. (As shown on drawing sheet and file number)		McCALLUM DRILLING	CE LON WATER DATUM		
5. NAME OF DRILLER		DH-6	12. MANUFACTURER'S DESIGNATION OF DRILL		
6. DIRECTION OF HOLE			CME 45		
7. THICKNESS OF OVERBURDEN			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	8 UNDISTURBED	
8. DEPTH DRILLED INTO ROCK			14. TOTAL NUMBER CORE BOXES W.O.C. @ 12.5		
9. TOTAL DEPTH OF HOLE		16' .0	15. ELEVATION GROUND WATER		
			16. DATE MOLE	STARTED 6 JUN 80 COMPLETED 6 JUN 80	
			17. ELEVATION TOP OF MOLE	23.0	
			18. TOTAL CORE RECOVERY FOR BORING	5	
			19. SIGNATURE OF INSPECTOR	<i>Mattew T. Lyons</i>	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 SOLENOID SAMPLE NO.	REMARKS (Condition of material, depth of penetration, etc., if significant)
25.0	0.0		(SP) fn-med. SAND, non plas., dry, brn.	4	DEPTH 6 FLOWS/6"
23.0	2.0		(SC) fn-med. SAND & hi. plas. CLAY moist, gty.	2	2 - 4 2-1-1-1
21.0	4.0		(SP) med. SAND, non plas., tr. gravel chips, w/occ. lense of SAND & hi plas. CLAY	3	4 - 6 3-2-2-3
17.0	8.0		fn-med. SAND non plas., tr. shell, wet, gray	4	6 - 8 2-3-3-3
15.0	10.0		(OH) organic fir plas. CLAY & SILT, sat, blk.	5	8 - 10 2-1-0-1
13.5	11.5		(SM-SP) vv. fn. SAND, tr. hi. plas. CLAY, wet, gray	6	10 - 12 2-4-3-1
13.0	12.0		(SP) fn-med. SAND non plas., tr shell, w/lenses of SAND some hi. plas. CLAY (SC)	7	12 - 14 1-0-1-4
9.0	16.0		BOH @ 16' .0 W.O.C. @ 12' .5	6	14 - 16 2-3-3-4

DRILLING LOG		DIVISION		INSTALLATION			
PROJECT		NAD		NAD			
CRANEY ISLAND MANAGEMENT STUDY		E2626, 900		NO. 00 SPLITSPOON			
LOCATION (Coordinates or Station)		DH-7		DATE FOR ELEVATION SHOWN (TOP OF LOG)			
DRILLING AGENCY		McCullum Drilling		CE LOW WATER DATUM			
NAME OF DRILLER		FLOYD DOWNING		MANUFACTURER'S DESIGNATION OF DRILL			
DIRECTION OF HOLE		VERTICAL <input type="checkbox"/> INCLINED <input type="checkbox"/>		CME 4.5			
THICKNESS OF OVERBURDEN		DEPTH DRILLED INTO ROCK		TOTAL NO. OF OVERBURDEN SAMPLES TAKEN			
TOTAL DEPTH OF HOLE		16'0		8			
CLASSIFICATION OF MATERIALS (Description)		LEGEND		ELEVATION			
		a b c		+			
23.0	0.0	(SP) fm-tr. med. SAND, tr. hi. plas, CLAY in lenses moist, hi. plas fm-med. SAND, non plas, moist, brn		4	1	0 - 2	1-4-6-8
22.0	1.0	@ 4:0 gets wet		2	2	2 - 4	9-7-7-10
14.0	9.0	occ. lense of (SC) SAND & hi. plas. clay, wet, from 6'.0 to 9'.0		1	3	4 - 6	6-5-5-4
13.0	10.0	(OH) org. hi. plas. CLAY & SILL		5	8	8 - 10	3-1-0-1
9.0	14.0	(SP) fm-med. SAND non plas., wet, brn.		6	10	10 - 12	3-5-6-4
7.0	16.0	lit. hi. plas CLAY in lenses		7	12	12 - 14	1-1-1-3
		BOH @ 16'.0 cave in @ 5'.5 No N.O.C.		15	8	14 - 16	2-2-4-4

19. SIGNATURE OF INSPECTOR
Matthew T Byrne

REMARKS
(Drilling time, water loss, depth of penetration, etc., if applicable)
BLOWS/6"

DRILLING LOG		DIVISION	NAD	INSTALLATION	SHEET	
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY				NAO	OF SHEETS	
2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON				
3. DRILLING AGENCY N215500 E2626900		11. DATUM FOR ELEVATION SHOWN (FSM or MSL) CE LOW WATER DATUM				
4. NAME OF DRILLER McCALLUM DRILLING		12. MANUFACTURER'S DESIGNATION OF DRILL CME 45				
5. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 8				
6. THICKNESS OF OVERBURDEN		14. TOTAL NUMBER CORE BOXES NO M.O.C.				
7. DEPTH DRILLED INTO ROCK		15. ELEVATION GROUND WATER NO M.O.C.				
8. TOTAL DEPTH OF HOLE		16. DATE HOLE STARTED 4 JUN 80				
9. ELEVATION		17. ELEVATION TOP OF HOLE 21.0				
10. TOTAL CORE RECOVERY FOR BORING		18. TOTAL CORE RECOVERY FOR BORING				
19. SIGNATURE OF INSPECTOR <i>Matthew Payne</i>		19. SIGNATURE OF INSPECTOR				
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 (-) #	BOX OR SAMPLE NO.	REMARKS (Drilling runs, water loss, depth of weathering, etc., if applicable) DEPTH
24.0	0.0	c	(SP) fm-med. SAND, non plas., moist, brn	1	0 - 2	1-2-4-5
18.0	3.0		color change to dk. gry. from 3'.0 to 4'.0	4	2 - 4	2-2-1-2
17.0	4.0		vy. fn. SAND non plas., lit. shell frag, wet, gray 4'.0 to 6'.0	3	4 - 6	2-0-2-1
15.0	6.0		fm-med. SAND, non plas., lit shell frag, wet, gray 6'.0-7'.5	4	6 - 8	1 0 0 0
13.5	7.5		(SM) vy. fn. SAND, non plas., lit. shell frag, wet, gray	5	8 - 10	WOH-1-2-1
12.0	9.0		(OH) org. hi. plas, CLAY & SILT, sat., dk. gry	69	10 - 12	1-0-0-1
11.0	10.0		(OH) org. CLAY, hi. plas., some SAND sat., grey	7	12 - 14	WOR WOR WOR
10.0	11.0		(SM) vy. fn. SAND, non plas., wet, gray	8	14 - 16	2-1-0-1
9.4	11.6		(OH) org CLAY & SILT, hi. plas., tr. vy. fn. SAND w/some lenses of vy. fn. SAND (SH-SC) wet, dk. gray			
5.5	15'		(SP) fn SAND, non plas, wet, brn. gray			
5.0	16'		BOH @ 16'.0 cave in @ 4'.0 No M.O.C.			

DRILLING LOG		DIVISION	NAD	INSTALLATION	SHEET
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY		NAD		NAO	OF 1 SHEETS
2. LOCATION (Coordinates or Station) N218390 E2626560		10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON			
3. DRILLING AGENCY McCALLUM DRILLING		11. DATUM FOR ELEVATION SHOWN (FSM or MSL) CE LOW WATER DATUM			
4. HOLE NO. (As shown on drawing title and file number) DR-9		12. MANUFACTURER'S DESIGNATION OF DRILL CNE 45			
5. NAME OF DRILLER FLOYD DOWNING		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 8			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		14. TOTAL NUMBER CORE BOXES			
7. THICKNESS OF OVERBURDEN		15. ELEVATION GROUND WATER NO M.O.C.			
8. DEPTH DRILLED INTO ROCK		16. DATE HOLE STARTED 9 JUNE 80 COMPLETED 9 JUNE 80			
9. TOTAL DEPTH OF HOLE 16'.0		17. ELEVATION TOP OF HOLE ± 22.5			
18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR <i>Matthew Irvine</i>			
ELEVATION + -	DEPTH a b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	#200 SIEVE NO. i	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
22.5	0		(SP) vy. fn.-fn. SAND, non plas., moist, brn. & gray 0'.0 to 2'.5	1	DEPTH 0 - 2 BLOWS/6" 1-2-3-4
20.0	2'.5		fn.-med. SAND (SP), non plas., moist, gray tr. med. SAND in lenses	5	2 - 4 4-5-6-6
18.5	4'.0		vy. fn. SAND (SP-SH), wet, non plas., gray	3	4 - 6 3-5-3-5
16.5	6'.0		fn. SAND (SP), non plas., tr. shell frag., wet, gray, tr. vy. fn. SAND w/tr. hl. plas. CLAY (CH) in lenses from 8'.0 to 10'.0	10	4 6 - 8 4-4-1-2
10.5	12'.0		Lit. hi. plas. org. CLAY in lenses from 10'.0 to 12'.0	26	6 10 - 12 1-0-1-0
8.5	14'.0		(SM,SC) alternating lenses of vy. fn. SAND & hi. plas. CLAY	7	12 - 14 NOB-NOB-NOB-NOB
7.0	15'		(SM,SC) alternating lenses of vy. fn. SAND & hi. plas. CLAY & SAND, wet, dk. gray	12	8 14 - 16 1-2-3-1
6.5	16'.0		(SP) fn.-med. SAND w/hi. plas. CLAY lenses BOB @ 16'.0 CAVE IN @ 14'.25 No M.O.C.		

DRILLING LOG		DIVISION NAD		INSTALLATION NAD		SHEET 1 OF 1 SHEETS	
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY							
2. LOCATION (Coordinate or Station) N218350 E2626240							
3. DRILLING AGENCY MCCALLUM DRILLING							
4. HOLE NO. (As shown on drawing title and log number) DH-10							
5. NAME OF DRILLER FLOYD DOWNING							
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.							
7. THICKNESS OF OVERBURDEN							
8. DEPTH DRILLED INTO ROCK							
9. TOTAL DEPTH OF HOLE 16'.0							
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 BOX OR SAMPLE NO.	DEPTH	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
21.0	0.0	(SP) fn.-tr. med. SAND non plas, moist., brn. from 0'.0 to 4'.0		1	0 - 2	BLONDS/6" 1-3-4-5	
19.0	2.0			2	2 - 4		
18.5	2.5	fn.-med. SAND non plas, moist., blk. 2'.0 to 2'.5					
17.0	4.0		(SM) vy. fn. SAND, lit. silt, wet, gray	37	4 - 6		
15.0	6.0		(SP) fn.-med. SAND, non plas, wet, gray, occ. lense of SAND & hi. plas. CLAY (SC) from 6'.0 to 7'.0				
14.0	7.0		(SM) vy. fn.-fn. SAND, non plas, wet, occ. lense of SAND & hi. plas. Clay (SC)				
9.4	11.6			33	8 - 10		
9.0	12.0		(SP) organic hi. plas. CLAY & SILT, blk., sat.				
8.9	13.0		(SM-SC) vy. fn. SAND, & hi. plas. CLAY, moist.				
7.5	13.5		(OH) organic hi. plas. CLAY & SILT, blk., sat.				
			(SP) med.-crs. SAND non plas, lit. shell frag, wet, gray				
5.0	16'.0		BOH @ 16'.0, W. O. C. @ 13'.1				
10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON							
11. DAYS FOR ELEVATION SHOWN FROM TO							
CE. LOG WATER DATUM							
12. MANUFACTURER'S DESIGNATION OF DRILL CME-45							
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 8 UNDISTURBED							
14. TOTAL NUMBER CORE BOXES							
15. ELEVATION GROUND WATER N.O.C. @ 7.9							
16. DATE HOLE STARTED 6 JUNE 1980 COMPLETED 6 JUNE 1980							
17. ELEVATION TOP OF HOLE + 21.0							
18. TOTAL CORE RECOVERY FOR BORING							
19. SIGNATURE OF INSPECTOR Matthew Byrne							

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1	
		NAD		NAO		OF 1 SHEETS	
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY							
2. LOCATION (Coordinates or Station) N221900 E2,624,950							
3. DRILLING AGENCY MCCALLUM DRILLING							
4. HOLE NO. (As shown on drawing title and site number) DH-11							
5. NAME OF DRILLER							
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.							
7. THICKNESS OF OVERBURDEN							
8. DEPTH DRILLED INTO ROCK							
9. TOTAL DEPTH OF HOLE 10'.0							
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 SIEVE NO.	BOX OR SPLITS NO.	REMARKS (Drilling time, meter logs, depth of penetration, etc. If split BORES/6"	
15.0	0.0		(SP) fn.-med. SAND, non plas., tr. gravel, moist, brn, some shell	4	1	0 - 2	1-1-1-2
11.0	4.0		(OH) organic hi. plas. CLAY & SILT, sat, blk	8	2	2 - 4	3-1-2-1
6.5	8.5		lenses of vy. fn. SAND (SM) from 6'.0 to 10'.0		3	4 - 6	1-0-0-1
6.0	9.0		(SM) vy. fn. SAND, non plas, gray		4	6 - 8	MOH-MOH -MOH-MOH
5.0	10.0		(OH) organic hi. plas. CLAY & SILT sat., blk. BOH @ 10'.0 CAVE IN @ 4'.0 No W.O.C.		5	8 - 10	1-2-0-0

Matthew T. Byrne

DRILLING LOG		DIVISION	NAD	INSTALLATION	SHEET
1. PROJECT		CRANEY ISLAND MANAGEMENT STUDY		NAD	OF 1 SHEETS
2. LOCATION (Coordinates or District)		NO. SIZE AND TYPE OF BIT 2" OD SPLITSPOON			
3. DRILLING AGENCY		11. DATUM FOR ELEVATION SHOWN (FSM or MLL)			
4. HOLE NO. (As shown on drawing title and file number)		CE LOW WATER DATUM			
5. NAME OF DRILLER		12. MANUFACTURER'S DESIGNATION OF DRILL			
6. DIRECTION OF HOLE		CME 45			
7. THICKNESS OF OVERBURDEN		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 8			
8. DEPTH DRILLED INTO ROCK		14. TOTAL NUMBER CORE BOXES			
9. TOTAL DEPTH OF HOLE 16'.0		15. ELEVATION GROUND WATER NO W.O.C.			
ELEVATION		CLASSIFICATION OF MATERIALS (Description)		#200 SOLE NO. (-) %	REMARKS (Drilling time, depth of weathering, etc., if significant)
DEPTH	LEGEND			DEPTH	BLOWS/6"
21.0	0	(SP) fn.-med. SAND, non plas. lft. shell, tr. gravel chips moist, brn.		1	0 - 2
		same but no shell		2	1-1-2-4
				3	4-3-2-4
14.5	6.5	(OH) organic hi. plas. CLAY & SILT w/lenses of med. SAND & hi. plas. CLAY from 6'.5 to 11'.0		4	3-1-0-1
				5	8 - 10
				6	1-1-1-0
10.0	11.0	(SP) vy. fn. SAND, non plas., blk, vet med. to coarse from 12'.0 to 13'.0		6	10 - 12
		fn.-med. SAND, non plas, moist w/shell frag., brn. from 13.0 - 16'.0		7	12 - 14
				8	3-10-7-10
5.0	16.0	BOH @ 16'.0 no water o/c, methane gas came out of casing for + 5.0 minutes until casing pulled & hole filled		6	14 - 16
				8	2-3-7-7

PROJECT		DIVISION		INSTALLATION		SHEET 1	
CRANEY ISLAND MANAGEMENT STUDY		NAD		XAO		OF 1 SHEETS	
LOCATION (County, State, Township)				10. SIZE AND TYPE OF BIT		2" OD SPLITSPOON	
N216820 E2627420				11. DAYUM FOR ELEVATION SHOWN (FEET OR METERS)		CE LOW WATER DATUM	
DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL		CME 45	
MCCALLUM DRILLING				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		8	
HOLE NO. (As shown on drawing title and bit number)		DH-13		14. TOTAL NUMBER CORE BOXES		1	
NAME OF DRILLER				15. ELEVATION GROUND WATER		W.O.C. @ 2.3	
FLOYD DOWNING				16. DATE MOLE		5 JUNE 1980	
DIRECTION OF MOLE				17. ELEVATION TOP OF MOLE		+ 17.0	
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		DEG. FROM VERT.		18. TOTAL CORE RECOVERY FOR BORING		3	
7. THICKNESS OF OVERBURDEN				19. SIGNATURE OF INSPECTOR		<i>Matthew T. Byrne</i>	
8. DEPTH DRILLED INTO ROCK				200		BOX OR SAMPLE NO.	
9. TOTAL DEPTH OF HOLE 16'.0				(-) %			

ELEVATION +	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	#200 (-) % f	BOX OR SAMPLE NO. g	DEPTH h	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
17.0	0		(SP) fn.-med. SAND, some silt, lit. plant fibers, tr. hi. plas. clay in lenses brn. moist	9	1	0 - 2	BLOWS/6" 3-3-4-4
15.0	2.0		(SP) fine SAND, non plas., moist, some shell fragments from 2'.0 to 4'.0	6	2	2 - 4	4-4-5-6
13.0	4.0		fn.-med. SAND, non. plas., occ. tr. hi. plas. clay fines in lenses, brn. wet		3	4 - 6	3-3-3-3
11.0	6.0		(SP-SC) fn.-crs. SAND w/ some hi. plas. CLAY in lenses, lit. shells, wet, gray	7	4	6 - 8	2-1-1-1
7.0	10.0		alternating lenses of fn.- med. (SP) & (SC) from 8'.0 to 10'.0		5	8 - 10	4-1-1-2
5.5	11.5		(SP) fn.-med. SAND, non plas., tr. shell, wet, gray		6	10 - 12	4-4-5-1
			(OH) org. hi. plas. CLAY & silt, tr. SAND blk. sat.		7	12 - 14	1-1-1-1
2.3	14.7				8	14 - 16	1-1-1-1
0.0	16.0		BOH @ 16'.0 WOC @ 14'.7				

DRILLING LOG		DIVISION	NAD	INSTALLATION	SHEET
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY		NAD		OF 1 SHEETS	
2. LOCATION (Coordinate or Station) N216300 E2627520		10. SIZE AND TYPE OF BIT 2" OD SPLITSPOON			
3. DRILLING AGENCY MCCALLUM DRILLING		11. DAYUM FOR ELEVATION BORN (YBM or MB)			
4. HOLE NO. (As shown on drawing title and file number) DH-14		CE LOW WATER DATUM			
5. NAME OF DRILLER FLOYD DOWNING		12. MANUFACTURER'S DESIGNATION OF DRILL CME 45			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	
7. THICKNESS OF OVERBURDEN		8		UNDISTURBED	
8. DEPTH DRILLED INTO ROCK		14. TOTAL NUMBER CORE BOXES			
9. TOTAL DEPTH OF HOLE 16'.0		15. ELEVATION GROUND WATER No W.O.C.			
ELEVATION		STARTED		COMPLETED	
16.0		5 JUNE 1980		5 JUNE 80	
14'.0		17. ELEVATION TOP OF HOLE		17. ELEVATION TOP OF HOLE	
11.0		+ 16.0		+ 16.0	
10.0		18. TOTAL CORE RECOVERY FOR BORING			
9.0		19. SIGNATURE OF INSPECTOR <i>Matthew B. Bays</i>			
8.4		20. BOX OR SAMPLE NO.		REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
7.0		1		DEPTH 3-2-3-4	
6.0		2		5-5-5-6	
5.0		3		3-3-2-1	
4.0		4		3-6-1-1	
3.0		5		1-0-1-0	
2.2		6		3-2-1-1	
1.6		7		1-1-1-7	
0.6		8		3-5-1-2	
0.0					

DRILLING LOG		DIVISION	INSTALLATION	SHEET		
PROJECT		NAD	NAD	OF 1 SHEETS		
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY						
2. LOCATION (Coordinates or Station) N213510 E2,628,130						
3. DRILLING AGENCY MCCALLUM DRILLING						
4. HOLE NO. (As shown on drawing title and file number) DH-15						
5. NAME OF DRILLER FLOYD DOWNING						
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.						
7. THICKNESS OF OVERBURDEN						
8. DEPTH DRILLED INTO ROCK						
9. TOTAL DEPTH OF HOLE 16'.0						
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Paragraph)	BOX OR SAMPLE NO.	DEPTH	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
15.0	0		(SM) fn. SAND, non plas., tr. shell, tr. gravel chips, tr. (SC) SAND & hi. plas. CLAY in lenses moist gray	1	0 - 2	BLON/6"
13.0	2.0		(SP) fn. med. SAND, lit. shell non plas., gray, wet	2	2 - 4	1-1-1-1
11.0	4.0		vy. fn.-fn. SAND, wet, w/lenses of (SM-SC), dk. gray.	3	4 - 6	3-2-5-6
9.0	6.0		med.-crs. SAND (SP), non plas., wet, brn.	4	6 - 8	4-4-5-6
8.0	7.0		fn. SAND (SP-SM), non plas., wet, gray	5	8 - 10	5-4-7-8
7.0	8.0		fn.-med. SAND, non plas., gray, w/lenses of organic hi. plas. Clay & SAND (SC) from 8'.0 11'.5	6	10 - 12	4-4-1-4
5.0	10.0		vy. fn. SAND (SP) gray, wet non plas. 11'.5 to 12'.0	7	12 - 14	1-1-2-6
3.5	11.5		med.-crs. SAND, tr. org., tr. fibers, tr. shell, blk, which grade w/d. into fn.-med. SAND, 12.0'-16'.0 lense of hi. plas. (CH) 4" thk.	8	14 - 16	5-5-5-4
3.0	12.0		gray 14'.0 to 16'.0, tr. GRAVEL & shell	5		
1.0	14.0					
-1.0			BOH @ 16'.0 cave in @ 4'.0 No W.O.C.			

1200
(-) %
NO. 1
SIGNATURE OF INSPECTOR
M. Lawrence Payne

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
PROJECT		NAO		NAO		Of 1 SHEETS	
1. PROJECT		CRANEY ISLAND MANAGEMENT STUDY		10. SIZE AND TYPE OF BIT		2" OD ART AUGER	
2. LOCATION (Coordinates or Station)		N212960 E2628210		11. DAY/UM FOR ELEVATION SHOWN (TZM or BSL)		CE LOW WATER DATUM	
3. DRILLING AGENCY		MCCALLUM DRILLING		12. MANUFACTURER'S DESIGNATION OF DRILL		CME 45	
4. HOLE NO. (As shown on drawing title and file number)		DH-16		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 8 UNDISTURBED 8	
5. NAME OF DRILLER		FLOYD DOWNING		14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE		VERTICAL <input type="checkbox"/> INCLINED <input type="checkbox"/> DEG. FROM VERT. _____		15. ELEVATION GROUND WATER W @ 24 Hrs. @ 8.5		COMPLETED 4 JUNE 1980	
7. THICKNESS OF OVERBURDEN		DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE ±		15.0 ?	
8. TOTAL DEPTH OF HOLE		16'.0		18. TOTAL CORE RECOVERY FOR BORING			
9. SIGNATURE OF INSPECTOR		M. J. Downey		19. SIGNATURE OF INSPECTOR		M. J. Downey	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 SOLE NO. (-) 2	SOLE NO. 1	DEPTH	REMARKS (Drilling time, water loss, depth of penetration, etc. if significant)
15.0	0		(SM) TOPSOIL				BLOWS/6"
14.5	0.5		(SP) med.-crs. SAND, tr. hi. plas. clay (CH) in clumps, moist		1	0 - 2	3-3-8-7
13.0	2.0		fn.-med, tr. crs. SAND (SP), some hi. plas. clay in lenses, moist, brn.	10	2	2 - 4	7-6-6-4
9.0	6.0		(SC) fn. SAND, some hi. plas. CLAY, set, blk.		3	4 - 6	2-1-0-1
8.5	6.5		(OH) org. CLAY, lit. vy. fn. SAND.		4	6 - 8	3-2-1-3
8.0	7.0		(SP) med.-crs. SAND, non plas. wet, brn., lit. shell frag. w/lenses of SAND & hi. plas. CLAY (SC)		5	8 - 10	2-1-4-2
5.4	9.6			12	6	10 - 12	3-1-1-3
3.8	11.2				7	12 - 14	2-1-5-9
3.2	11.8		blk. from 11'.2 to 11'.8		8	14 - 16	3-5-4-5
3.0	12.0		(OH) org. CLAY & SAND, blk.		5		
			(SP) vy. fn. SAND non plas.				
1.0	14.0		lense of (SC) SAND, some clay				
0.5	14.5		fn. crs. SAND, non plas., brn., tr. shell				
-1.0	16.0		BOH @ 16'.0 WOC @ 9'.6 W @ 24 hrs. @ 6'.5				

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1	
PROJECT CRANEY ISLAND MANAGEMENT STUDY		NAD		NAO		OF 1 SHEETS	
1. LOCATION (Coordinates or Station)							
N212900 E2,627,900							
2. DRILLING AGENCY							
MCCALLUM DRILLING							
3. HOLE NO. (As shown on drawing title and file number)							
DH-17							
4. NAME OF DRILLER							
FLOYD DOWNING							
5. DIRECTION OF HOLE							
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.							
6. THICKNESS OF OVERBURDEN							
7. DEPTH DRILLED INTO ROCK							
8. TOTAL DEPTH OF HOLE 16.10							
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	DEPTH	BLONS/6"	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
23.0	0.0		(SP) fn.-med. SAND, non plas., lit. shell frag., tr. of (SC) in lenses, moist, brn.	1 0 - 2	2-2-4-3		
21.0	2.0		fn.-med. SAND non plas., moist, tr. of (SC) in lenses	2 2 - 4	3-3-4-5		
19.0	4.0		fn.-med. SAND (SP), brn. & white, some shell frag w/lenses of org. hi. plas. clay, sat, blk.	3 4 - 6	3-2-1-1		
17.0	6.0		vy. fn.-med. (SP) SAND, non plas. w/tr. (SC) in lenses, gray, wet	4 6 - 8	2-1-1-0		
14.0	9.0		(OH) org. FLAG-CLAY & SILT, sat.	5 8 - 10	1-0-3-1		
13.5	9.5		(SP) fn. SAND, non plas., wet, gray, tr. of (SC) in lenses	6 10 - 12	1-0-0-1		
12.4	10.6		(SC) fn.-med. SAND, some hi. plas. clay, lit. shell frag., tr. roots, wet, brn.	7 12 - 14	4-4-6-5		
11.0	12.0		(OH) org. CLAY & SILT sat., blk.	8 14 - 16	2-2-3-5		
10.5	12.5		(SP) fn.-crs. SAND, non plas., gray, wet				
7.0	16.0		BOH @ 16'.0 cave in @ 10'.5 No W.O.C. NOTE: Area contains trash from dredge disposal: hunks of metal, chains, cables, stumps, etc....				

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 1 SHEETS	
1. PROJECT CRANEY ISLAND MANAGEMENT STUDY LOCATION (Coordinates or Station) N21200 E2,627,820		NAD		NAO			
2. DRILLING AGENCY MCCALLUM DRILLING		DH-18		10. SIZE AND TYPE OF BIT 2" O.D. SPLITSPoon			
3. HOLE NO. (As shown on drawing title and file number)				11. DATUM FOR ELEVATION SHOWN (TBM or BENCH) CE LOW WATER DATUM			
4. NAME OF DRILLER FLOYD DOMING				12. MANUFACTURER'S DESIGNATION OF DRILL CME 45			
5. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		8	
6. THICKNESS OF OVERBURDEN				14. TOTAL NUMBER CORE BOXES			
7. DEPTH DRILLED INTO ROCK				15. ELEVATION GROUND WATER		W.O.C. @12.5	
8. TOTAL DEPTH OF HOLE 16.10				16. DATE HOLE STARTED		5 JUNE 1980	
				17. ELEVATION TOP OF HOLE		+ 22.0	
				18. TOTAL CORE RECOVERY FOR BORING		1	
				19. SIGNATURE OF INSPECTOR		Matthew I. Bryan	
ELEVATION + a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	#200 SIEVE (-) % e	BOX OR SAMPLE NO. f	DEPTH BLOW/6" g	REMARKS (Chilling time, water loss, depth of weathering, etc., if significant)
22.0	0.0		(SP) fn.-med. SAND, non plas., some shell frag., moist, brn.	6	1	0 - 2	1-2-2-3
20.0	2.0		fn.-med. SAND				
19.0	3.0		(OH) organic CLAY & Silt, sat, hi. plas., bik.		2	2 - 4	2-1-0-0
18.0	4.0		(SP) vy. fn. SAND w/lenses of hi. plas. clay & SAND (SC), soft, wet	23	3	4 - 6	WOH-WOH-1-WOH
16.0	6.0		occ. lenses of soft, hi. plas. (OH) from 6'.0 to 8'.0	26	4	6 - 8	WOH-WOH-WOH
14.0	8.0		fn. SAND (SP)				
13.0	9.0		(OH) org. CLAY & SAND sat., bik.		5	8 - 10	2-1-0-0
12.5	9.5		(SC) fn. SAND and hi. plas. CLAY, loose				
12.0	10.0		(OH) org. CLAY & SAND sat., bik.		6	10 - 12	WOH-WOH-WOH
11.2	10.8		(SP) fn. SAND, non plas., brn.				
10.5	11.5		fn. to crs. SAND (SP), non plas., gray, wet from 12'.0 to 16'.0	3	7	12 - 14	4-2-2-5
10.0	12.0		same w/tr. pea GRAVEL				
8.0	14.0				8	14 - 16	4-2-1-2
6.0	16.0		BOH @ 16'.0 W. O. C. @ 9'.5				

NOTE: Area contains trash from dredge disposal: hunks of metal, chains, cables, etc...

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
PROJECT		NAD		NAO		OF 1 SHEETS	
1. PROJECT		CRANEY ISLAND MANAGEMENT STUDY		10. SIZE AND TYPE OF BIT		2" OD SPLITSPOON	
2. LOCATION (Coordinates or Name)		N215670 E2627770		11. DATE FOR ELEVATION SHOWN		7 FEB 1980	
3. DRILLING AGENCY		MCCALLUM DRILLING		12. MANUFACTURER'S DESIGNATION OF DRILL		CME 45	
4. HOLE NO. (As shown on drawing title and log number)		DH-19		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		8	
5. NAME OF DRILLER		FLOYD DOWNING		14. TOTAL NUMBER CORE BOXES		/	
6. DIRECTION OF HOLE		<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER		H.O.C. (86.7)	
7. THICKNESS OF OVERBURDEN				16. DATE MOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF MOLE		+ 19.0	
9. TOTAL DEPTH OF HOLE		16'.0		18. TOTAL CORE RECOVERY FOR BORING		x	
				19. SIGNATURE OF INSPECTOR			
ELEVATION +	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	#200 (-) %	BOX OR SAMPLE NO.	REMARKS (Coring time, water loss, depth of penetration, etc., if relevant)	DEPTH
19.0	0	c	(SP-SH) SAND, vy. fn-fn, non plas, lit. shell frag., moist brn., brick fragments 0'.0 to 2'.0		1		0 - 2
15.0	4.0		fn-crs. SAND 2'.0 to 4'.0	9	2		2 - 4
14.0	5.0		tr. of GRAVEL 4'.0 - 6'.0 gets wet @ 5'		3		4 - 6
13.0	6.0		lenses of hi-plas. CLAY & SAND (SC) from 6'.0 - 9'.0		4		6 - 8
10.0	9.0		fn.-med. SAND, non plas. (SP)		5		8 - 10
9.0	10.0		vy. fn. SAND (SP), non plas, tr: GRAVEL from 10'.0 to 11'.0		6		10 - 12
8.0	11.0		fn.-med. SAND (SP), non plas, tr: GRAVEL from 10'.0 to 11'.0	10	6		10 - 12
7.0	12.0		fn.-med. SAND (SP) non plas some shell, occ. CLAY lense (OH), hi-plas. from 12'.0 to 16'.0		7		12 - 14
6.7	12.3				8		14 - 16
3.0	16.0		B.O.H. @ 16'.0 MOC @ 12'.3		6		14 - 16

DRILLING LOG		DIVISION		REGISTRATION		SHEET	
		North Atlantic		Norfolk District		1 of 3	
1. PROJECT		Craney Island Disposal Area		10. SIZE AND TYPE OF BIT		2" Spoon, 3" Shelby Tube	
2. LOCATION (Coordinates or Section)		See Map		11. DATUM FOR ELEVATION SHOWN (TEAM #/MEL)		MUM	
3. DRILLING AGENCY		Carpenter Construction Company		12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (1/4 above or showing side and file number)		CI-3		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		21	
5. NAME OF DRILLER		Caldwell		14. TOTAL NUMBER CORE BOXES		N/A	
6. DIRECTION OF HOLE		VERTICAL <input type="checkbox"/> INCLINED <input type="checkbox"/> DRG. FROM VERT.		15. ELEVATION GROUND WATER		-2.0 Below Surface	
7. THICKNESS OF OVERBURDEN		122.0		16. DATE HOLE		STARTED 27 Jul 71 COMPLETED 29 Jul 71	
8. DEPTH DRILLED INTO ROCK		N/A		17. ELEVATION TOP OF HOLE		+5 MUM	
9. TOTAL DEPTH OF HOLE		122.0		18. TOTAL CORE RECOVERY FOR BORING		N/A	
				19. SIGNATURE OF INSPECTOR			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
+ 3.0		(SP)	fine SAND, trace silt and shell fragments, brown		1	6-7-8	
+ 3.0	2.0	(SP-SM)	fine SAND, trace to little silt and shell, gray		2	10-11-10	
+ 1.0	4.0	(SM)	fine SAND, little silt, trace shell, gray		3	5-4-5	
- 2.0	7.0	(SM)	SHELL FRAGMENTS and sand, little silt and organic matter, brown		4	6-7-7	
- 9.0	14.0	(SP)	fine to medium SAND and shell fragments w/lenses of organic silt (OL)		5	5-7-9	
-15.0	20	(SP-SM)	fine SAND, some shell fragments, trace to little silt, gray		6	4-4-4	
-20.0	25	(SP)	fine to coarse SAND and shell fragments, brown		7	3-4-4	
-25.0	30	(SP)	fine SAND, trace silt, brown		8	4-5-5	
-29.0	34	(MH)	micro-organic CLAY and silt, gray		9	2-2-2	
	40		high to very high plasticity				
	45		LL = 67 PI = 32 Average Moisture = 70%				
			LL = 77 PI = 34 Average Moisture = 84%				
					U-10	3" Shelby Tube	
					11	2-2-2	
					U-12	3" Shelby Tube	

Hole No. CI-3

DRILLING LOG	DIVISION North Atlantic	INSTALLATION Norfolk District	SHEET 2 OF 3 SHEETS
1. PROJECT Craney Island Disposal Area	LOCATION (Coordinates or Section)	SIZE AND TYPE OF BIT 2" Spoon, 3" Shelby Tube	
2. LOCATION (Coordinates or Section)	MANUFACTURER'S DESIGNATION OF DRILL MLJ	DATE FOR ELEVATION SHOWN (ZEM or NEM)	
3. DRILLING AGENCY See Map			
4. DRILLING COMPANY Carpenter Construction Company	DRILLING AGENCY CI-3		
5. NAME OF DRILLER Caldwell			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.			
7. THICKNESS OF OVERBURDEN 122.0			
8. DEPTH DRILLED INTO ROCK N/A			
9. TOTAL DEPTH OF HOLE 122.0			
10. SIGNATURE OF INSPECTOR			
11. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 21			
12. TOTAL NUMBER CORE BOXES N/A			
13. ELEVATION GROUND WATER -2.0 Below Surface			
14. DATE HOLE 27 Jul 71			
15. ELEVATION TOP OF HOLE +5 MLJ			
16. SIGNATURE OF INSPECTOR			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	NO. OF SAMPLES	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
50					U-12	
55					13	1-1-1
60					14	1-1-1
65					15	2-1-2
70					16	1-1-1
75					N/R	3" Shelby Tube
80					N/R	3" Shelby Tube
85					N/R	3" Shelby Tube
90					19	1-1-1
95					20	1-1-1
100					21	1-2-1

(cont'd)

ENG FORM 1836

PREVIOUS EDITIONS MAY BE USED (ZEM 1719-1-1807)

1 APR 65

DOW 1965 67-74-05

PROJECT

Craney Island

HOLE NO.

CI-3

DRILLING LOG		DIVISION	INSTALLATION	SHEET		
1. PROJECT Craney Island Disposal Area See Map		North Atlantic		23		
2. LOCATION (Coordinate or Station)		Norfolk District		of 3		
3. DRILLING AGENCY Carpenter Construction Company		2" Spoon, 3" Shelby Tube MIX				
4. HOLE NO. (As shown on drawing title and file number)		CI-3				
5. NAME OF DRILLER Caldwell		MANUFACTURER'S DESIGNATION OF DRILL				
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VEE.		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		21		
7. THICKNESS OF OVERBURDEN		14. TOTAL NUMBER CORE BOSES		N/A		
8. DEPTH DRILLED INTO ROCK		15. ELEVATION GROUND WATER		-2.0 Below Surface		
9. TOTAL DEPTH OF HOLE		16. DATE HOLE STARTED		27 Jul 71		
		17. REFLECTION TOP OF HOLE		COMPLETED 29 Jul 71		
		18. TOTAL CORE RECOVERY FOR BORING		+5 MILM		
		19. SIGNATURE OF INSPECTOR		N/A		
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Describe)	% CORE RECOV. BY HOLE	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of overburden, etc. if significant)
-100.0	105	(OH)	micro-organic SILT and clay, w/ thin lenses of very fine sand, gray high plasticity	22	2-2-2	
-117.0	125		boring terminated 122.0 (Elev. -117.0)	23	4-5-5	
				24	5-5-6	
				25	4-6-6	
				26	5-4-6	

DRILLING LOG		DIVISION	INSTALLATION		SHEET	
		North Atlantic	Norfolk District		1	
1. PROJECT		Craney Island Disposal Area				
2. LOCATION (County or Station)		2" Spoon				
3. SEE MAP		N/A				
4. DRILLING AGENCY		Carpenter Construction Company				
5. HOLE NO. (As shown on drawing title and for number)		CI-17				
6. NAME OF DRILLER		Caldwell				
7. DIRECTION OF HOLE		VERTICAL <input checked="" type="checkbox"/> INCLINED <input type="checkbox"/> SIG. FROM VERT.				
8. THICKNESS OF OVERBURDEN		37.0				
9. DEPTH DRILLED INTO ROCK		N/A				
10. TOTAL DEPTH OF HOLE		37.0				
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERED	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
74.0			WATER			
5.0		(OL)	organic SILT and clay, black (MUCK) -saturated-		1	W/R
-5.5		(SC)	(trace fine sand) → fine SAND, some clay, trace of silt and pea gravel, gray		2	W/R
-13.0		(SC)	low to medium plasticity		3	5-6-8
-21.0		(SP)	fine to coarse SAND and pea gravel, little clay, trace of silt, brown		4	6-7-8
			low to medium plasticity		5	10-14-16
		(SP)	fine to medium SAND, trace of silt, gray		6	6-8-10
			(indication of (CH) lenses) →			
-30.0			boring terminated at 37.0' (Elev. -30.0')		7	8-10-15

DRILLING LOG		DIVISION	INSTALLATION		SHEET	
1. PROJECT Craney Island Disposal Area		North Atlantic	Norfolk District		1 of 1 SHEETS	
2. LOCATION (Coordinates or Station)		See Map	10. SIZE AND TYPE OF BIT 2" SPOON			
3. DRILLING AGENCY Carpenter Construction Company			11. BASIS FOR ELEVATION SHOWN (78N or 78L) MLN			
4. HOLE NO. (As shown on drawing title and file number)		CI-19	12. MANUFACTURE'S DESIGNATION OF DRILL			
5. NAME OF DRILLER Childwell			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		6	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED			14. TOTAL NUMBER CORE BOIES		N/A	
7. THICKNESS OF OVERBURDEN		37.0	15. ELEVATION GROUND WATER			
8. DEPTH DRILLED INTO ROCK		N/A	16. DATE HOLE STARTED		4 Aug 71	
9. TOTAL DEPTH OF HOLE		37.0	17. ELEVATION TOP OF HOLE AS SLIDE		+7.0 MLN	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Discipline)	% CORE RECOV. EST	BOI OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
7.0						
5.5			WATER			
		(OL)	organic SILT and clay, black (MUCK) -saturated-		1	W/R
					2	W/R
					3	W/R
					4	W/R
-23.0		(OH)	micro-organic CLAY and silt, dark gray, high to very high plasticity		5	1-1-1
-30.0			boring terminated at 37.0' (Elev.-30.0)		6	1-1-1

Hole No. CI-20

DRILLING LOG		DIVISION	REGISTRATION		SHEET	
		North Atlantic	Norfolk District		1	
1. PROJECT Craney Island Disposal Area						
2. LOCATION (Continuation of Summary)						
3. DRILLING AGENCY Carpenter Construction Company						
4. HOLE NO. (As shown on drawing title and file number)						
5. NAME OF DRILLER Caldwell						
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED <input type="checkbox"/> DIR. FROM VERT.						
7. THICKNESS OF OVERBURDEN 37.0						
8. DEPTH DRILLED INTO ROCK N/A						
9. TOTAL DEPTH OF HOLE 37.0						
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	SOIL OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
71.0						
4.0			WATER			
	5	(OL)	organic SILT and clay, black (MUCK) -saturated-		1	W/R
	10					
	15					
	20	(SP)	fine SAND, trace of silt, gray		4	4-6-7
	25	(OL-SM)	organic silt and clay and fine sand, gray		5	3-3-3
	30	(SP)	fine SAND, trace of silt, gray		6	4-5-6
	35		(trace of shell fragments)		7	4-7-9
	40		boring terminated at 37.0' (Elev.-30.0)			

ENG FORM 1836

PREVIOUS EDITIONS MAY BE USED / (EN 1110-1-1801)

APR 63

PROJECT

Craney Island

HOLE NO.

CI-20

APPENDIX C: LABORATORY DATA



ATEC Associates, Inc.

of Virginia, Inc.
7611 Sewells Point Road/Norfolk, Virginia 23513
Phone 804-583-1557

April 29, 1980

Army Corps of Engineers
803 Front Street
Norfolk, Virginia 23501

Attention: Mr. Dave Pezza

Re: Craney Island Project
Laboratory & Classification Results
ATEC Job No. 26-01053

Gentlemen:

Submitted herewith are the results of our laboratory analysis (natural moisture contents and Atterberg Limits) for the referenced project. Samples from borings 2, 3, and 4 were tested.

We appreciate the opportunity to serve you in this regard and trust that you will consult with us if there are any questions concerning this investigation. Please feel free to contact us at any time if we can provide you with any additional technical and/or professional assistance in connection with this project.

Very truly yours,

ATEC ASSOCIATES OF VIRGINIA, INC.

Peter A. Lipphardt
Testing Manager

PAL/cs

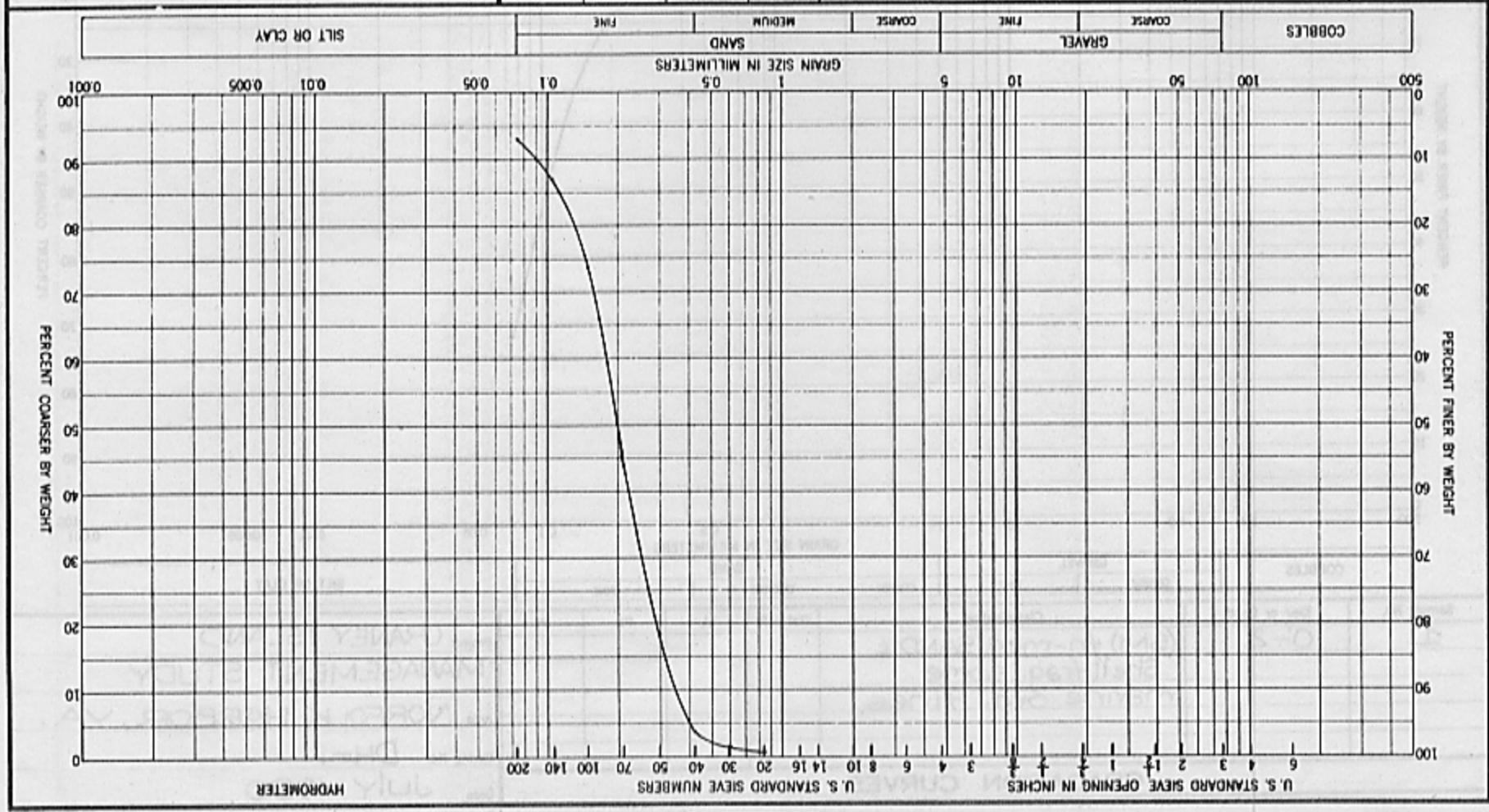
Copies submitted:
(3) Client

Corporate Office:
Indianapolis, IN

District Offices:
Atlanta, GA
Baltimore, MD
Birmingham, AL
Cincinnati, OH
Dallas, TX
Freeport, TX
Louisville, KY
Salsbury, MD
Washington, DC
York, PA

District Affiliates:
Beckley, WV
Norfolk, VA
Rydon, SA

Sample No.	3	Classification	Nat %	LL	PL	PI	Elev or Depth	4'-6"	(SP-SM) f.n. SAND fr. marine organic fines
Project	CRANEY ISLAND								
Area	NORFOLK HARBOR, VA.	GRADATION CURVES							
Boring No.	DH-1	Date July 1980							

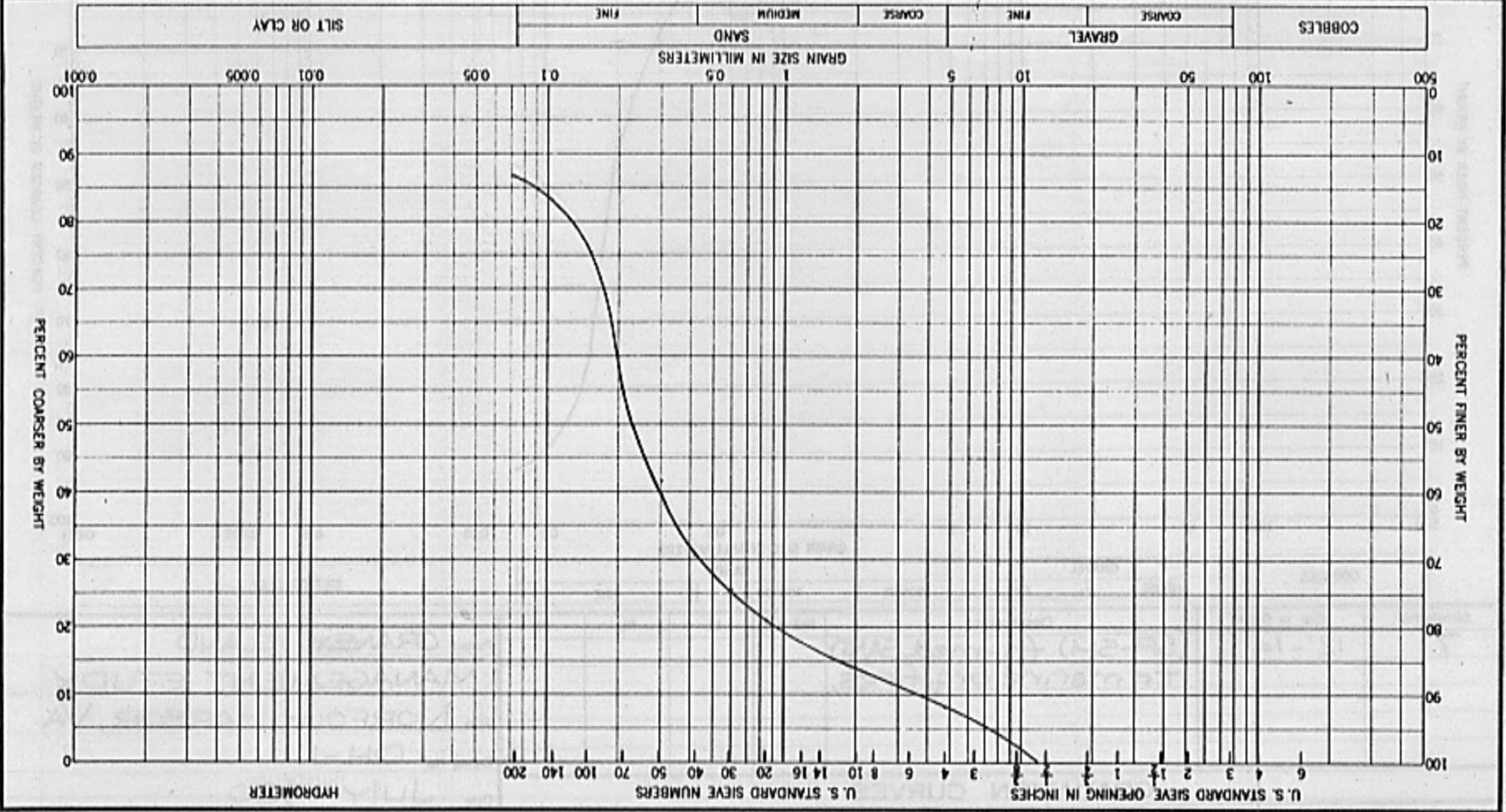


C-6-2

GRADATION CURVES

Sample No.	5	Elev or Depth	8'-10'	Classification	Nat W %	LL	PL	PI	Project	CRANEY ISLAND	Area	MANAGEMENT STUDY NORFOLK HARBOR, VA.	Boring No.	DH-1	Date	JULY 1980

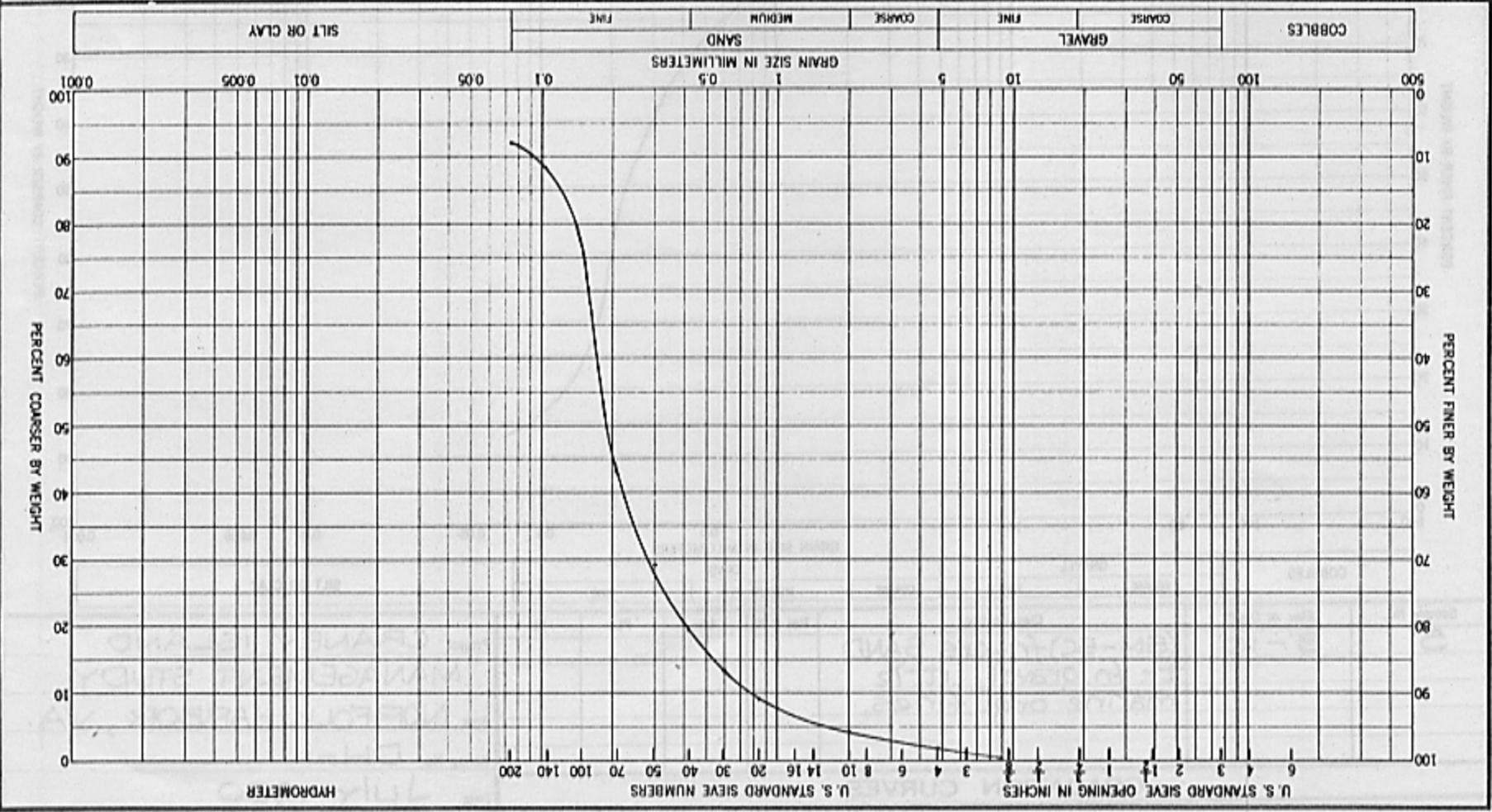
(SM-SC)fn-gr SAND
Fr. fn. gravel, little
marine org. fines,



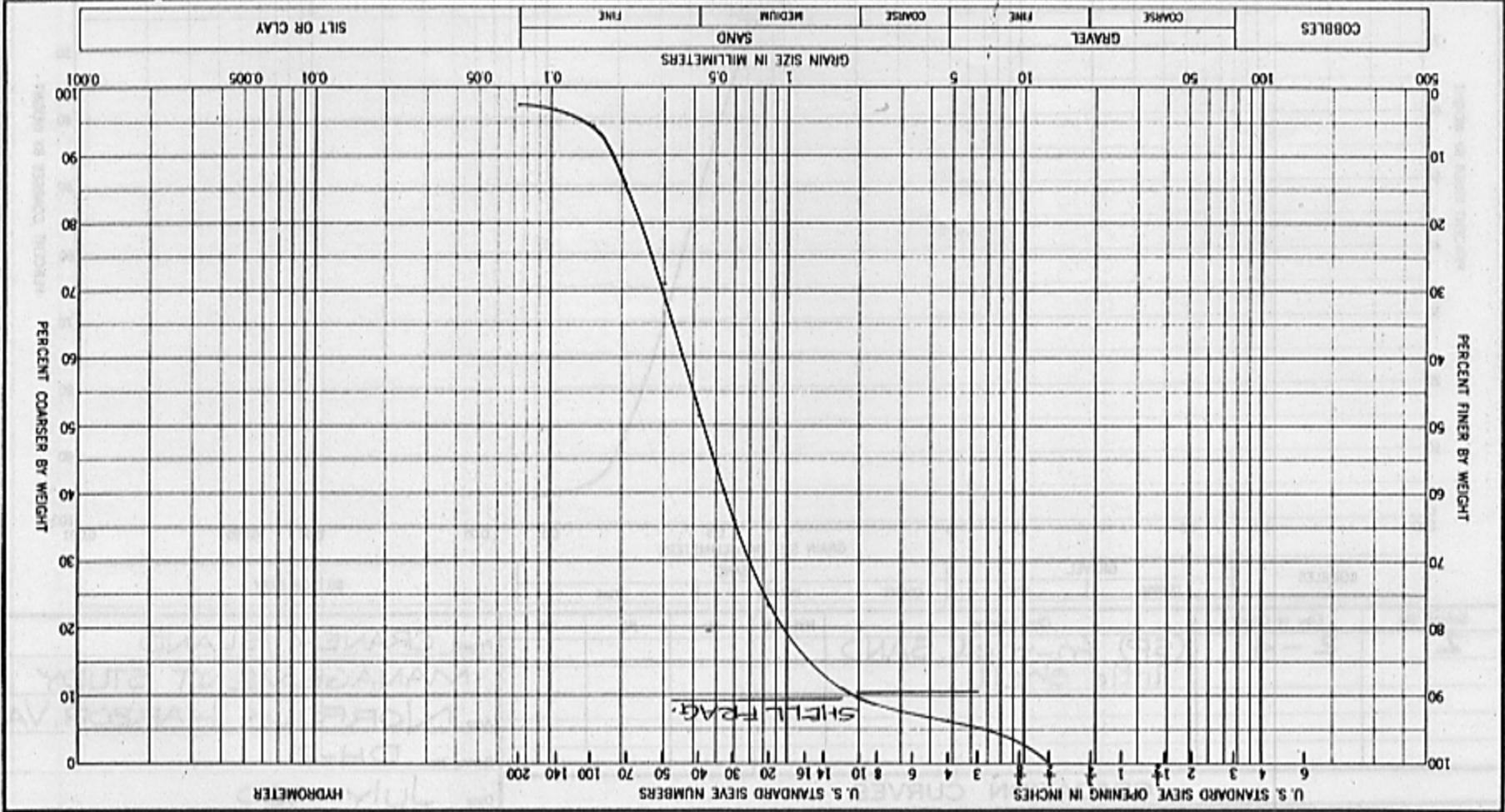
C-7

GRADATION CURVES

Sample No.	7	Classification	(SP-SM) fn-med SAND fr. marine org. fines)	Nat W %	LL	PL	PI
Elev or Depth	12'-14'	Project CRANEY ISLAND MANAGEMENT STUDY NORFOLK HARBOR, VA					
Boring No.	DH-1	Date July 1980					

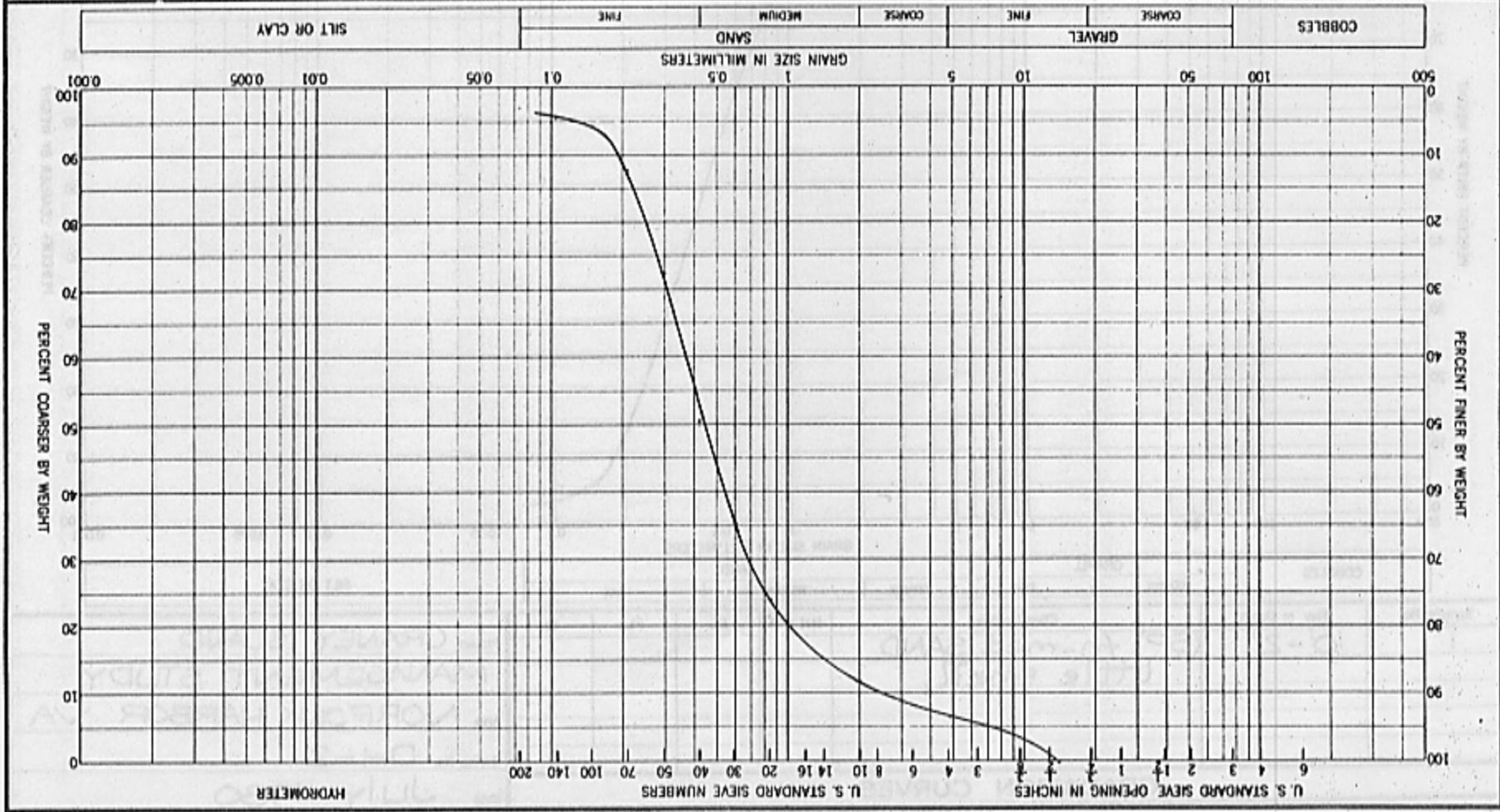


GRADATION CURVES		Sample No.	1
Classification		Elev or Depth	0'-2'
Nat W %		(SP) f _n -med SAND little shells	
PI	PL	Project	
Area		CRANEY ISLAND MANAGEMENT STUDY NORFOLK HARBOR VA	
Boring No.		DH-2	
Date		JULY 1980	



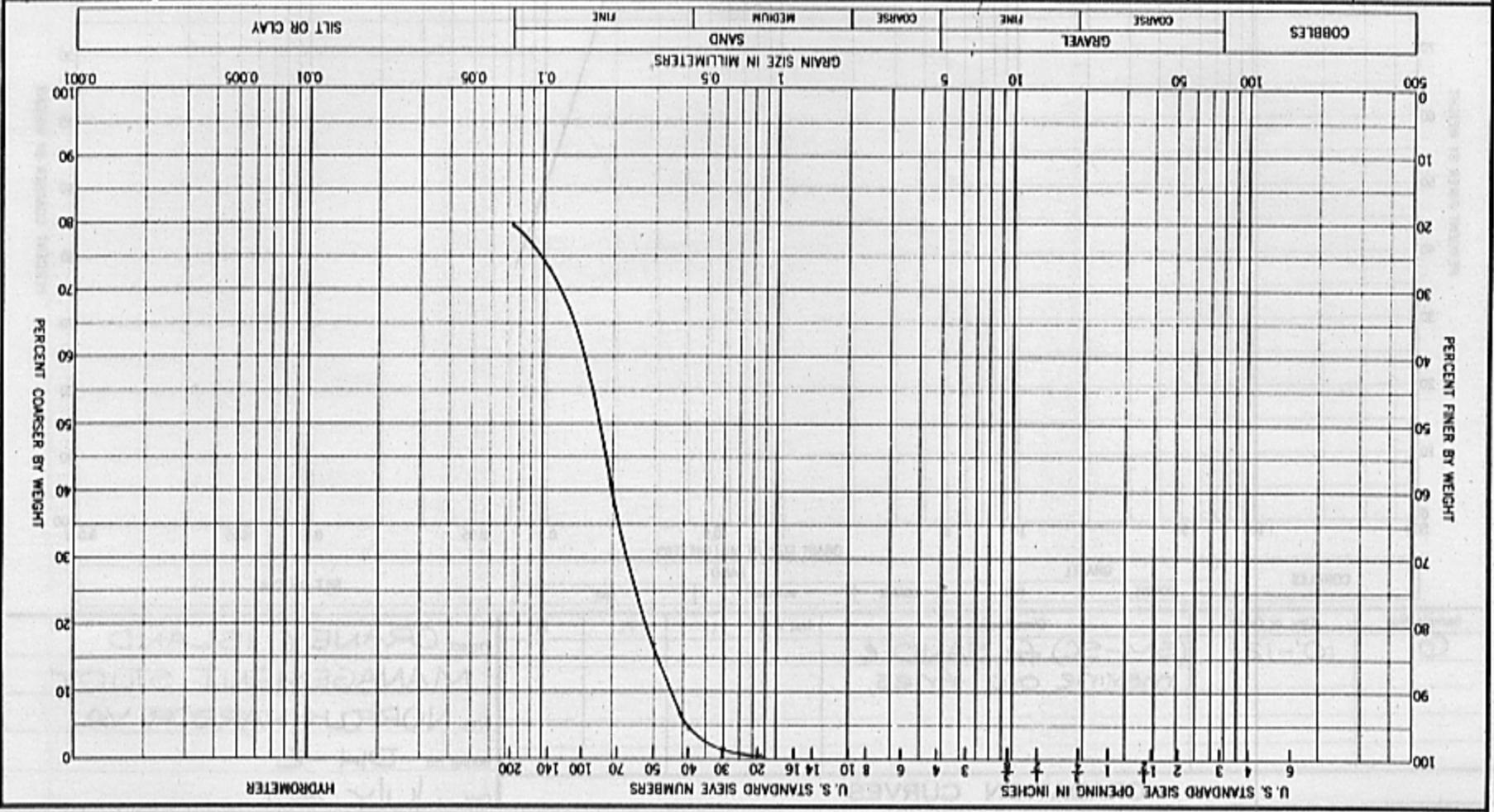
C-6-C

Sample No.	2	Classification	(SP) fn-med. SAND little shells
Elev or Depth	2-4	Nat W %	
		LL	
		PL	
		PI	
Project	CRANEY ISLAND		
Area	NORFOLK HARBOR, VA		
Boxing No.	DH-2		
Date	JULY 1980		



GRADATION CURVES

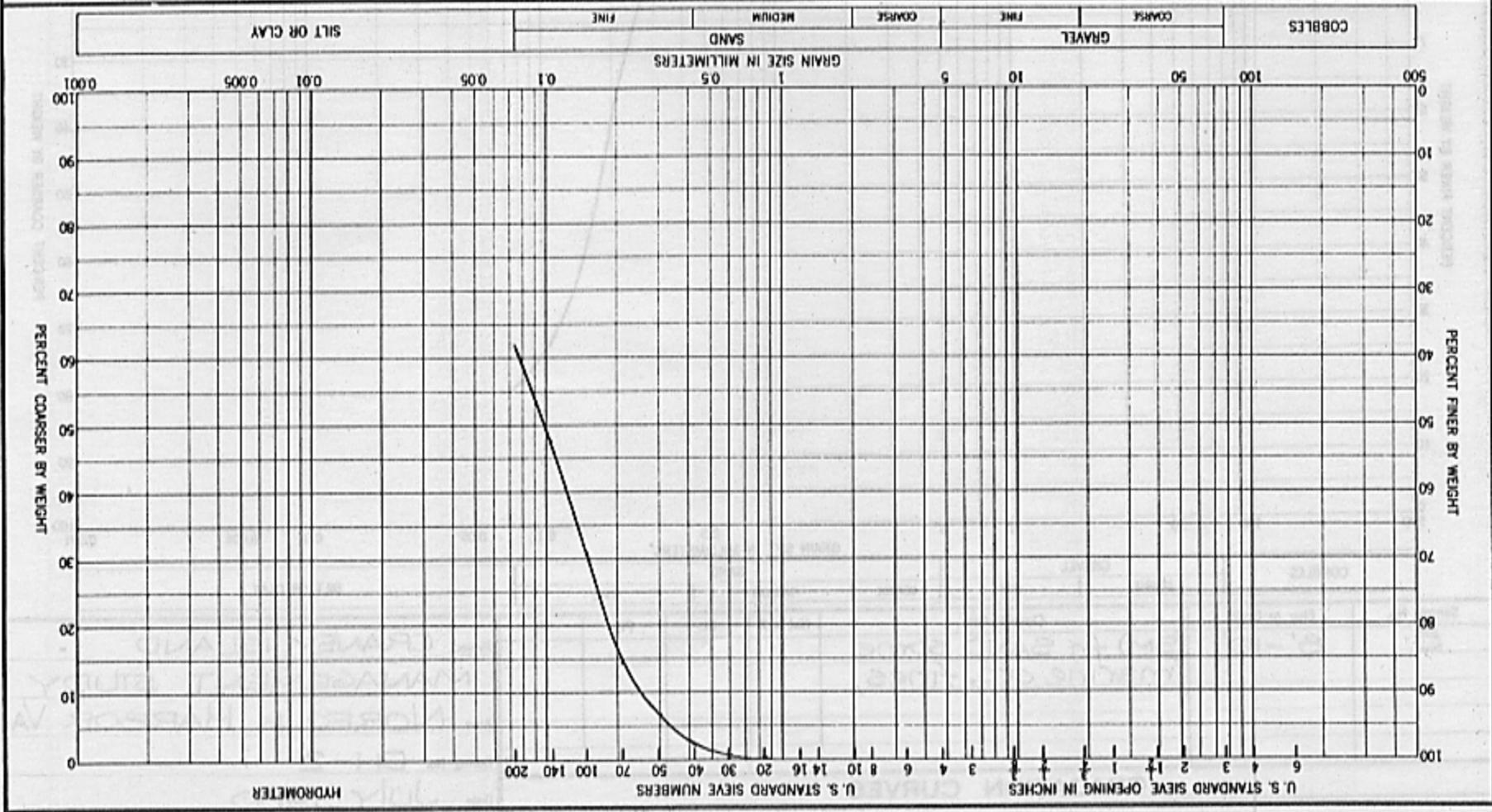
Sample No.	5	Classification	Nat %	LL	PL	PI
Elev or Depth	8'-10"					
Project	CRANEY ISLAND		MANAGEMENT STUDY			
Area	NORFOLK HARBOR VA		Boring No. DH-2			
Date	July 1980					



11-C

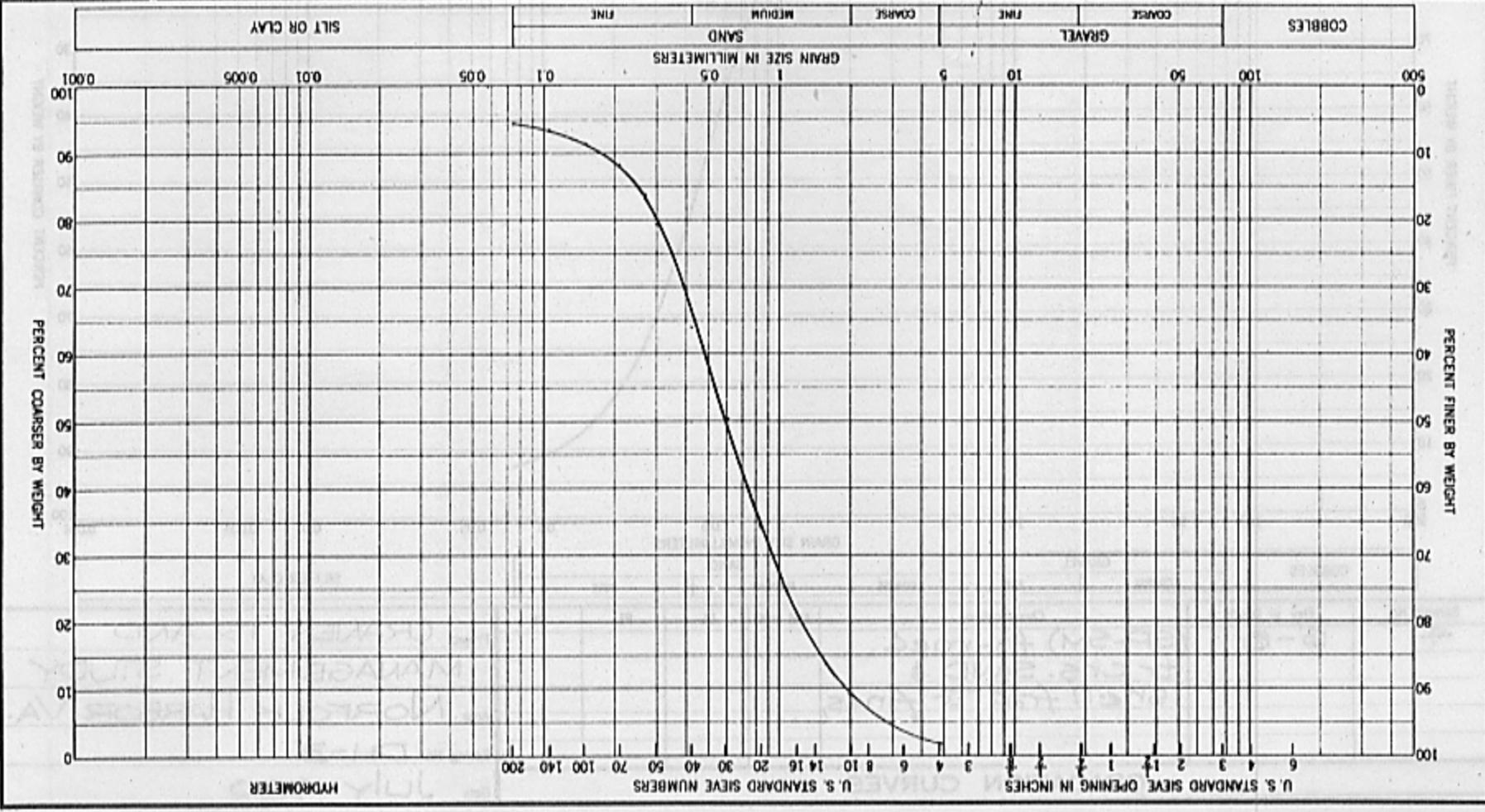
GRADATION CURVES

Sample No.	6	Elev or Depth	10'-12'	Classification	(SM-SC) fn SAND & MAYINE ORD FINES
Project	CRANEY ISLAND	Area	NORFOLK HARBOR VA.	Boring No.	DH-2
Date July 80					



GRADATION CURVES

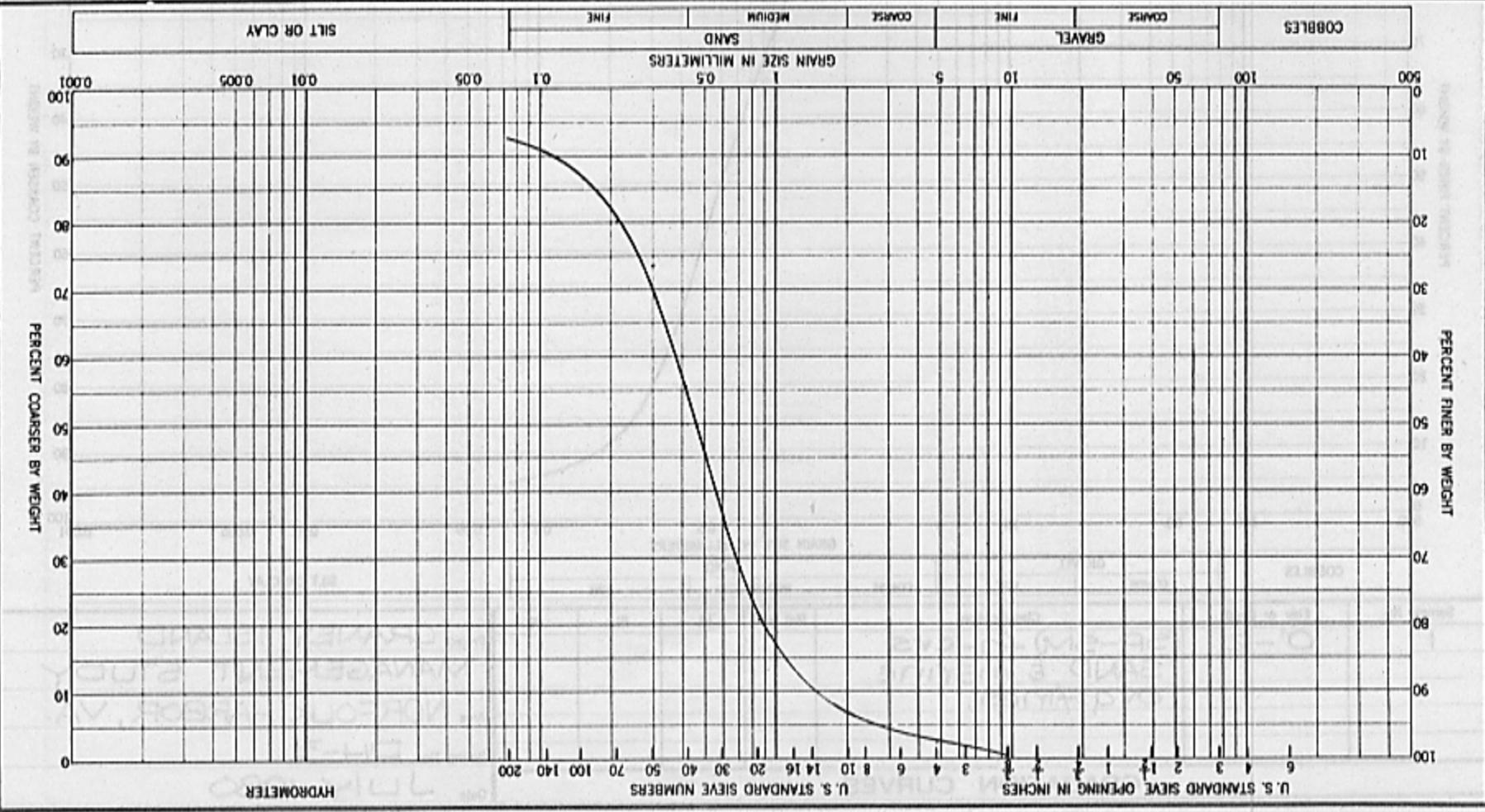
Sample No.	1	Classification (SP-SM) f _n -cvs SAND & MARINE ORG. FINES	Elev or Depth 0'-2'	Project CRANEY ISLAND	Area MANAGEMENT STUDY NORFOLK HARBOR, VA.	Boring No. DH-3	Date JULY 1980
Nat %							



C-13

GRADATION CURVES

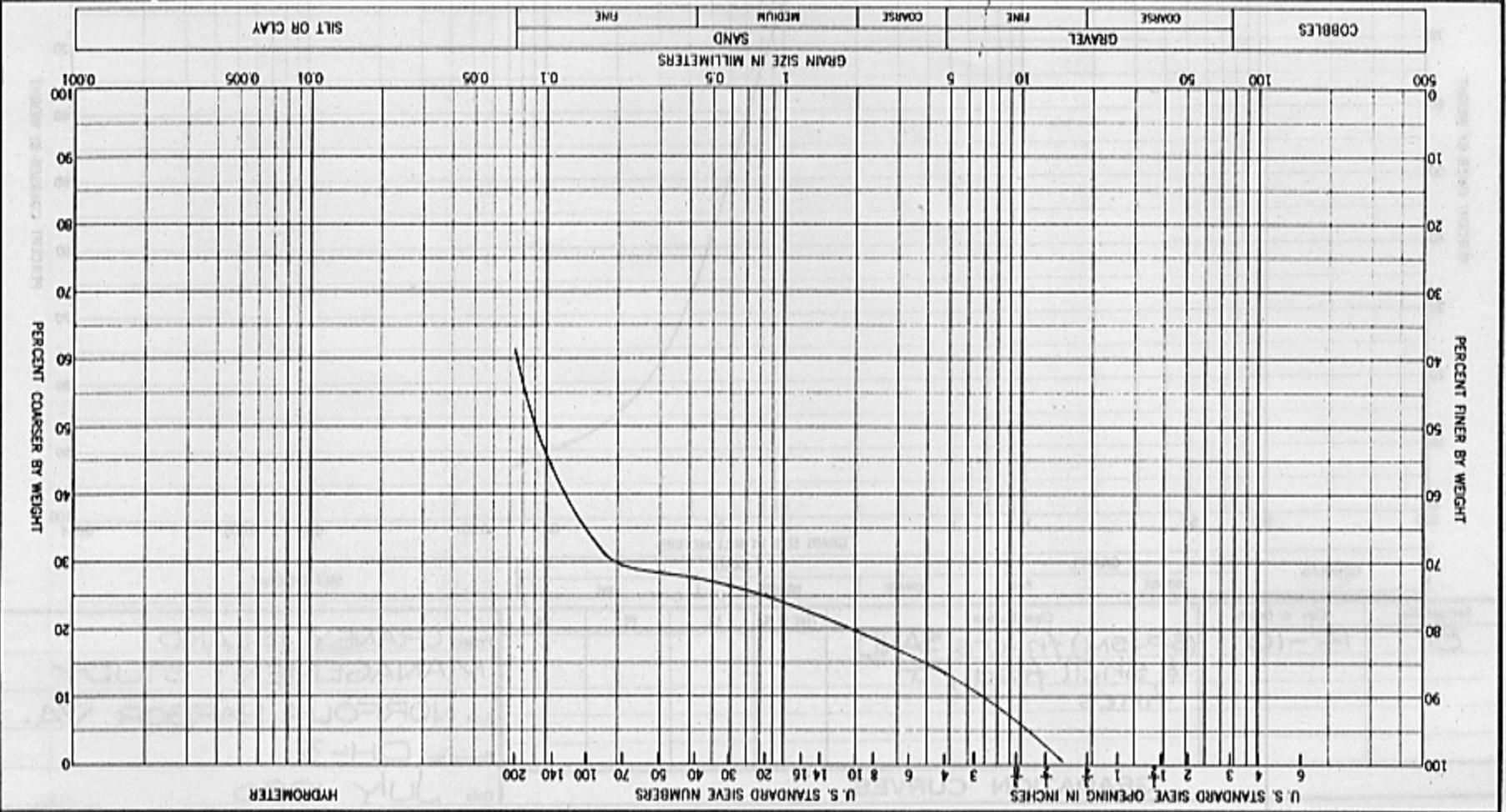
Sample No.	4	Elev or Depth	6-2'	Classification	Nat w %	LL	PL	PI
Project								
CRAWLEY ISLAND			MANAGEMENT STUDY					
Area			NORFOLK HARBOR VA.					
Boring No.			DH-3					
Date			JULY 1980					



C-14 41-3

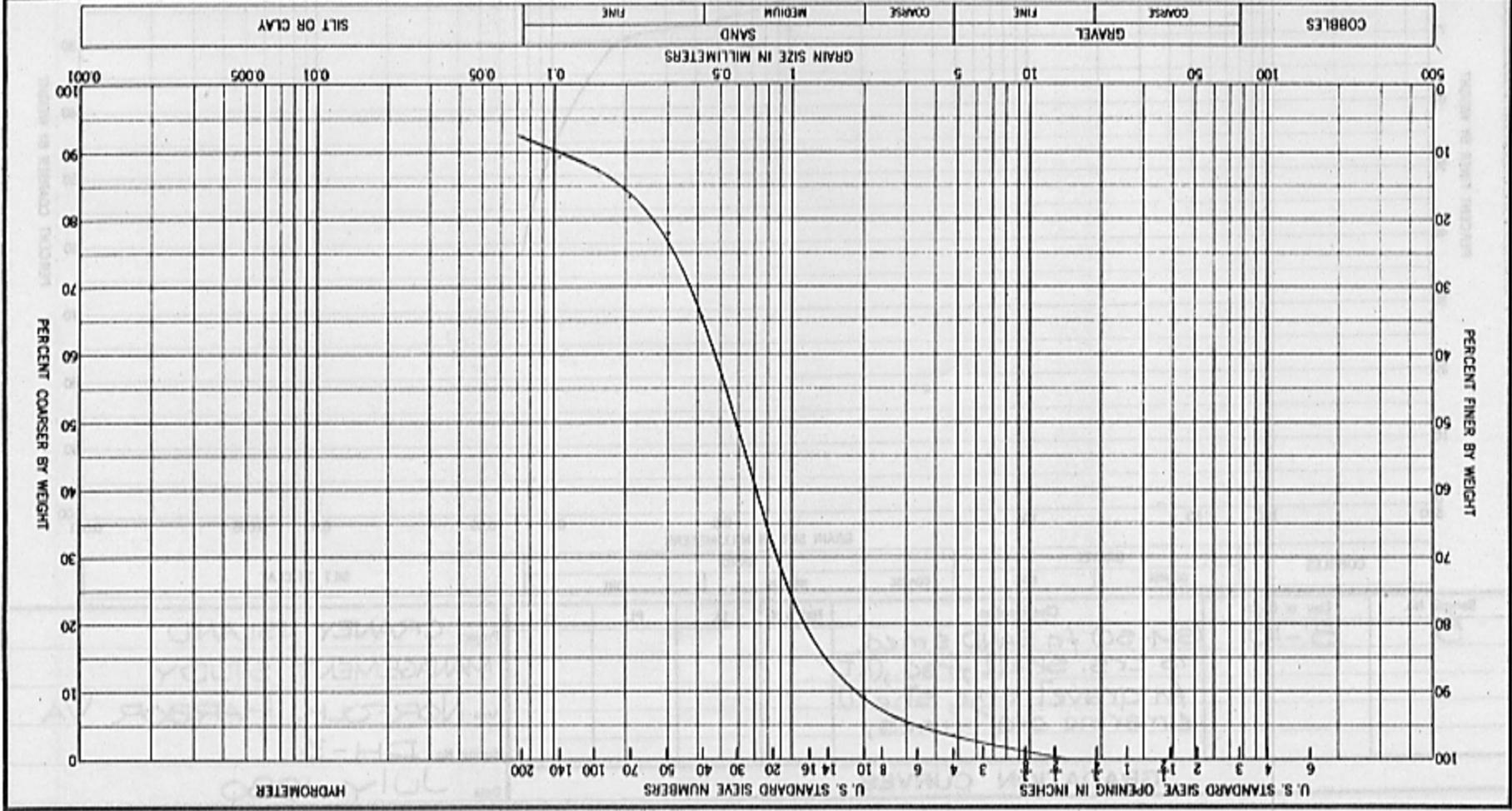
GRADATION CURVES

Sample No.	5	Classification	Nat. w %	LL	PL	PI	Project	CRANEY ISLAND	Area	NORFOLK HARBOR VA	Boring No.	DH-3	Date	JULY 1980
Elev or Depth	8'-10"													
		(SM-SG) fn SAND & med. shell frag. (lit to crs. shell frag. (lit & marine org. fines), fn gravel size shell)												



51-3

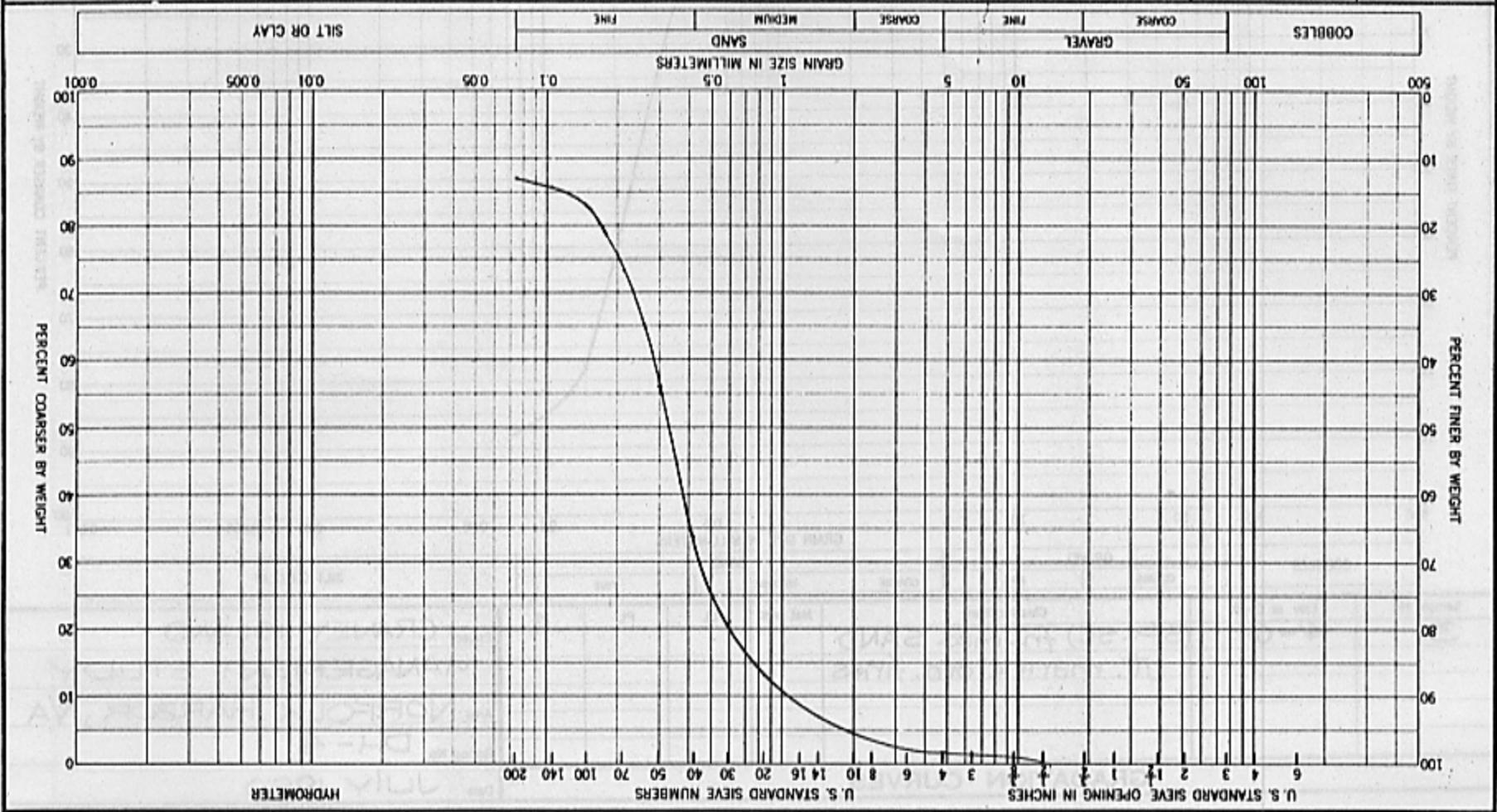
Sample No.	B	Elev or Depth	14'-16'	Classification	(GP-SM) f-n-grs. SAND & shell frag., tr fines
Date	July 1980				
Boring No.	DH-3				
Area	NORFOLK HARBOR VA.				
Project	CRANEY ISLAND MANAGEMENT STUDY				
	PI	PL	LL	Nat w %	



91-3

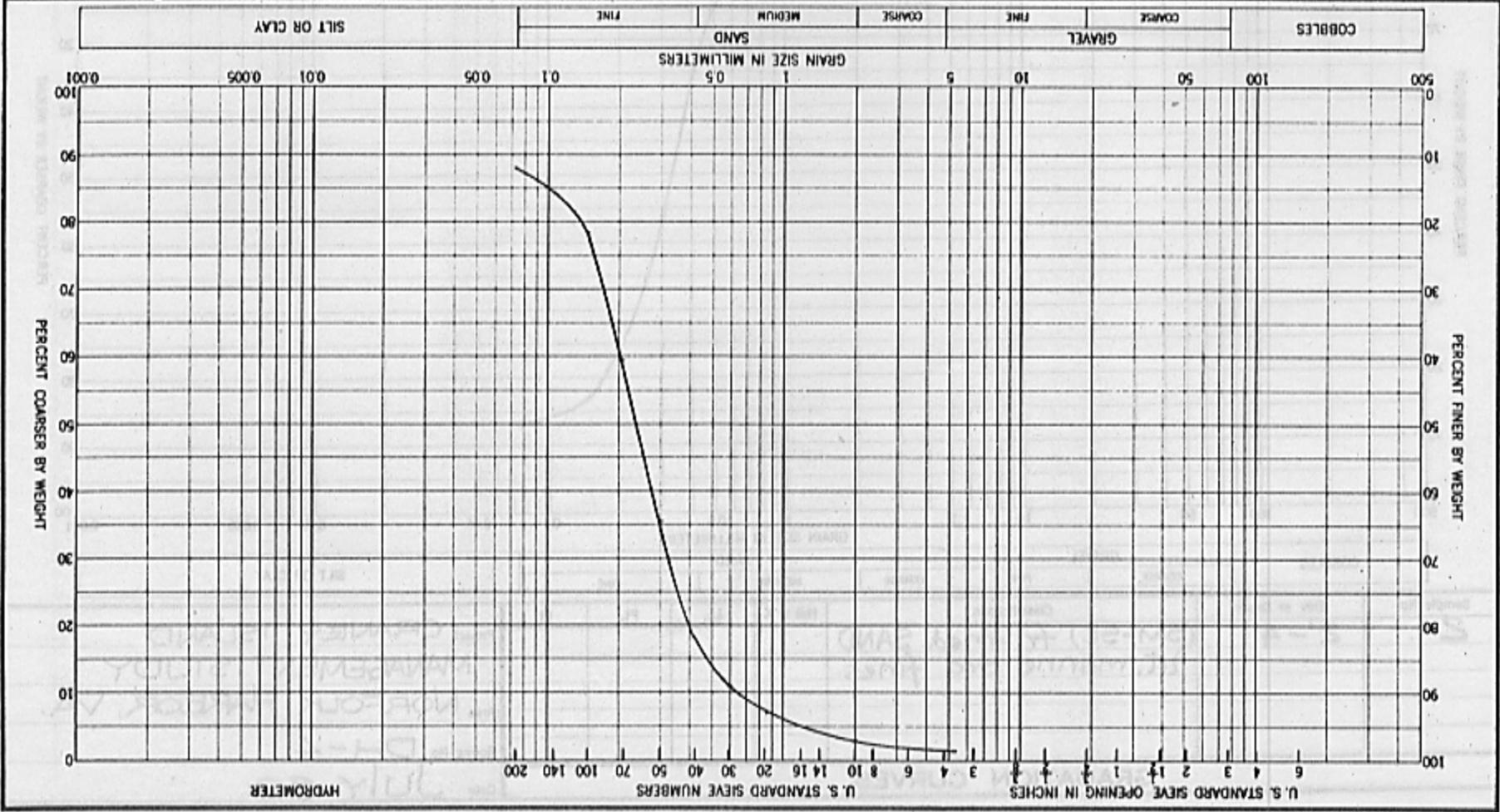
GRADATION CURVES

Sample No.	2	Classification (SM-SC) fr-med SAND 1 1/2 ft. marine org fines	Mat W %	LL	PL	PI	Elev or Depth 2'-4"
Area	CRANLEY ISLAND MANAGEMENT STUDY NORFOLK HARBOR, VA.						
Boring No.	DH-4						
Date	JULY 80						



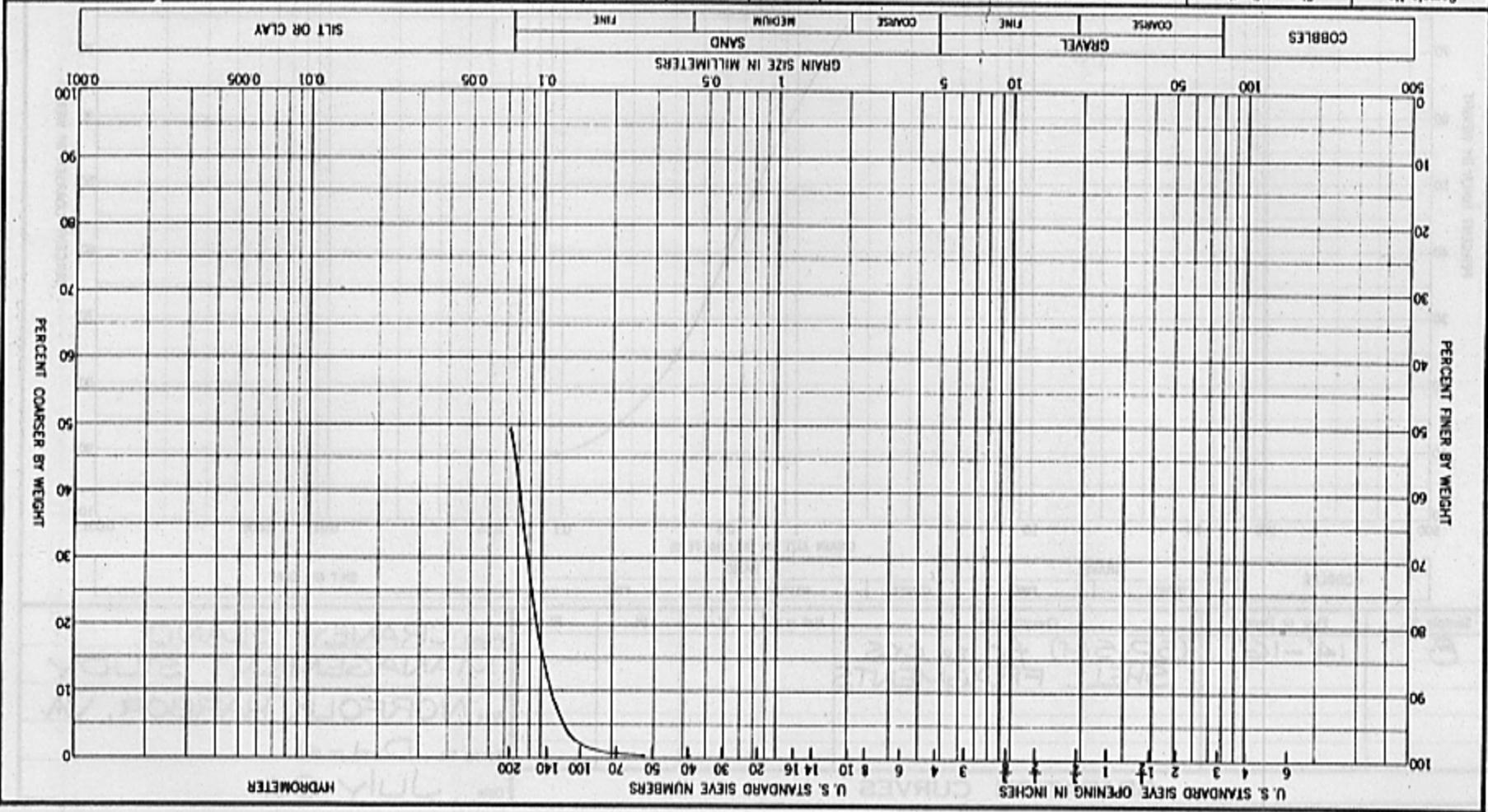
C-17

Date JULY 1980		GRADATION CURVES					
Boring No. DH-4							
Area NORFOLK HARBOR, VA							
Project CRANEY ISLAND MANAGEMENT STUDY							
Sample No.	Elev. or Depth	Classification					
3	4'-6"	(SP-SC) fn-med SAND		Nat W %		LL PL PI	
lt. marine org. fines							



Sample No.	51	Classification	Nat. %	LL	PL	PI
Elev or Depth	8'-10"					
Project						
CRANEY ISLAND						
MANAGEMENT STUDY						
Area						
NORFOLK HARBOR VA.						
Boring No.						
DH-4						
Date						
July 1980						

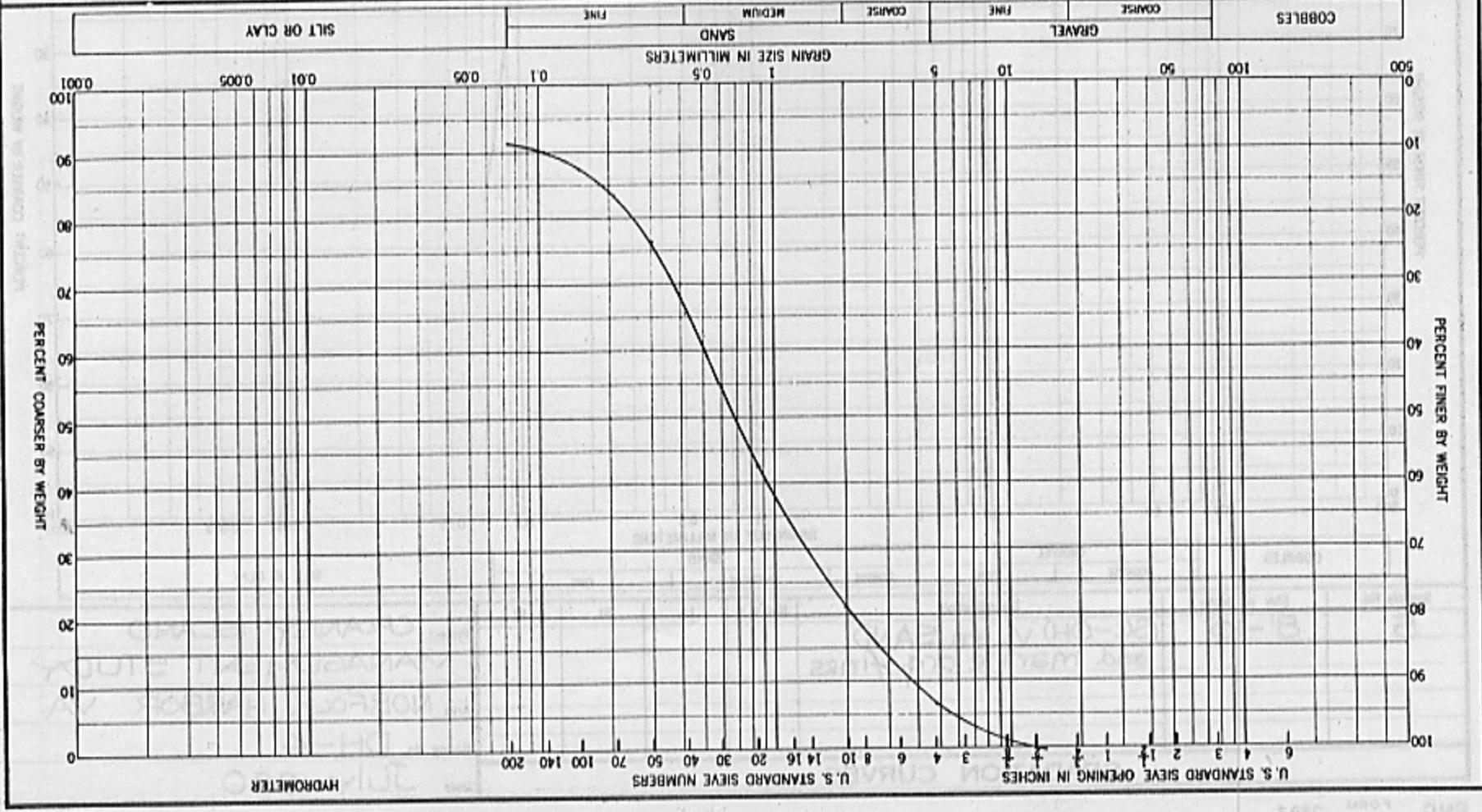
(SC-OH) v. fn SAND
and marine org. fines



61-0

GRADATION CURVES

Sample No.	8	Class. (SP-5M) fn. to CRS.	Nat. W. %	LL	PL	PI
Elev. or Depth	14'-16'					
Project	CRANEY ISLAND MANAGEMENT STUDY					
Area	NORFOLK HARBOR, VA.					
Boring No.	DH-4					
Date	JULY 80					

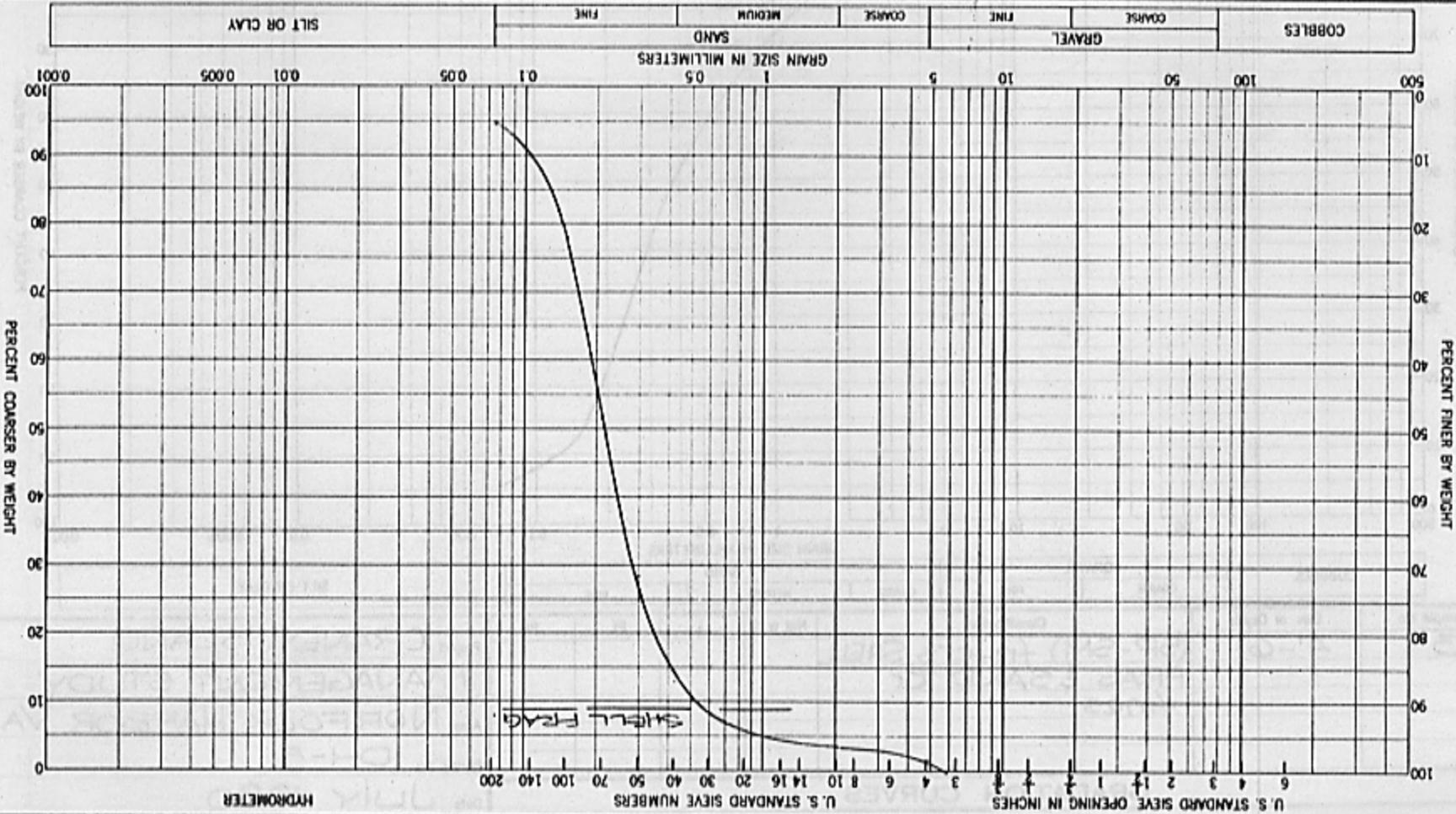


C-20

GRADATION CURVES

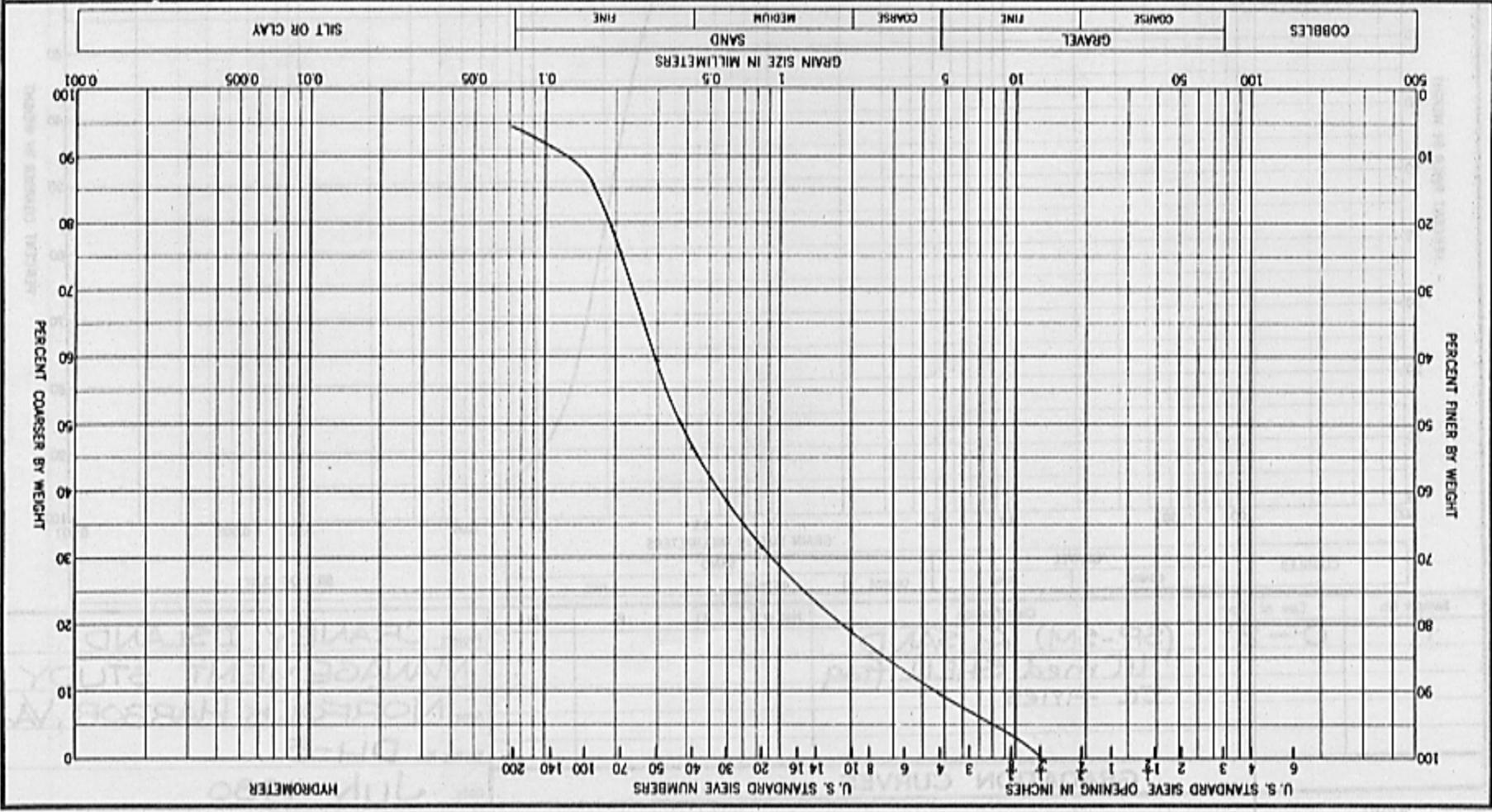
Date: July 1980
 Boring No. DH-5
 Area: NORFOLK HARBOR, VA
 Project: CRANEY ISLAND MANAGEMENT STUDY

Sample No.	1
Elev or Depth	0'-2'
Classification	(SP-SM) Fm SAND LIT med SHELL frag etc fines
Nat W %	
LL	
PL	
PI	



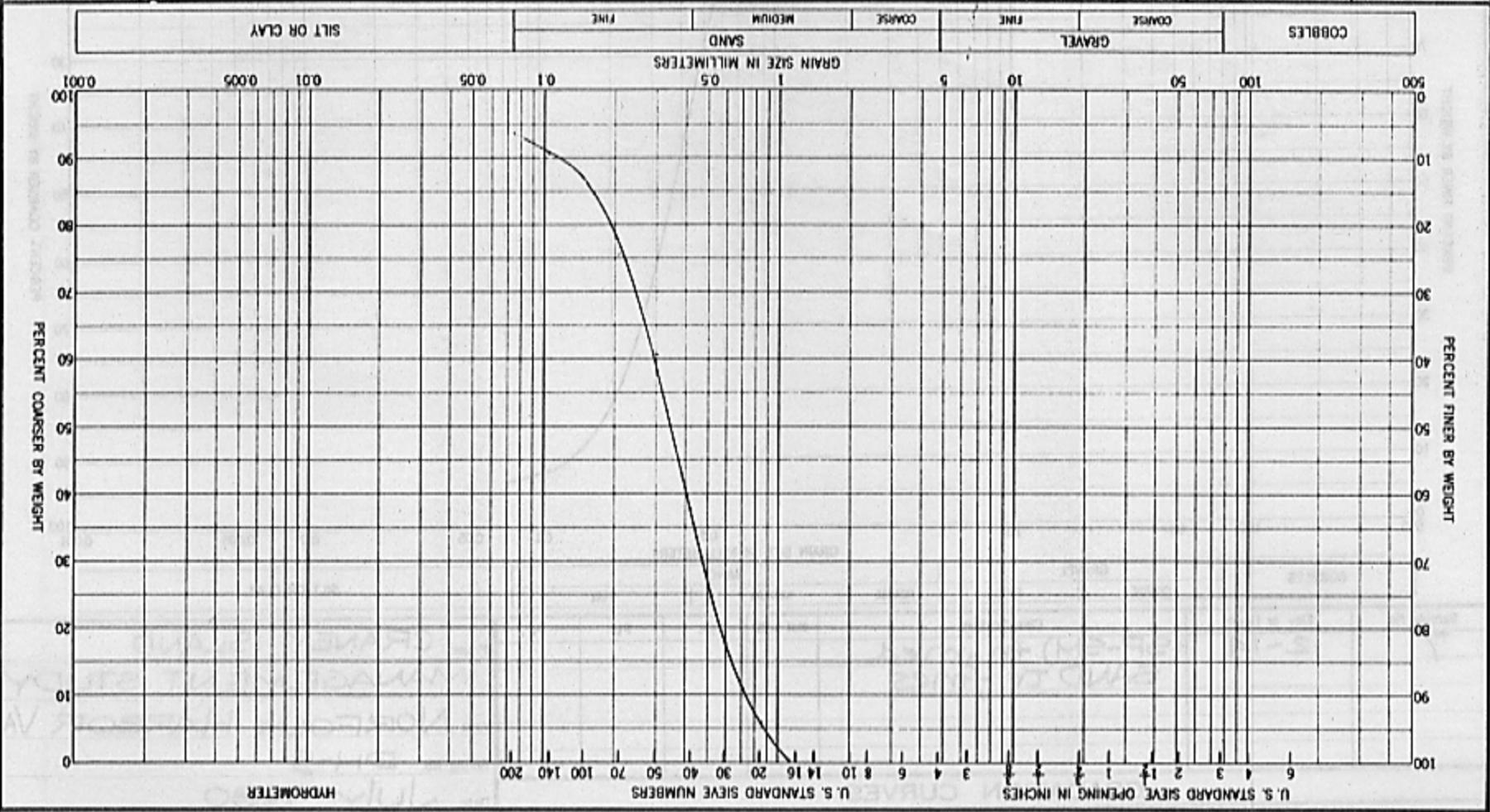
C-21

Sample No.	3	Elev or Depth	4'-6"	Classification	(SP-SM) f-n-crs. shell FRAG & SAND fr. fines	Project	CRANEY ISLAND
Area	NORFOLK HARBOR VA.		Boring No.		DH-5		
Date	JULY 1980						



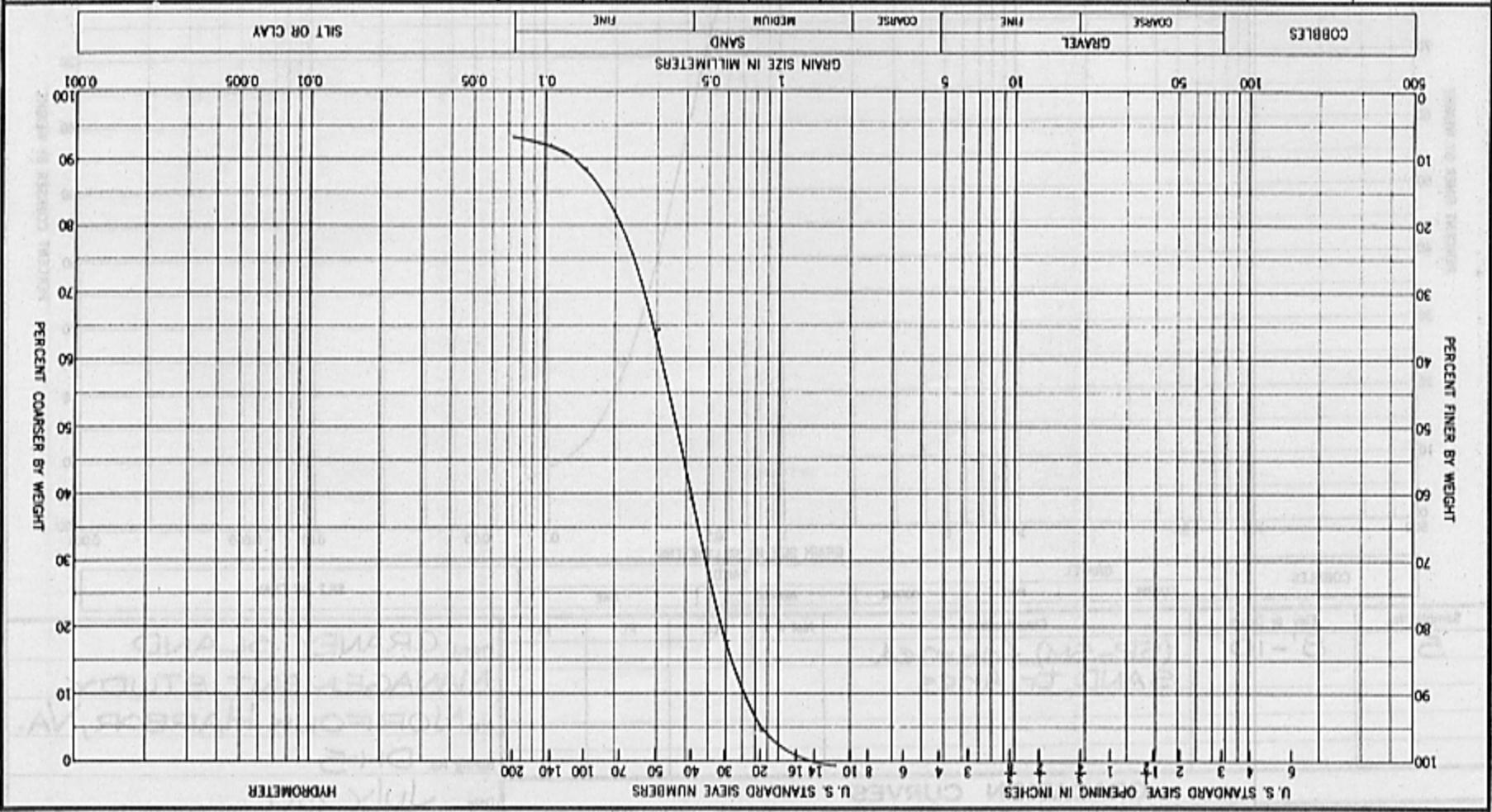
C-22

Date JULY 80		GRADATION CURVES				
Boring No. DH-5						
Area NORFOLK HARBOR, VA.		Classification SAND f _n -med SAND f _n -fines				
Project CRANEY ISLAND MANAGEMENT STUDY						
Sample No.	5	Elev or Depth	8'-10'	Nat %	LL	PL



C-23

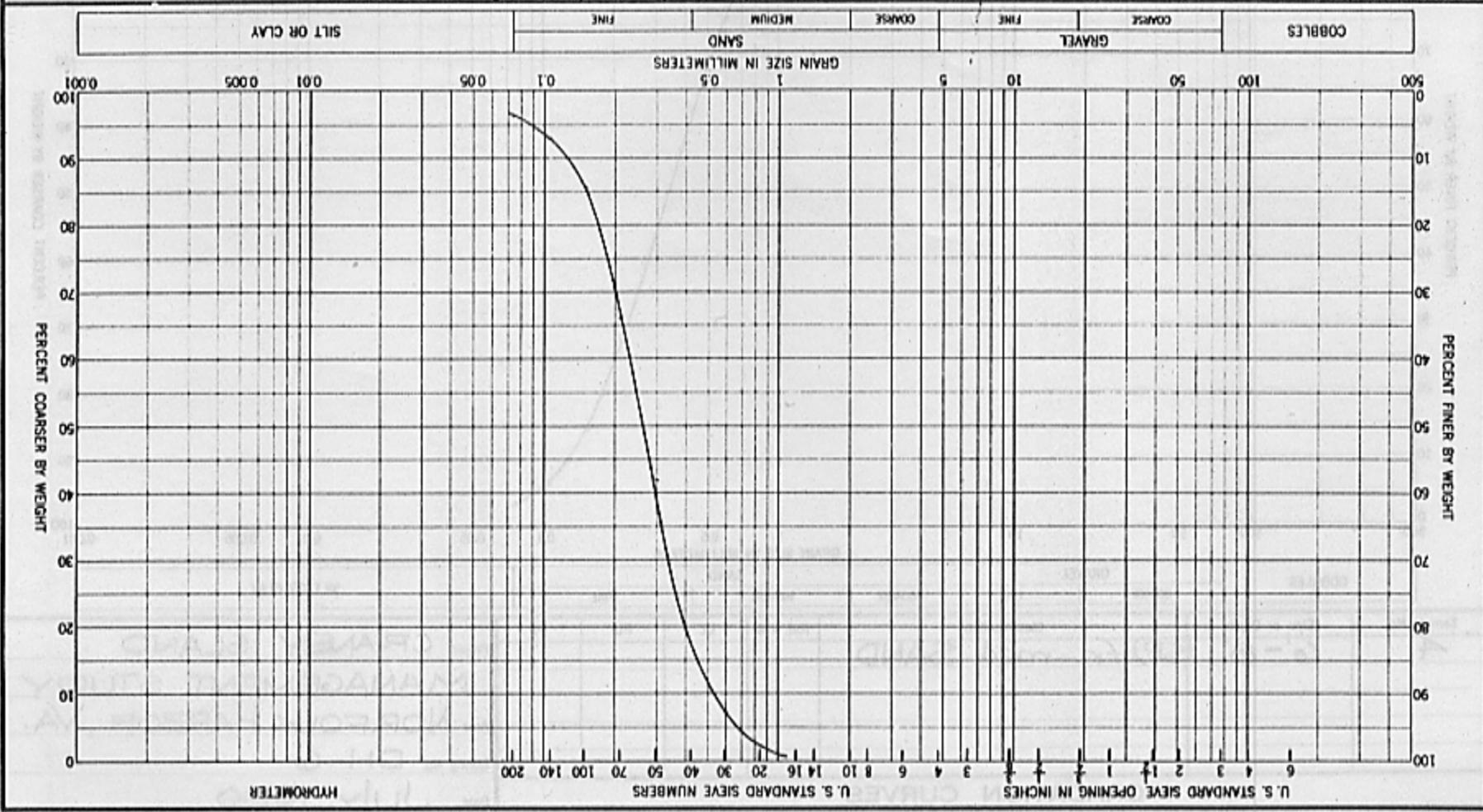
Sample No.	7	Elev or Depth	12-14	Classification	(SP-SM) f _h -med SAND IT FINES	Project	CRANEY ISLAND MANAGEMENT STUDY
Area	NORFOLK HARBOR VA		Boring No.	DH-5		Date	July 1980



C-24 65

GRADATION CURVES

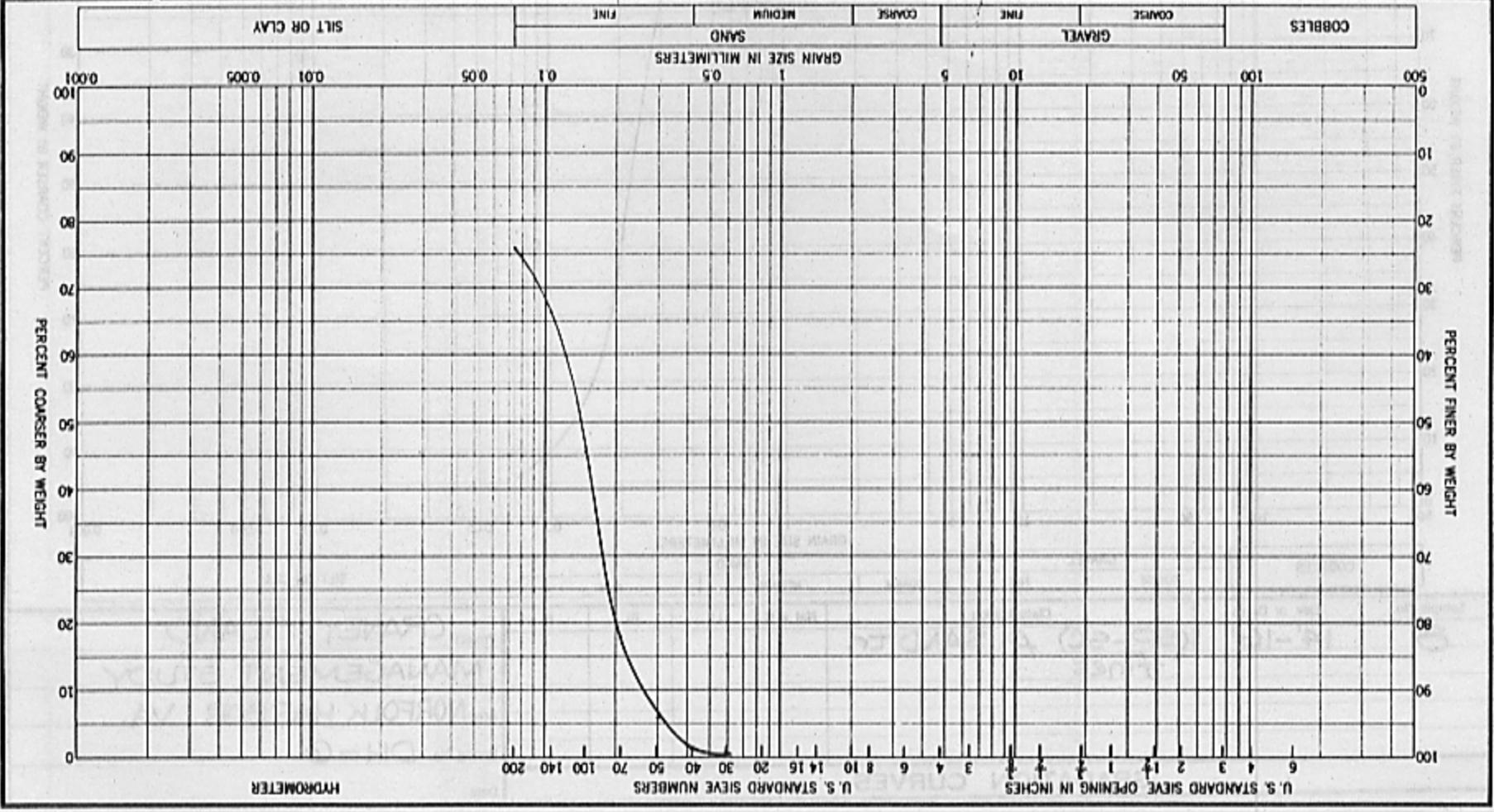
Sample No.	1	Elev or Depth	0-2'	Classification	(SP) fn-med SAND	Nat w %	LL	PL	PI
Project	CRANEY ISLAND MANAGEMENT STUDY								
Area	NORFOLK HARBOR VA								
Boring No.	DH-6								
Date	JULY 1980								



C-25

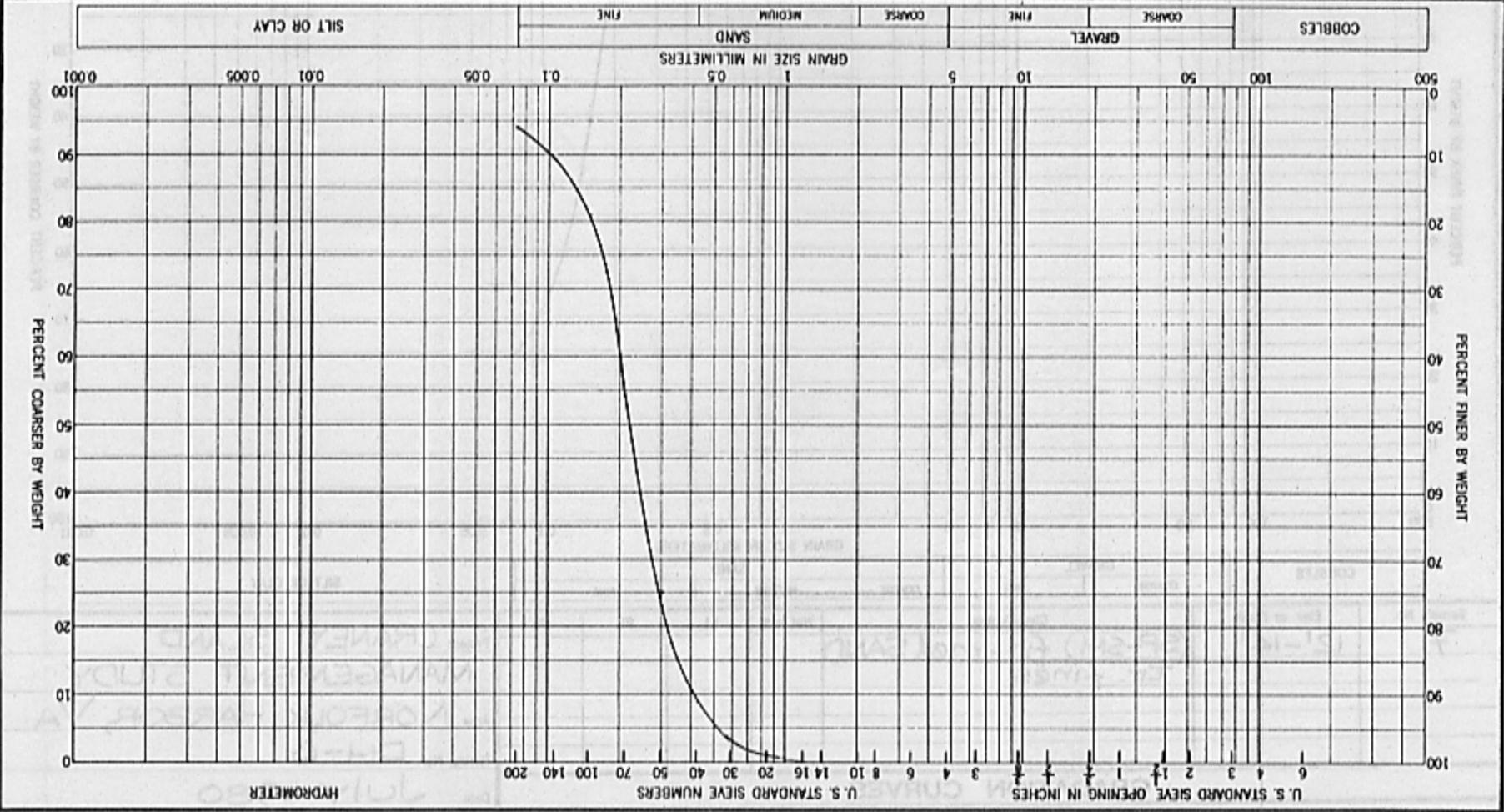
GRADATION CURVES

Sample No.	7	Elev or Depth	12'-14'	Classification	(SP-SM) fn-med SAND fr. fines	Project	CRANEY ISLAND
Area	NORFOLK HARBOR, VA.		Boxing No.	D1-6		Date	JULY 1980



C-27

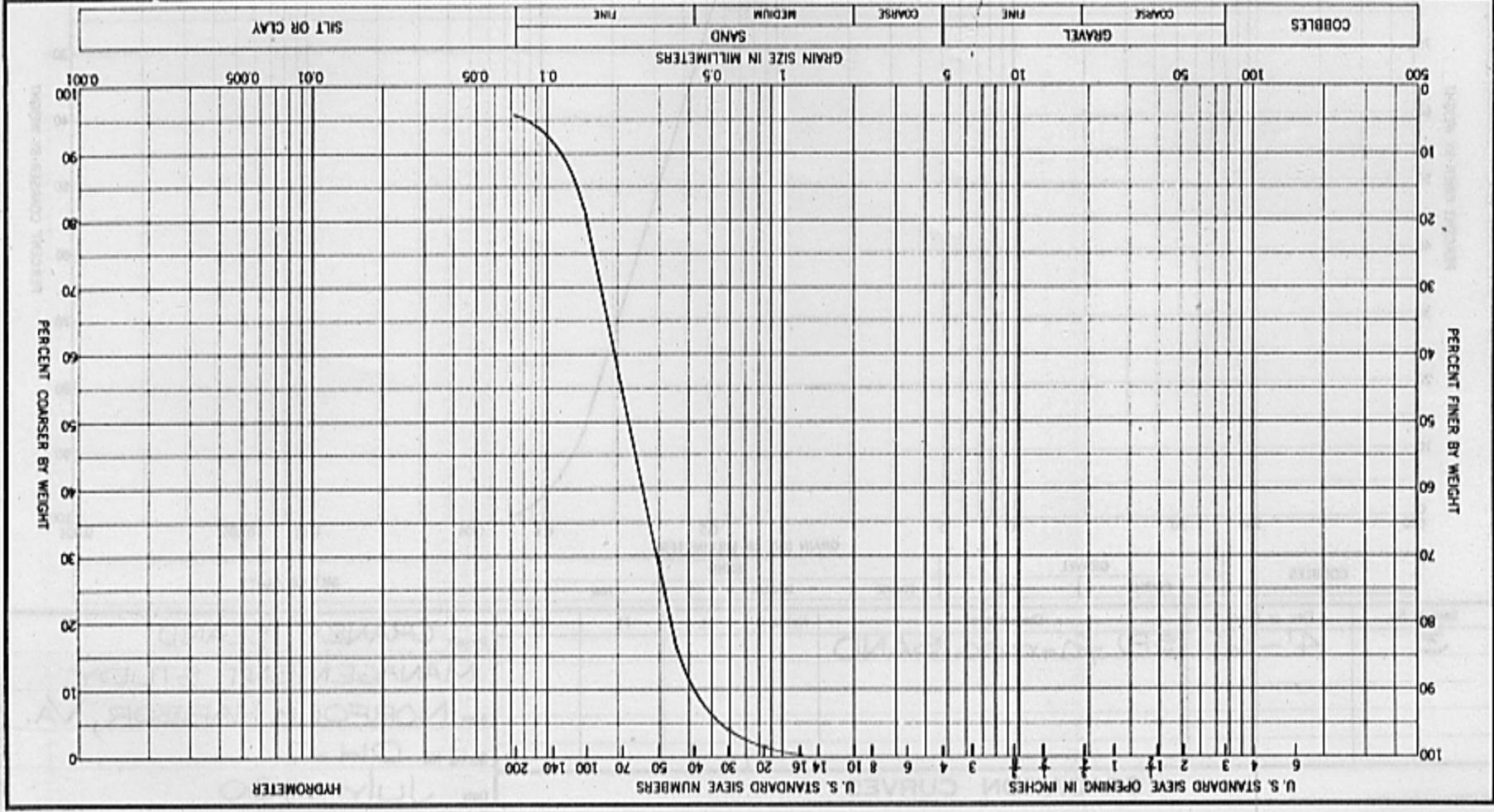
GRADATION CURVES		Date	
Sample No.	Elev or Depth	Classification	Nat W %
8	14'-16'	(SP-SC) ^{finer} SAND-F.	PL
Project	Area	Boring No.	Date
CRANEY ISLAND	NORFOLK HARBOR VA.	DH-6	
MANAGEMENT STUDY			



C-28

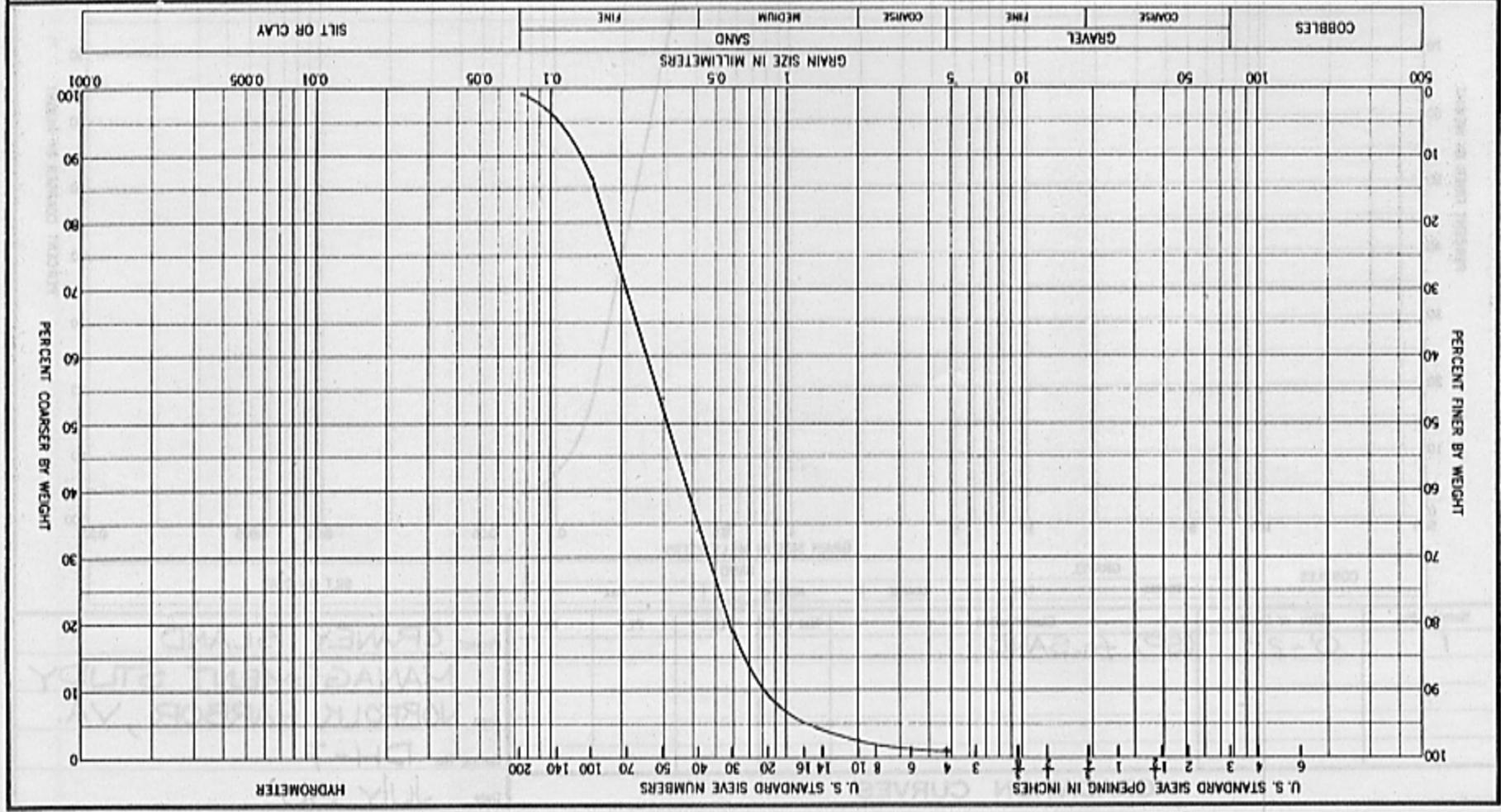
GRADATION CURVES

Sample No.	1	Elev or Depth	0'-2'	Classification	(SP) f.n. SAND
Project	CRANEY ISLAND MANAGEMENT STUDY				
Area	NORFOLK HARBOR, VA.				
Boring No.	DH-7				
Date	July 80				



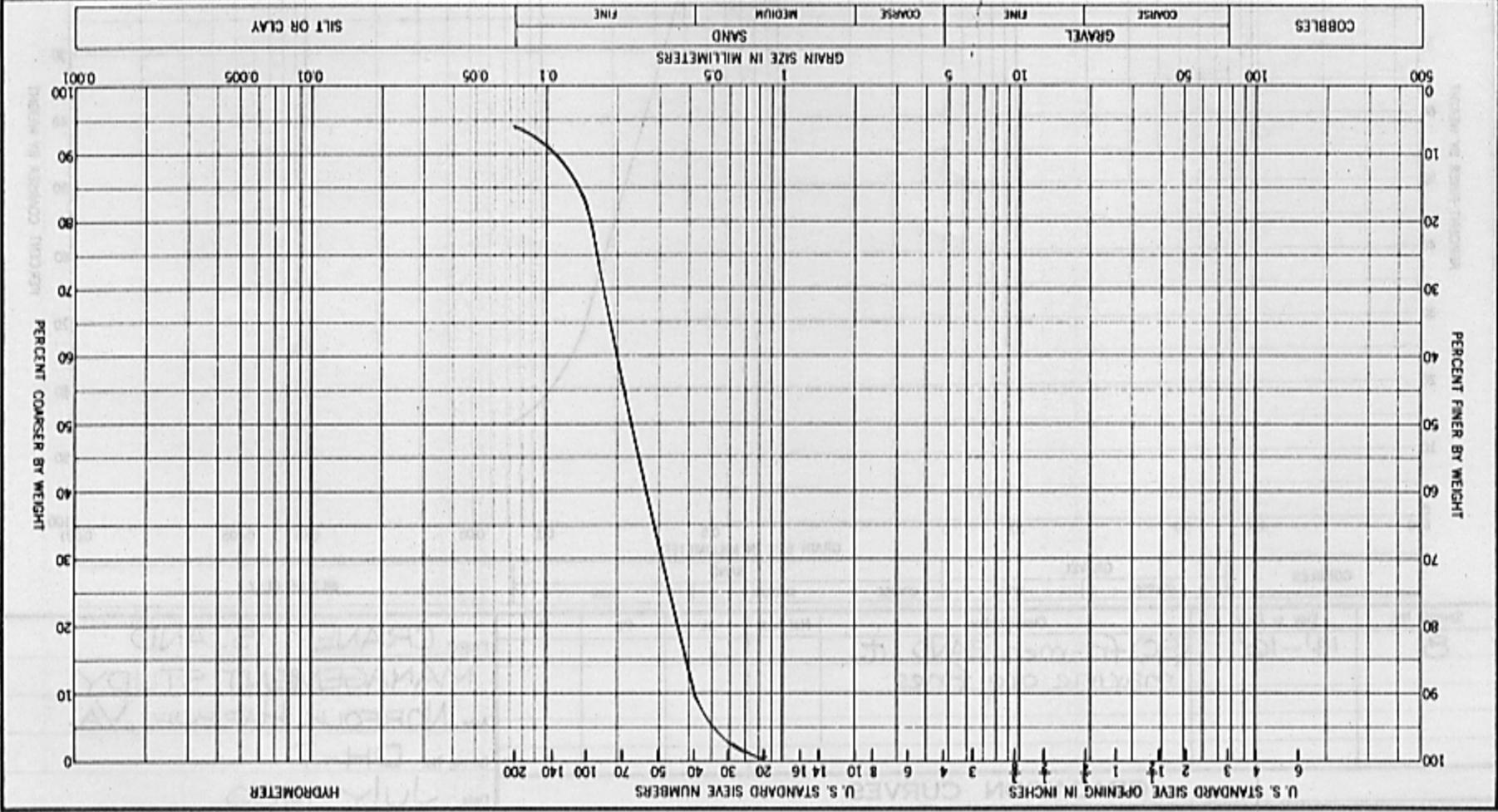
C-29

Sample No.	3	Elev or Depth	4'-6"	Classification	fn-med SAND (SP)	Nat w %	LL	PL	PI
Project	CRANEY ISLAND								
Area	MANAGEMENT STUDY								
	NORFOLK HARBOR, VA.								
Boring No.	DH-7								
Date	July 1980								



C-30

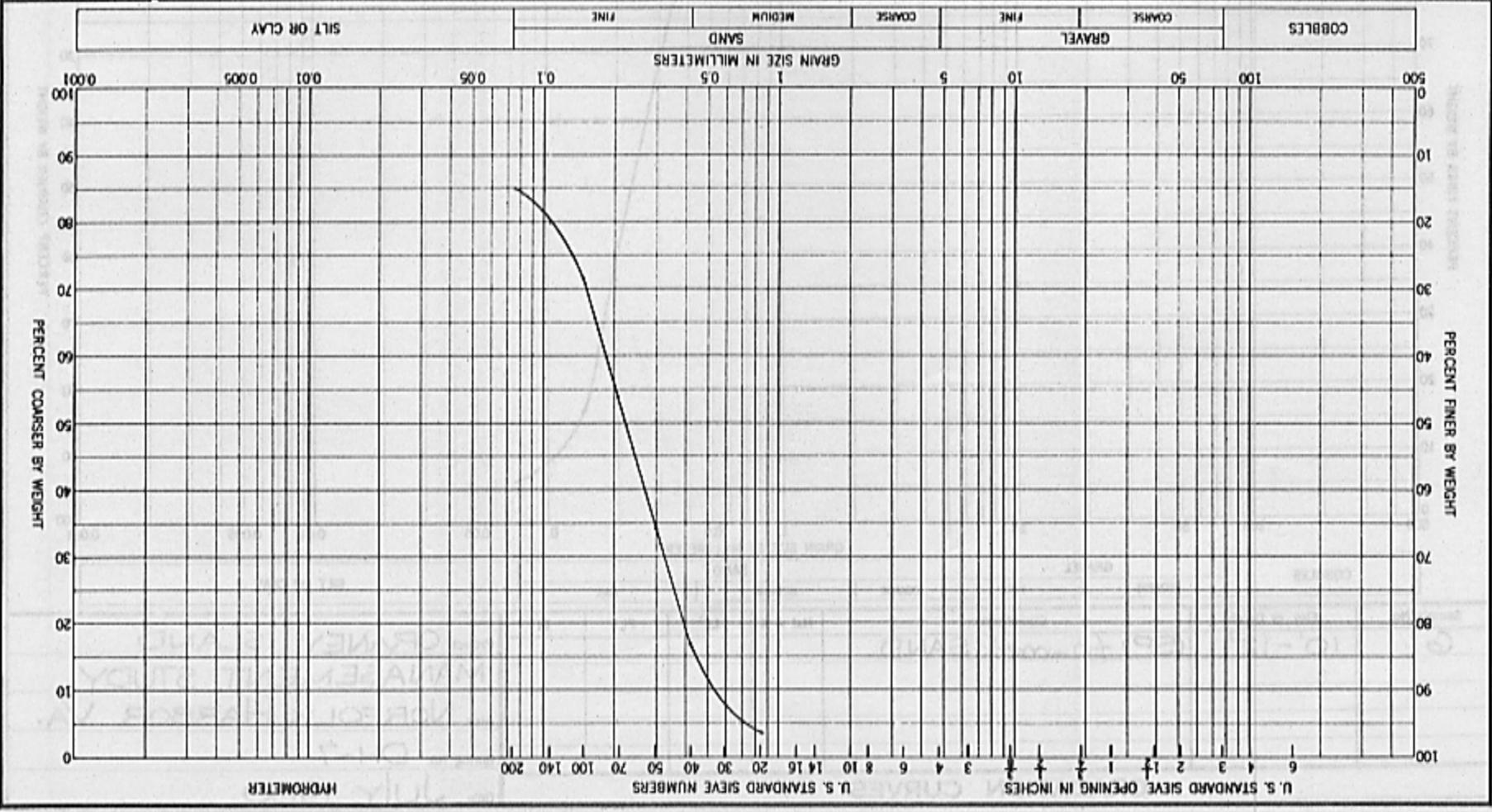
Date July 1980		GRADATION CURVES				
Boring No. DH-7						
Area NORFOLK HARBOR VA.						
Project CRANEY ISLAND MANAGEMENT STUDY						
Sample No. G	Elev or Depth 10'-12'	Classification (SP) f _n -med SAND				
		PI	PL	LL	Nat W %	



C-31

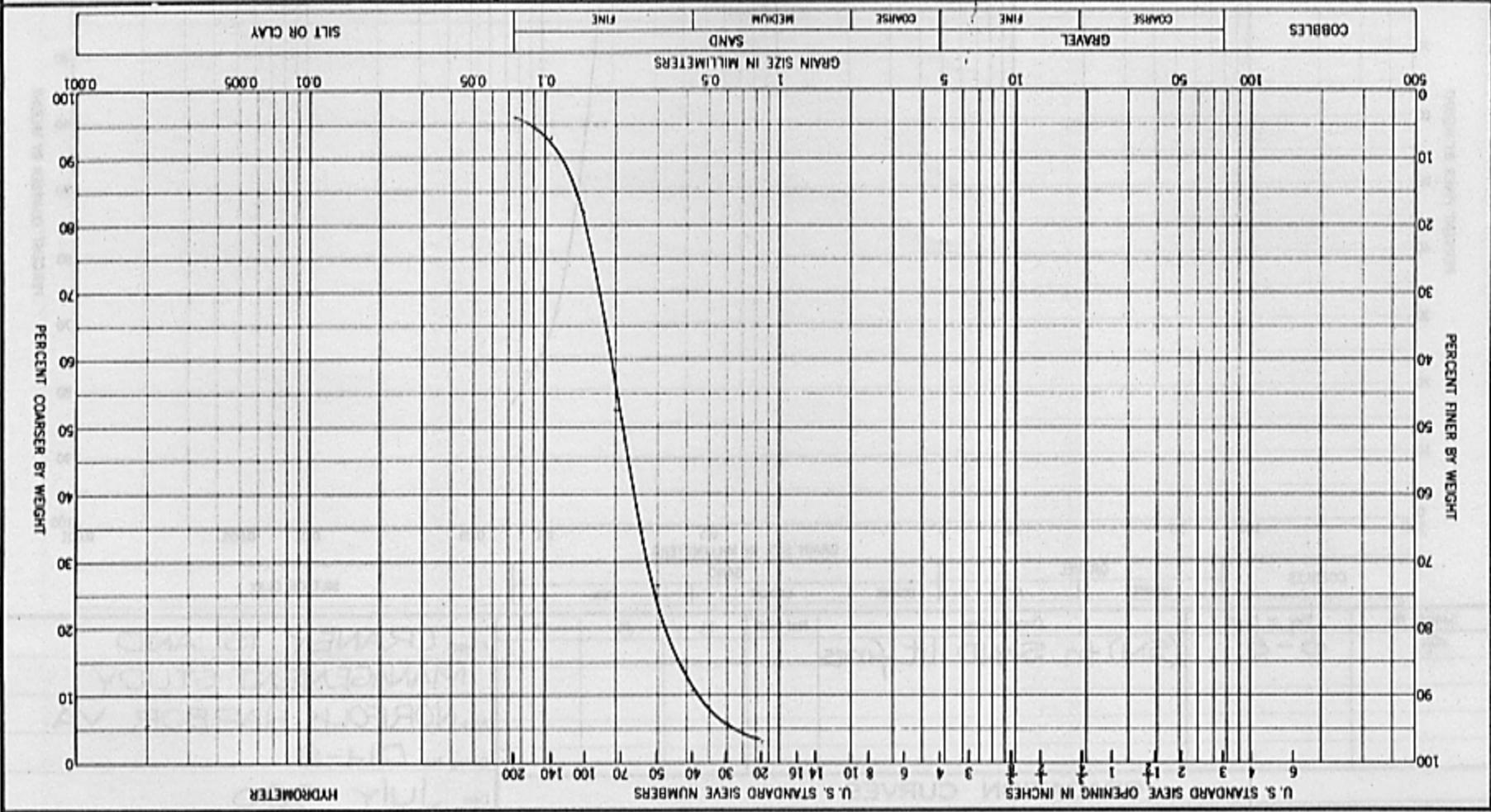
GRADATION CURVES

Sample No.	8	Classification	(SC) fn-med SAND lt. marine org fines
Elev or Depth	14-16'	Nat w %	
		LL	
		PL	
		PI	
Project	CRANEY ISLAND		
Area	NORFOLK HARBOR, VA.		
Boring No.	DH-7		
Date	July 1980		



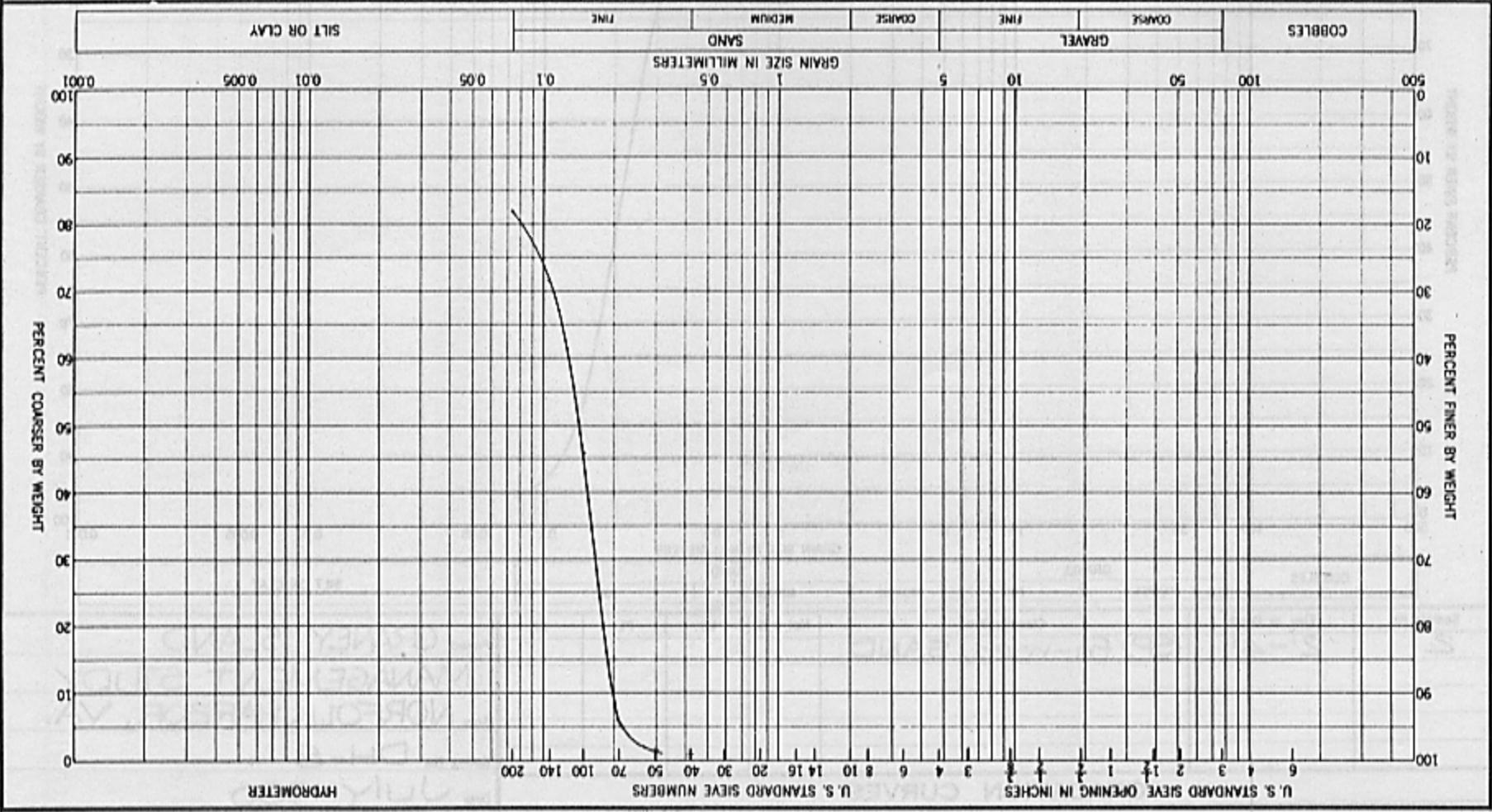
C-32

Date July 1980		GRADATION CURVES					
Boring No. DH-8							
Area NORFOLK HARBOR, VA.							
Project CRANEY ISLAND MANAGEMENT STUDY							
Sample No.	2	Classification	(SP) fn-med. SAND				
Elv or Depth	2'-4"	Mat w %	LL	PL	PI		



CC-33

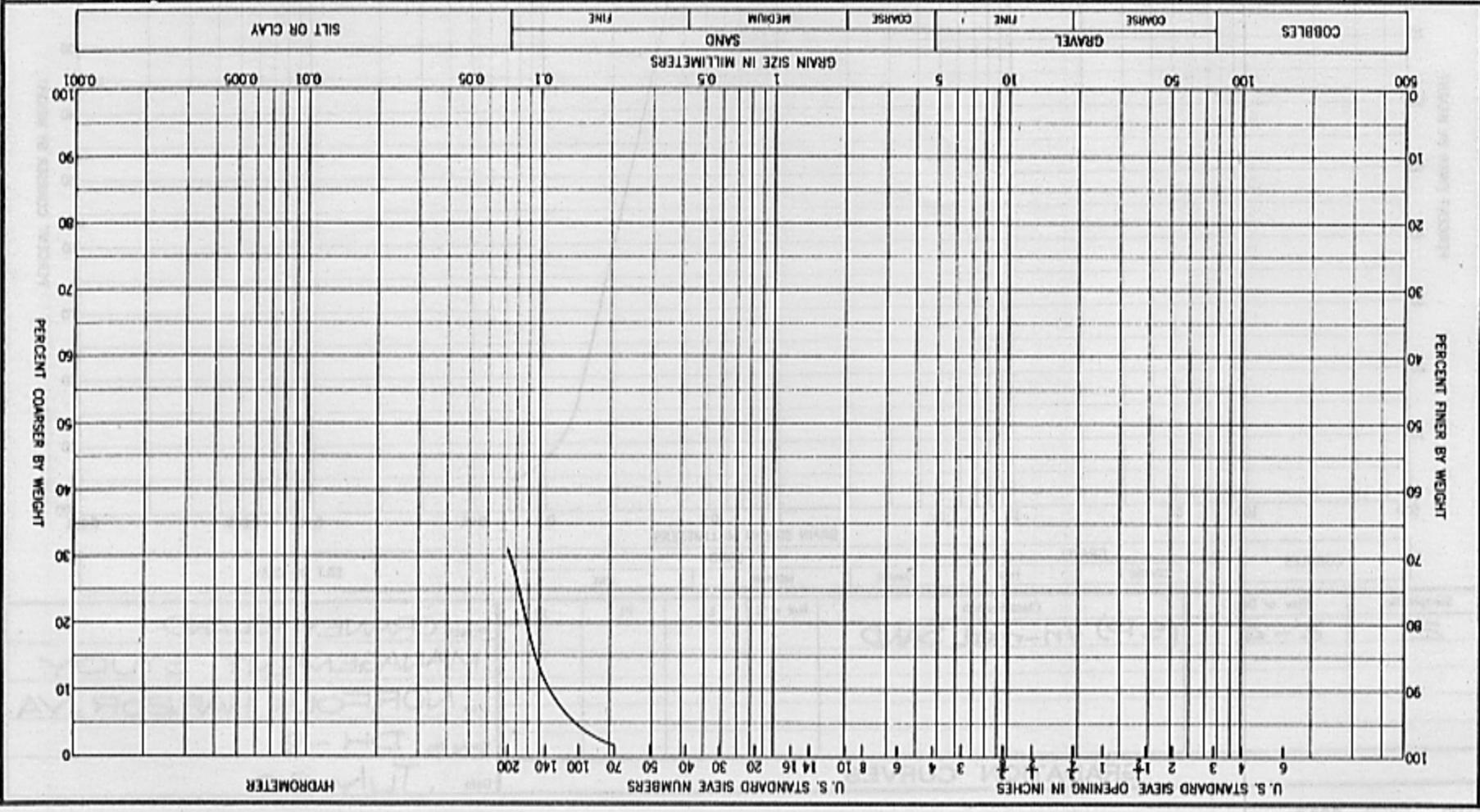
Sample No.	4	Elev or Depth	6-0	Classification	(SM) fn. SAND lt. fines	Nat W %	LL	PL	PI
Project	CRANEX ISLAND								
Area	NORFOLK HARBOR VA.								
Boring No.	D1-8								
Date	July 1980								
GRADATION CURVES									



C-34

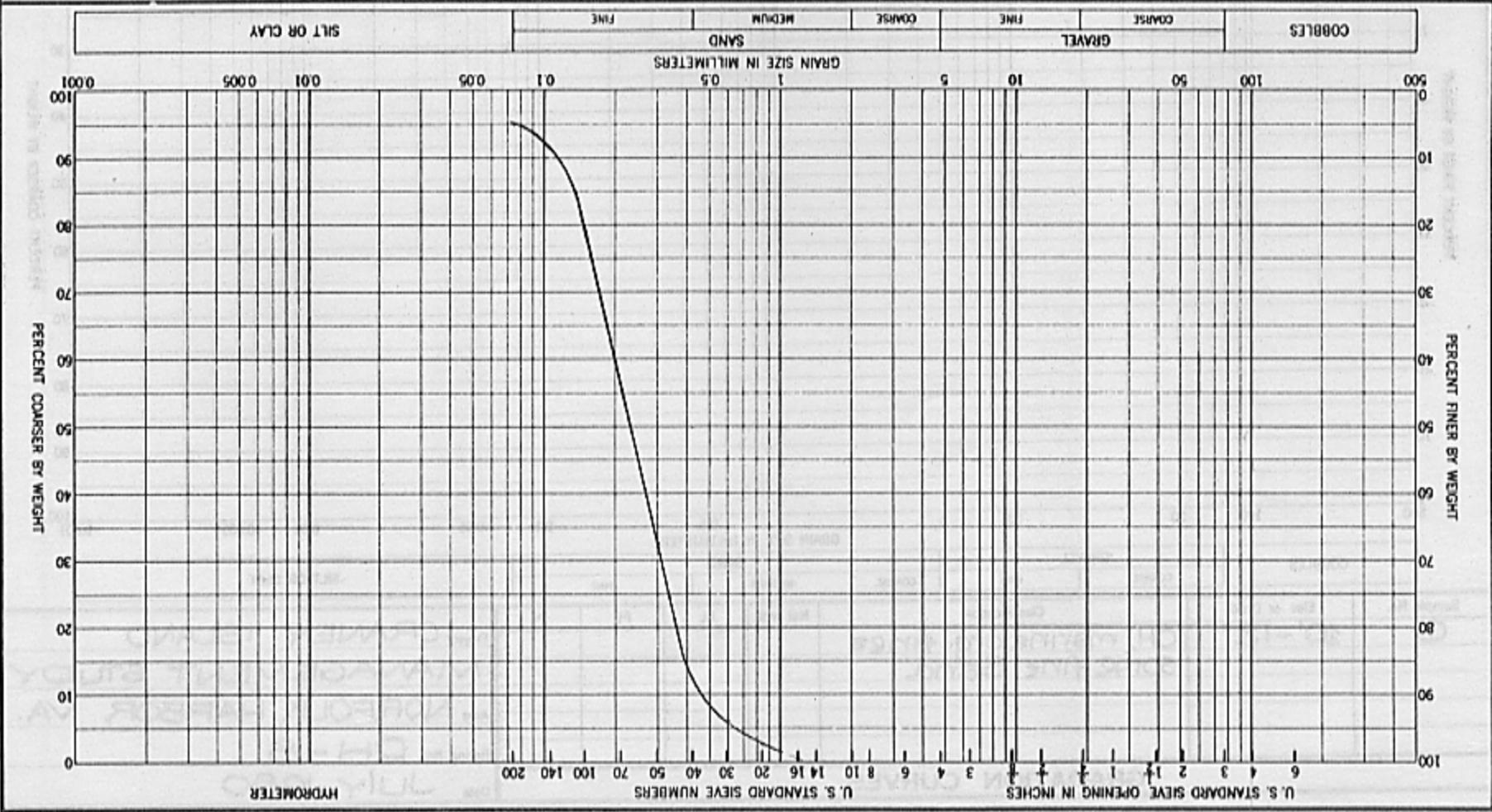
GRADATION CURVES

Sample No.	6	Elev or Depth	10'-12"	Classification	(OH) marine org. fines some fine sand	Mat W %	LL	PL	PI
Project	CRANEY ISLAND			MANAGEMENT STUDY					
Area	NORFOLK HARBOR VA.			Boring No. DH-8					
Date	JULY 1980								



5C-3

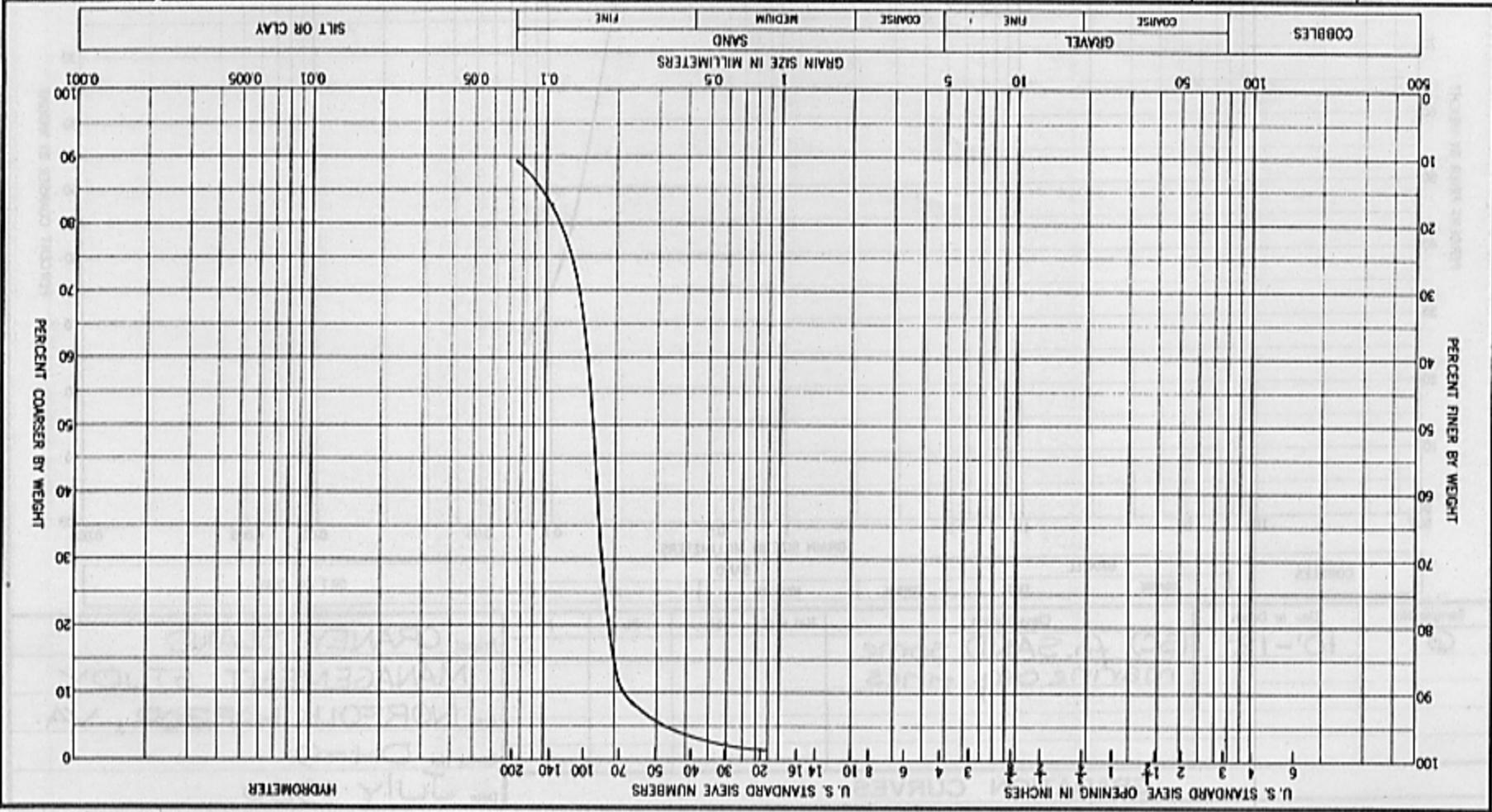
Sample No.	2	Elev or Depth	2'-4"	Classification	(SP) f _h -med SAND	Nat W %	LL	PL	PI
Project	CRANEY ISLAND								
Area	MANAGEMENT STUDY								
Area	NORFOLK HARBOR, VA								
Boring No.	DH-9								
Date	JULY 80								



C-36

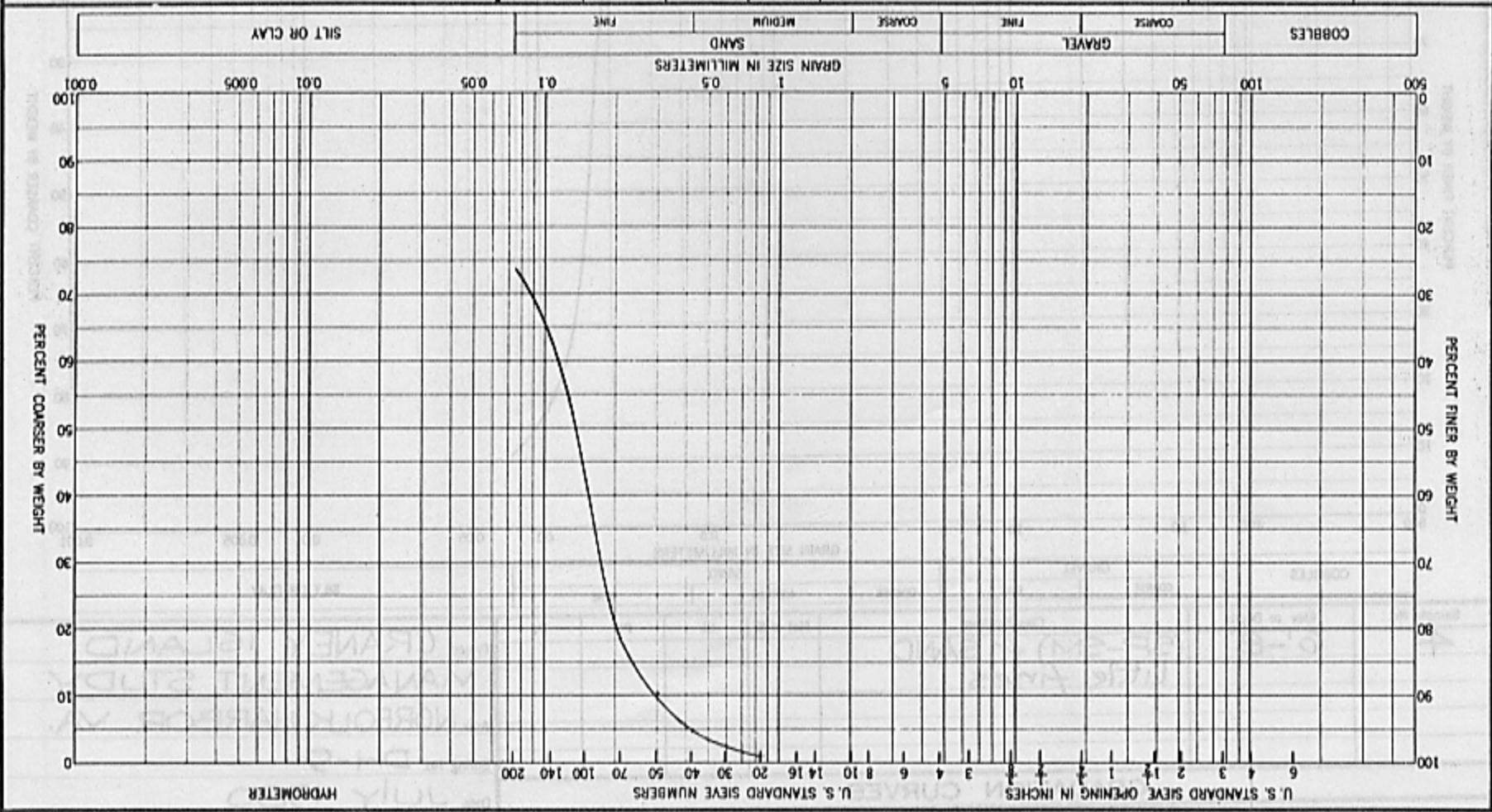
GRADATION CURVES

Sample No. 4	Elev or Depth 6'-8"	Classification (SP-SM) ^{little fines}	Nat W %	LL	PL	PI
Project CRANEY ISLAND	Area NORFOLK HARBOR VA.	Boring No. DH-9	Date JULY 1980			



C-37

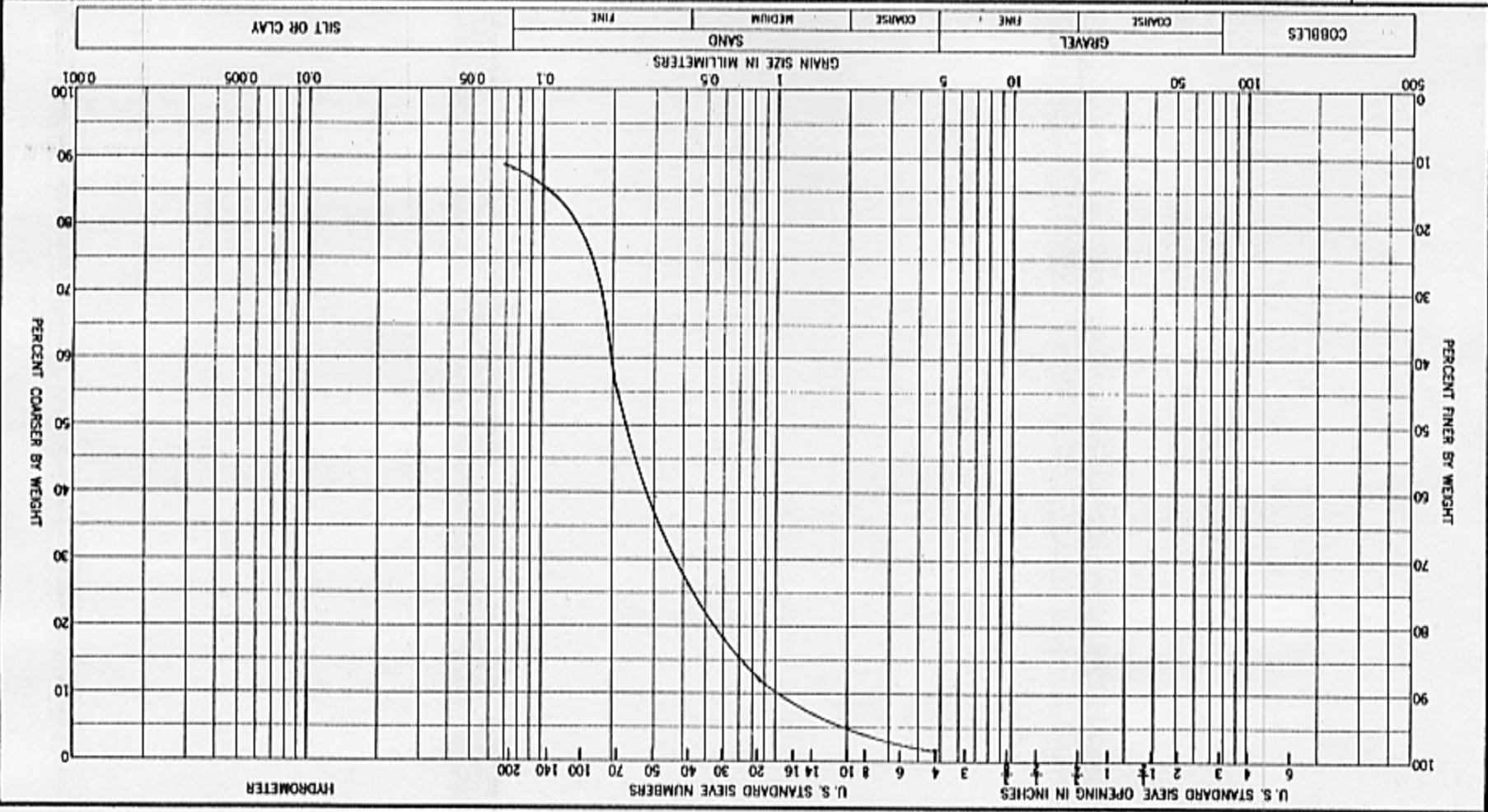
GRADATION CURVES		Date July 1980	
Sample No. 6		Boring No. DH-9	
Elev or Depth 10'-12'		Area NORFOLK HARBOR, VA.	
Classification (SC) f.n. SAND some marine org. fines		Project CRANEY ISLAND MANAGEMENT STUDY	
PI	PL	LL	Nat. W. %



C-38

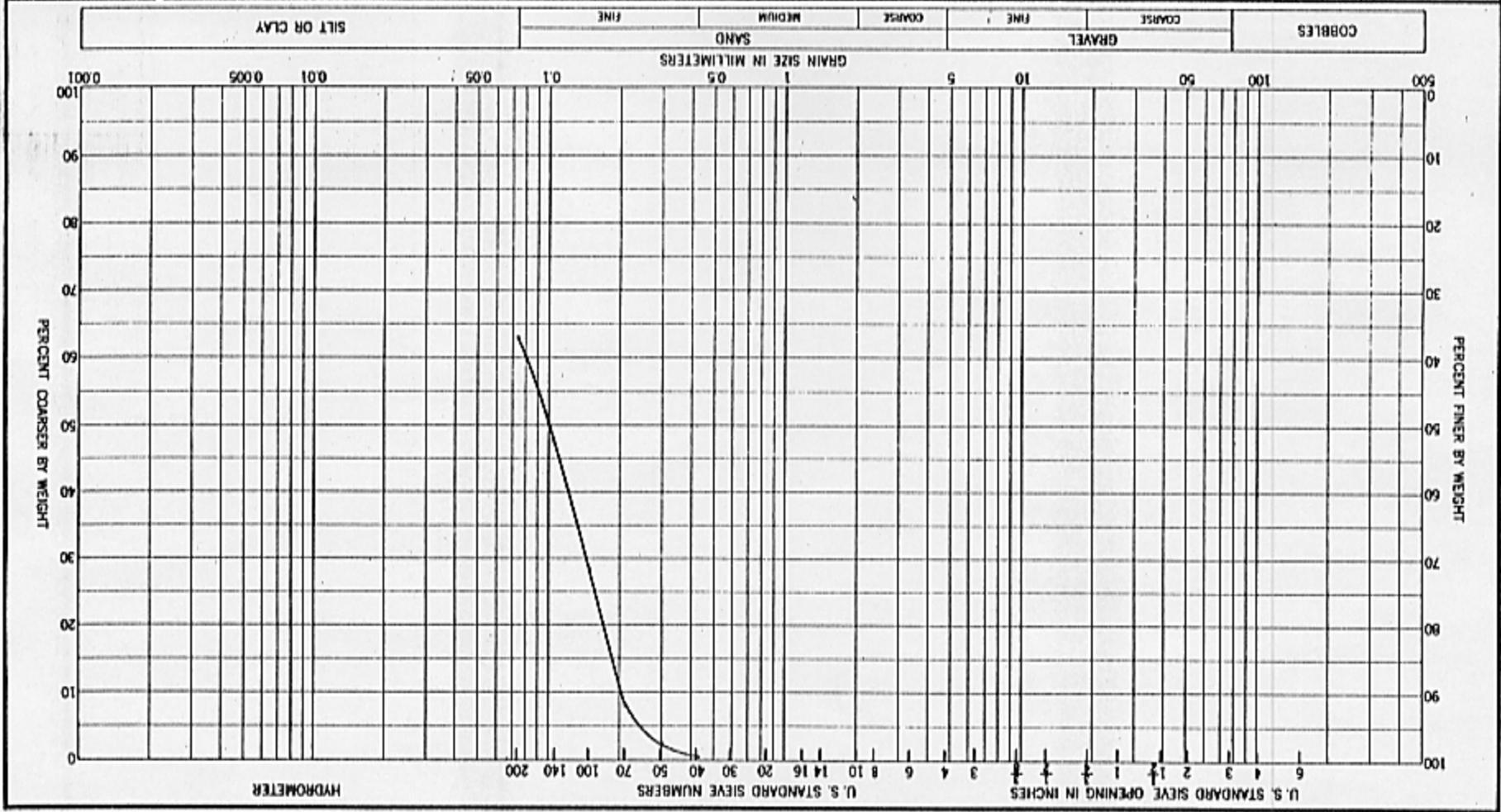
GRADATION CURVES

Sample No.	8
Elev. or Depth	14'-16'
Classification	(SP-SC) <i>fin med sand</i> <i>lit. marine org. fines</i>
Nat. W. %	LL
PL	PL
PI	PI
Project	CRANEY ISLAND MANAGEMENT
Area	NORFOLK HARBOR, VA.
Boring No.	DH-9
Date	July 1980



63-2

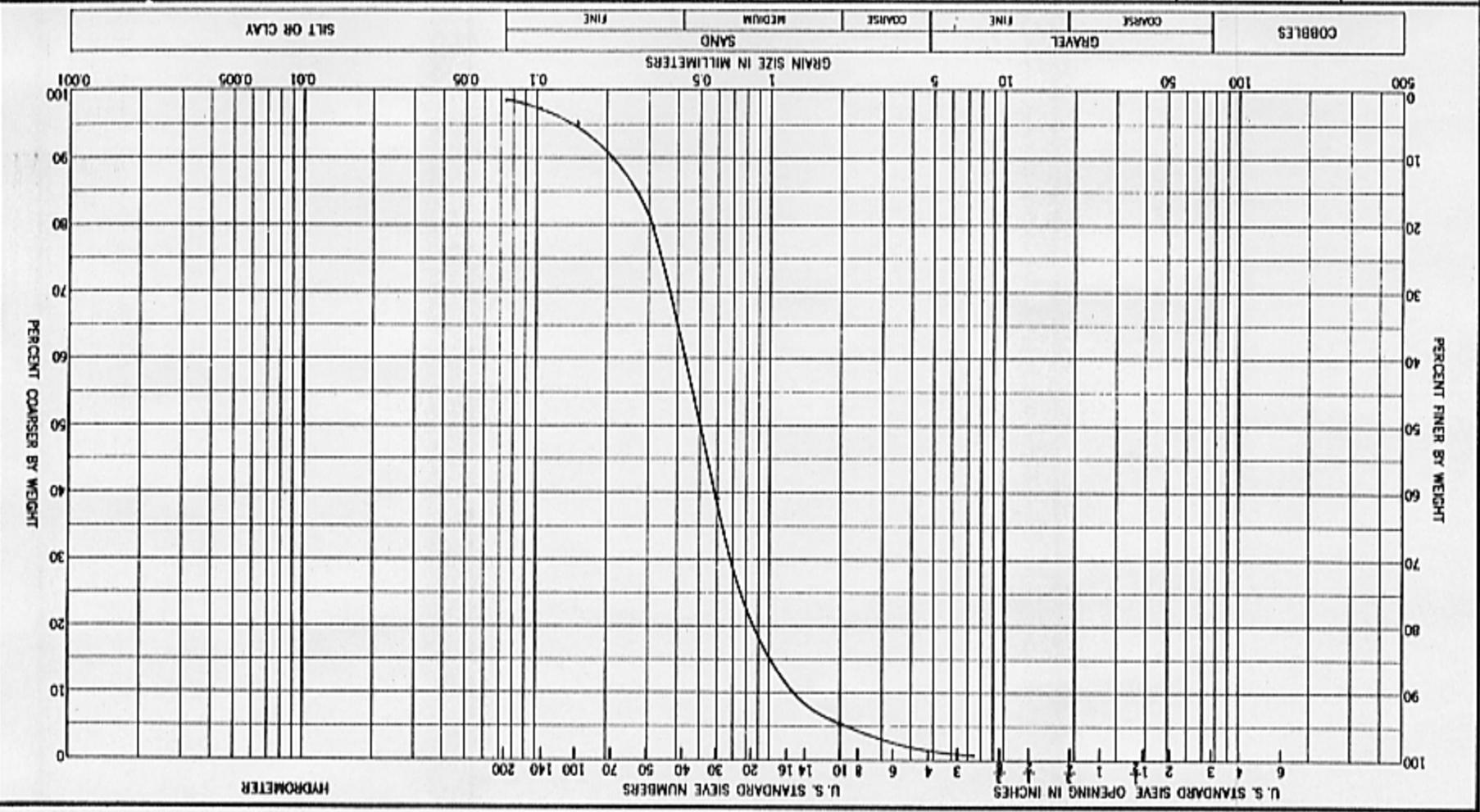
Date JULY 1980		GRADATION CURVES						
Boring No. DH-10								
Area NORFOLK HARBOR, VA								
Project CRANEY ISLAND MANAGEMENT STUDY								
Sample No. 3	Elev or Depth 4'-6"	Classification (SM) f ⁿ SAND & silt			Nat W %	LL	PL	PI



C-41

GRADATION CURVES

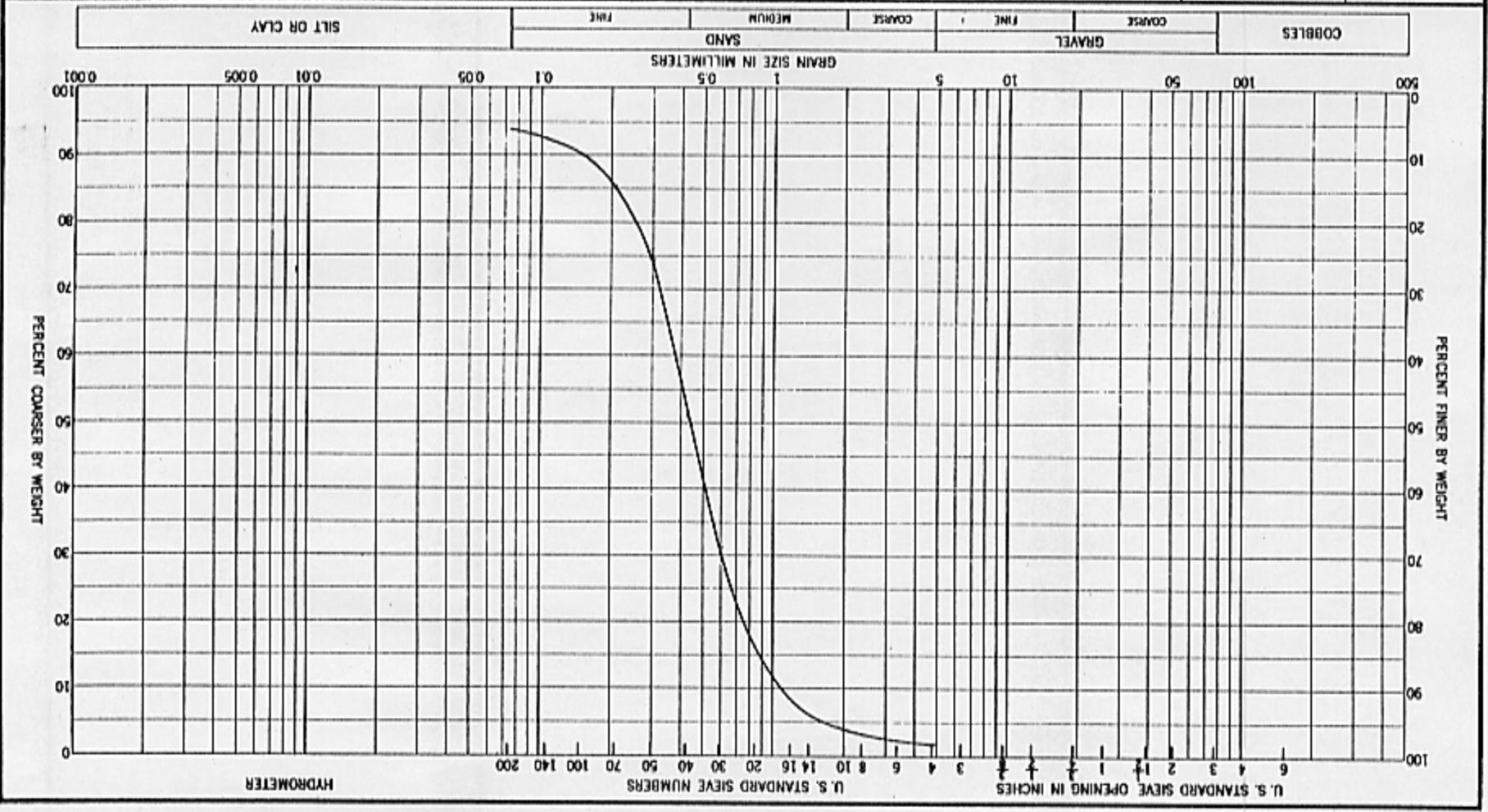
Sample No.	1	Elev or Depth	0'-2'	Classification	(SP) f _{n-m+d} SAND tr shell fragment
Project	CRANEY ISLAND	Area	NORFOLK HARBOR, VA.	Boring No.	DH-12
Date		JULY 1980			



57-0

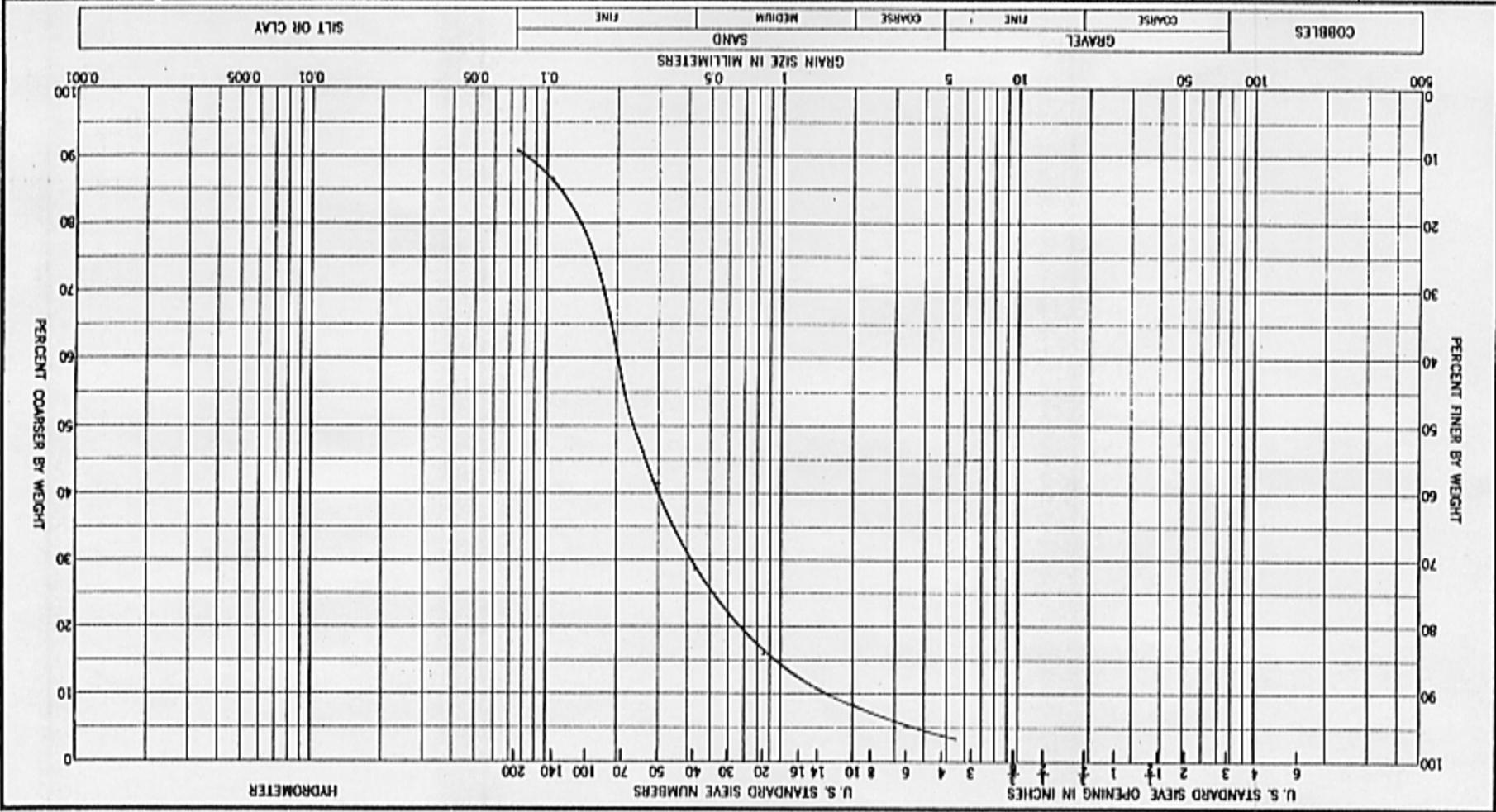
GRADATION CURVES

Sample No.	7	Elev or Depth	12'-14'	Classification	(SP-SM) f _n -med SHELL FRAGMENTS
Project	CRANEY ISLAND				
Area	MANAGEMENT STUDY				
Area	NORFOLK HARBOR VA				
Boring No.	DH-12				
Date	July 1980				



C-47

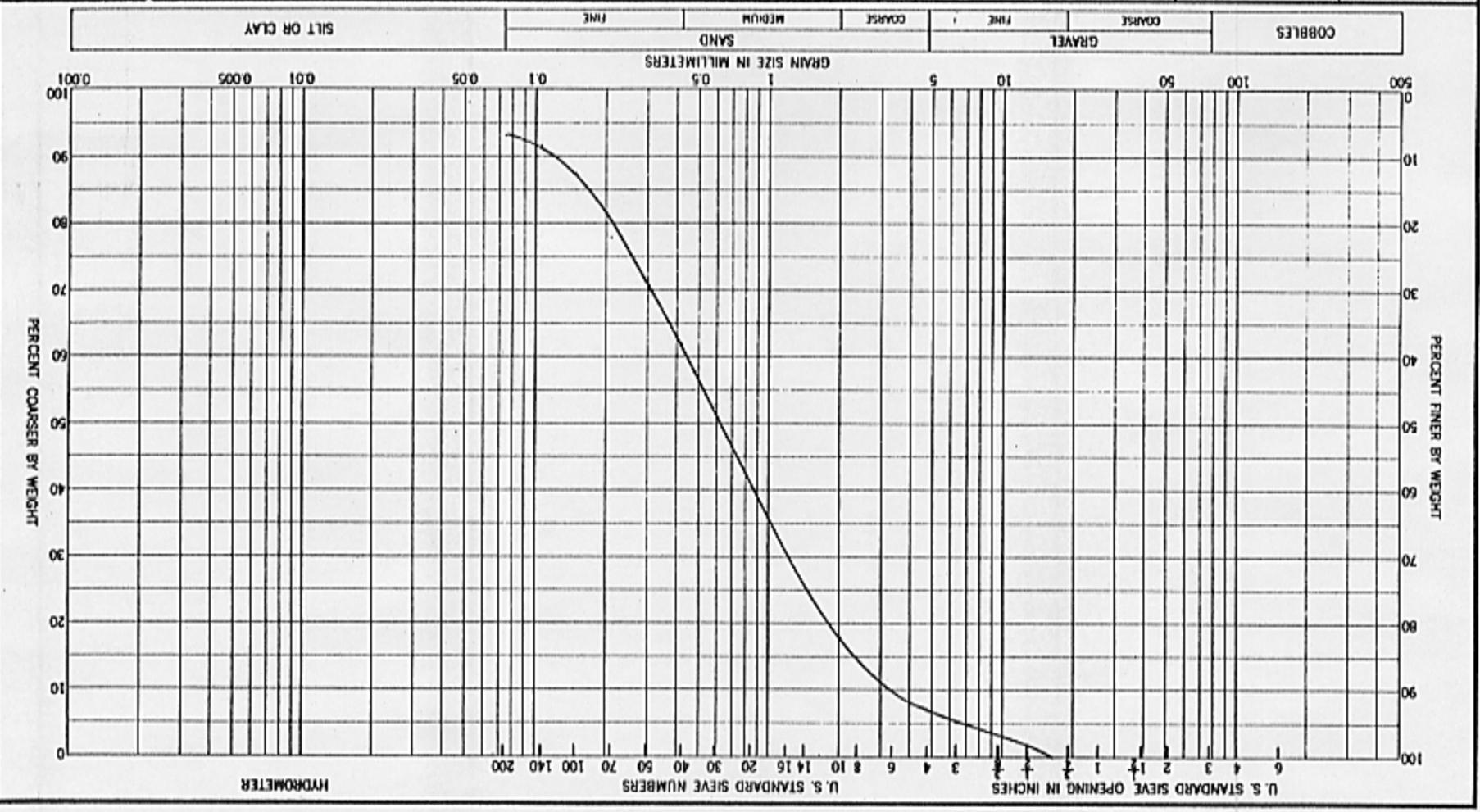
GRADATION CURVES		Date July 1980	
Sample No. 1		Boring No. DH-13	
Elev or Depth 0-2'		Area NORFOLK HARBOR	
Classification (SP-SC) f-n med SAND & SHELL FRAGS. + marine org. fines		Project CRANEY ISLAND	
PI		PL	
PI		PL	



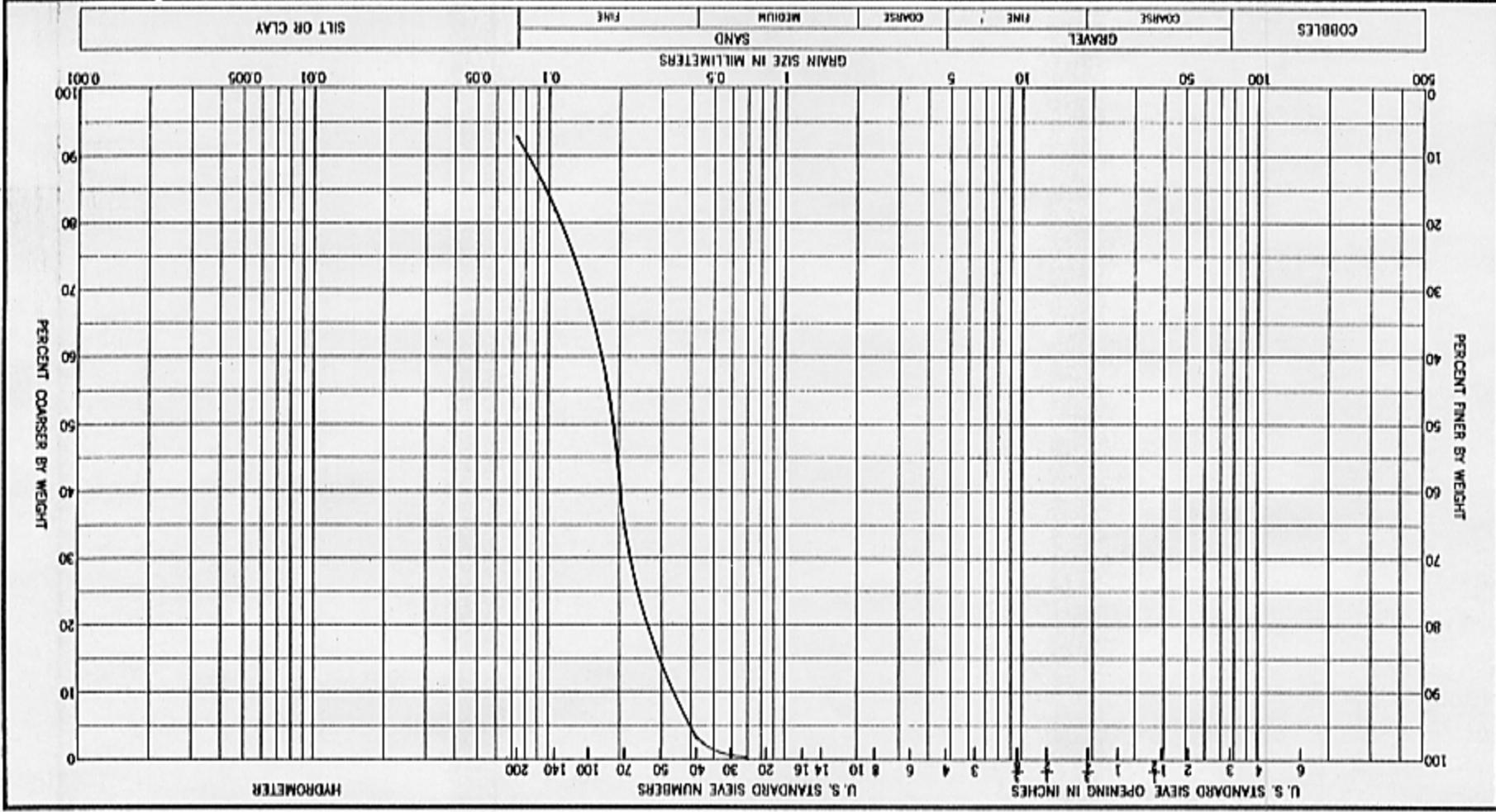
67-2

GRADATION CURVES

Sample No.	4	Elev or Depth	G1-2	Classification	(SP-SC) f.n. to c.r.s. SAND & SHELL FRAG. f. fines
Project	CRANEY ISLAND	Area	NORFOLK HARBOR, VA	Boring No.	DH-13
Date		JULY 1980			



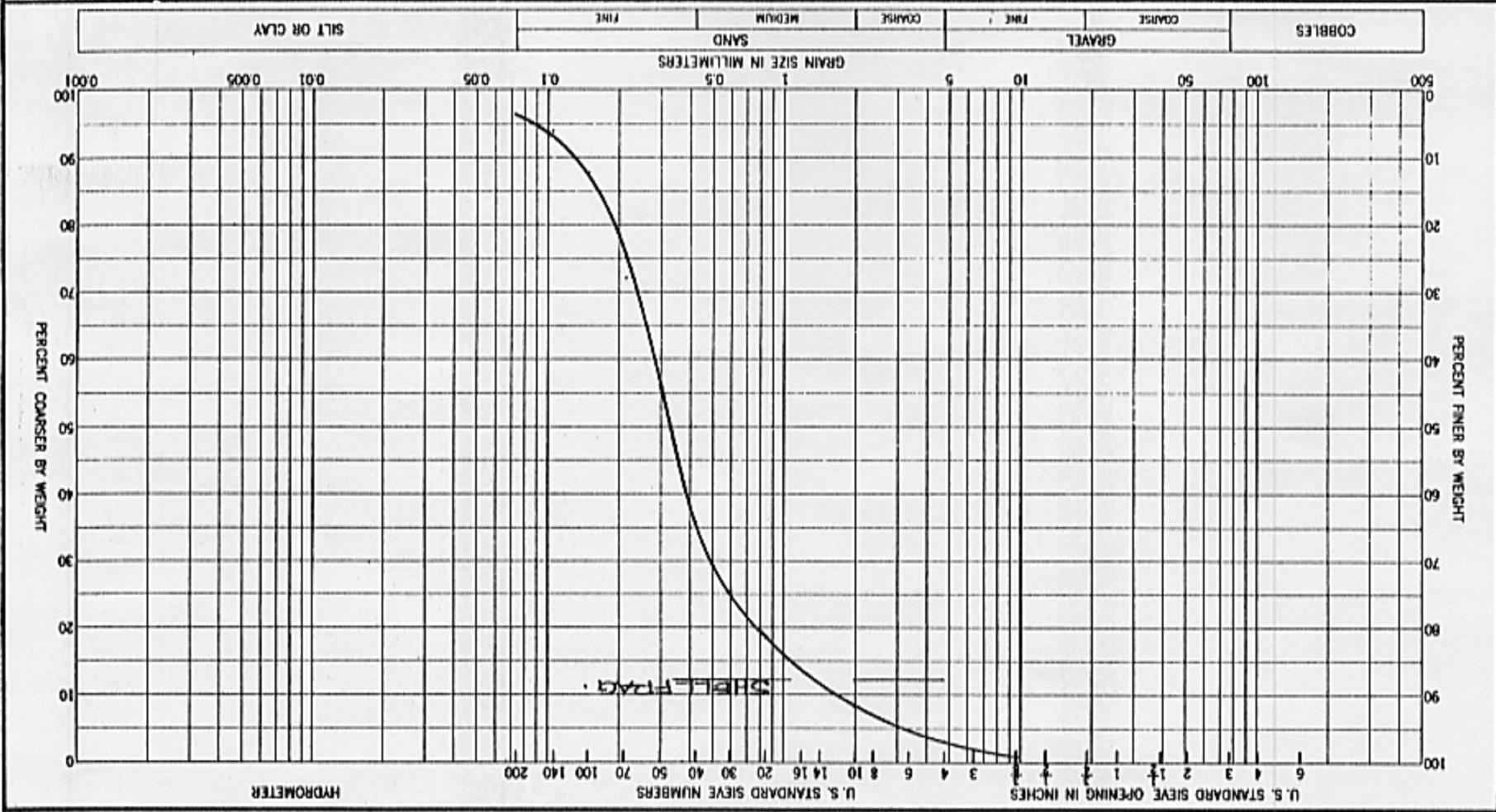
Sample No.	3	Classification (SP-SM) f _n SAND f _r fines	Nat W %	LL	PL	PI	Elev or Depth 4'-6"
Area							
Project	CRANEY ISLAND	MANAGEMENT STUDY					
Area		NORFOLK HARBOR VA					
Boring No.	DH-14						
Date	July 1980	GRADATION CURVES					



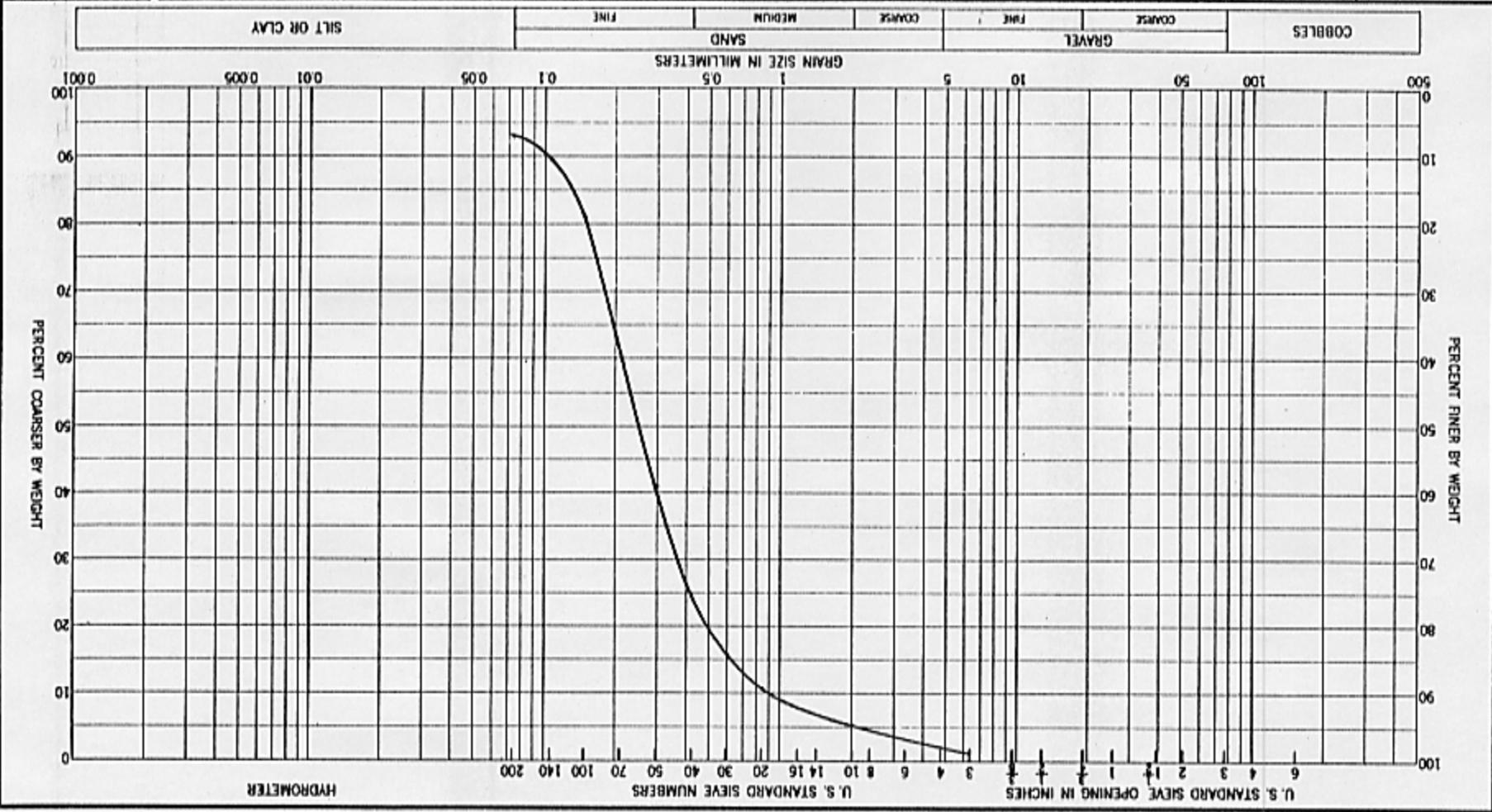
C-53

GRADATION CURVES		Date	July 1980
Sample No.		Boring No.	DH-15
Elev or Depth		Area	NORFOLK HARBOR VA.
Classification		Project	CRANEY ISLAND MANAGEMENT STUDY
Nat W %		PI	
LL		PL	
COARSE			
FINE			
GRAVEL			
SAND			
MEDIUM			
FINE			
SILT OR CLAY			

(SP) f_n-mod SAND Lt
Shell frag.



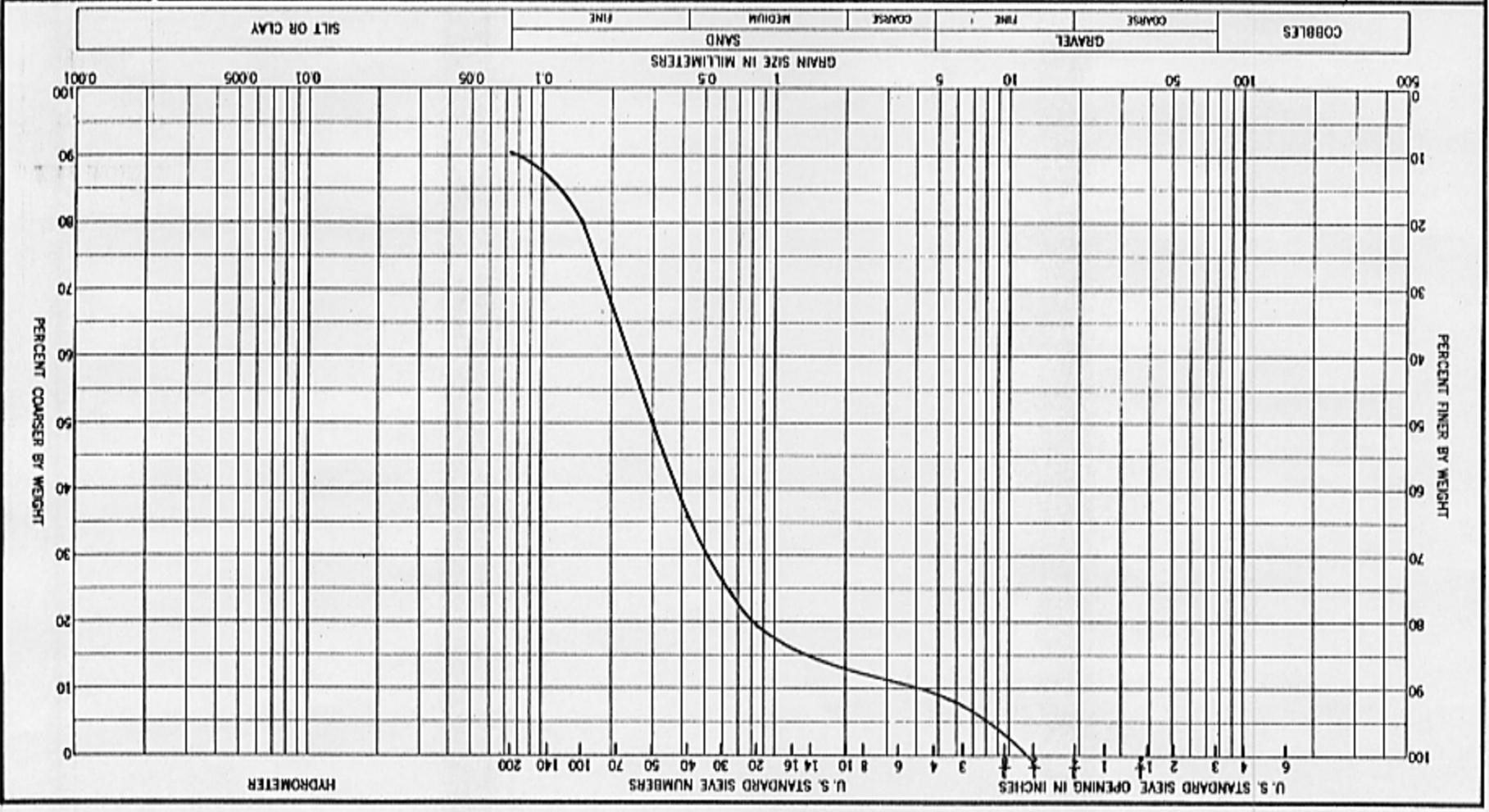
Date JULY 1980		GRADATION CURVES					
Boring No. DH-15							
Area NORFOLK HARBOR VA							
Project CRANEY ISLAND							
MANAGEMENT STUDY							
Sample No.	①	Elev or Depth	10'-12"	Classification	(SP-SC) f _n -med SAND f ₇₅ fines		
				Nat W %	LL	PL	PI



C-57

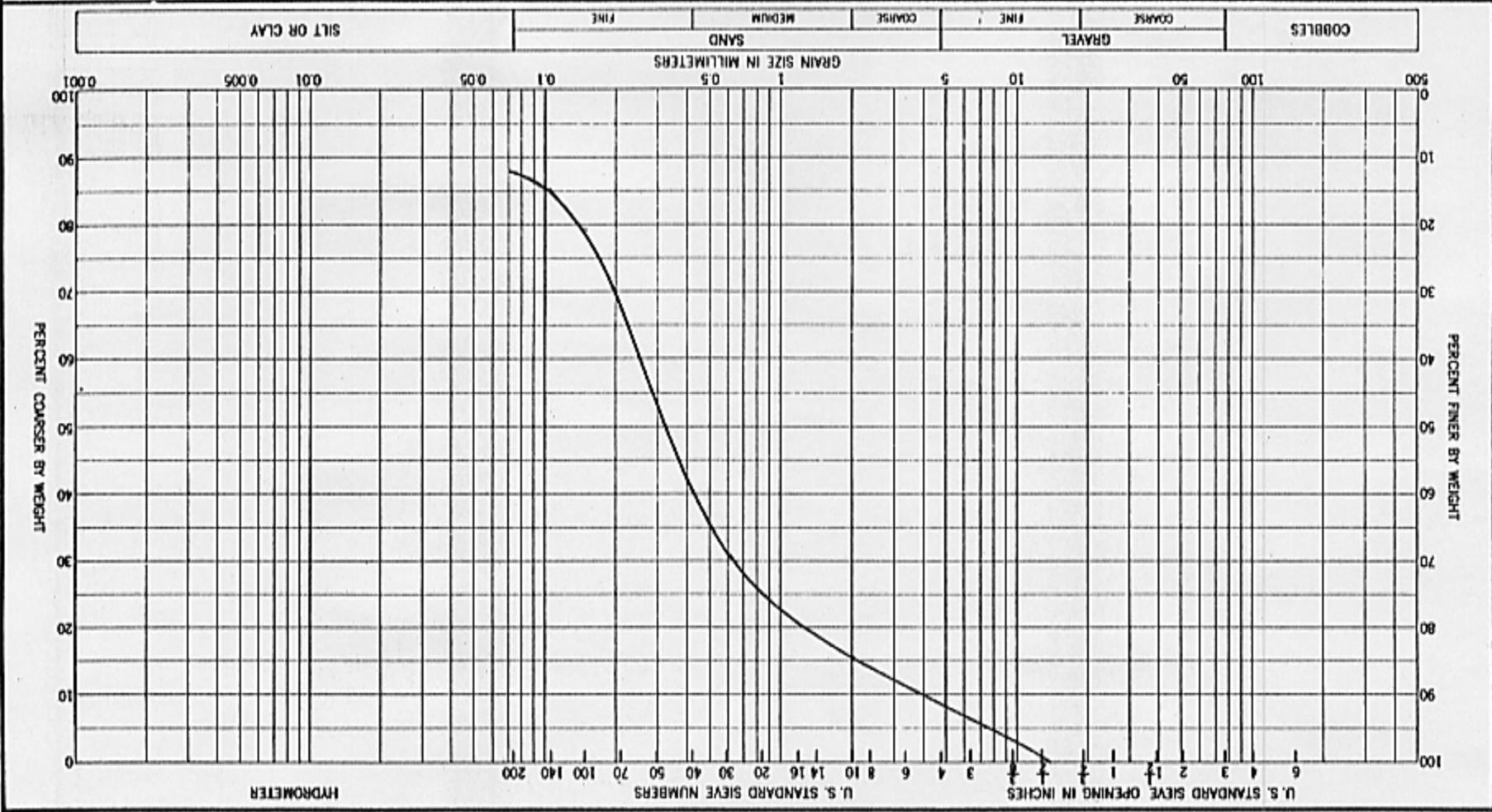
GRADATION CURVES

Sample No.	2	Elev or Depth	2'-4"	Classification	(SP-SC) f _{med} SAND f _{fine} gravel, f _{fine} fines	Project	CRAVEY ISLAND
Area	NORFOLK HARBOR, VA.		Boring No.	DH-16		Date	July 1980
MANAGEMENT STUDY							

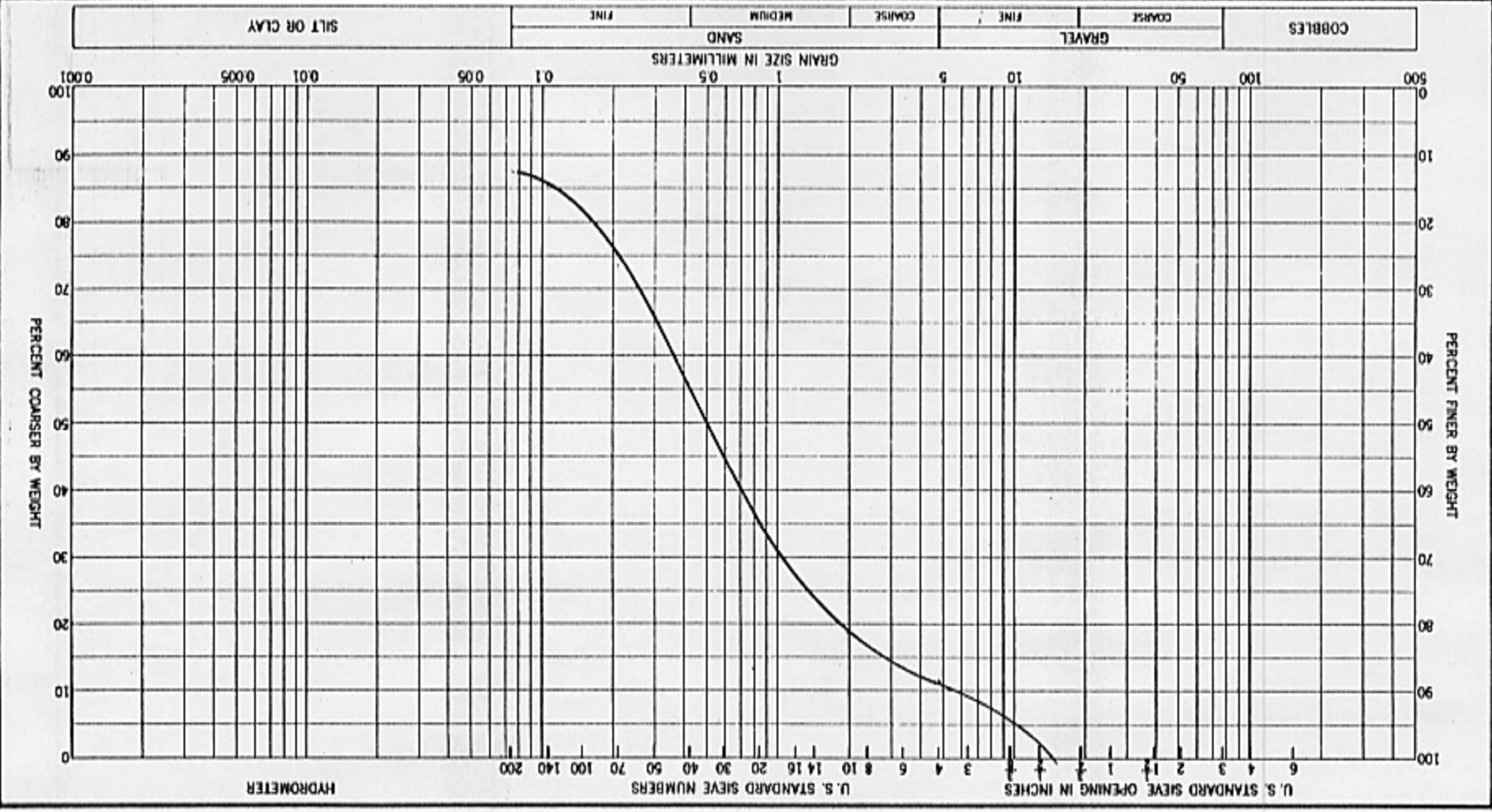


C-59

Date July 1980		GRADATION CURVES				
Boring No. DH-16						
Area NORFOLK HARBOR VA						
Project CRANEY ISLAND MANAGEMENT STUDY						
Sample No. 5	Elev or Depth B'-10'	Classification (SP-SC) fine grs SAND or fine gravel little organic fines	Nat W %	LL	PL	PI



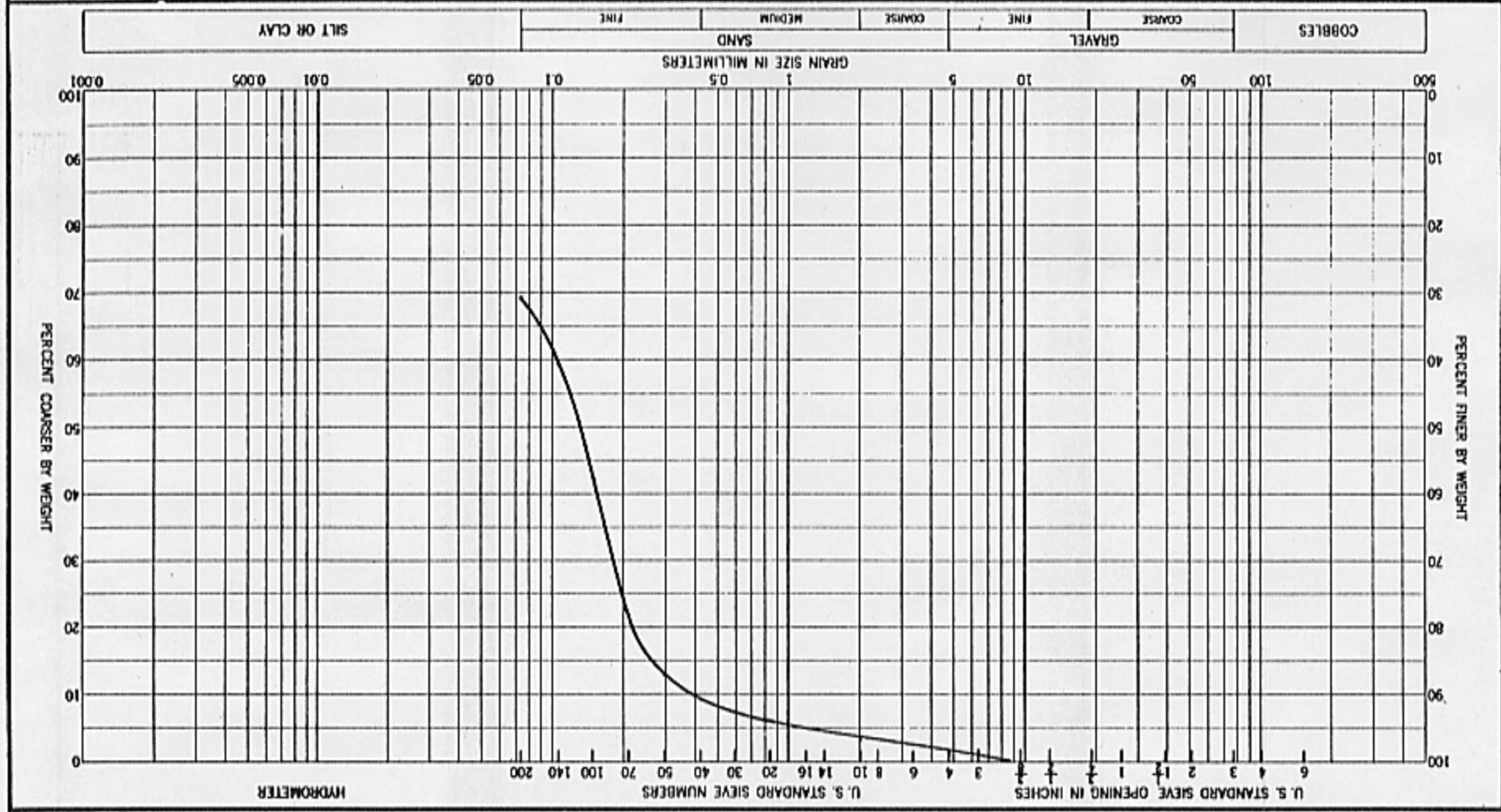
Date July 1980		GRADATION CURVES					
Boring No. DH-17							
Area NORFOLK HARBOR, VA							
Project CRANER ISLAND MANAGEMENT STUDY							
Sample No. 2	Elev or Depth 2-4'	Classification (SC) f-med SAND Lt. in gravel & shell little manne org. fines		Nat W %	LL	PL	PI



CG-3

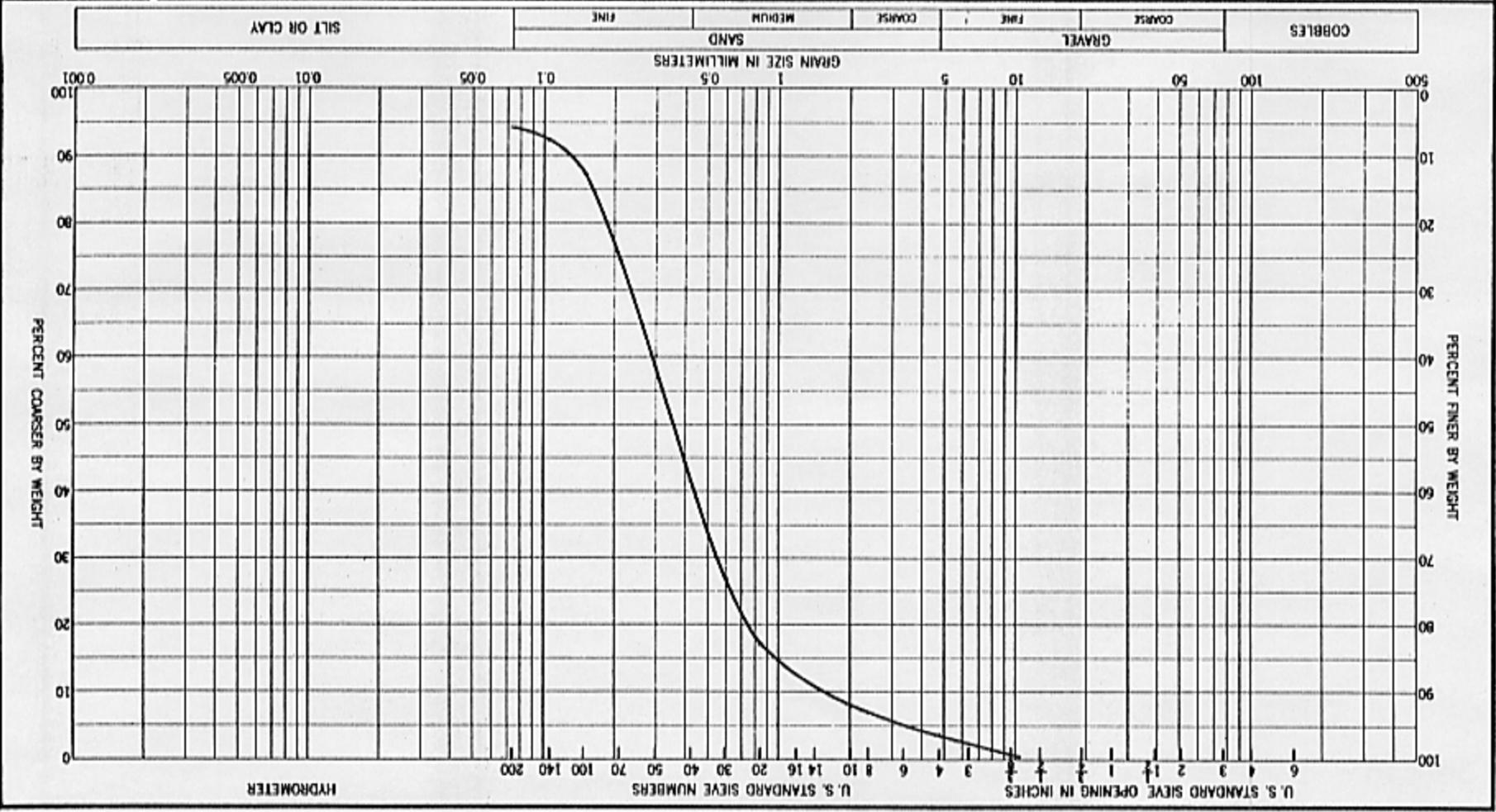
GRADATION CURVES

Sample No.	6	Elev or Depth	10'-12'	Classification	(SC) f-med SAND some marine org. fines	Project	CRANEY ISLAND
Area	NORFOLK HARBOR VA		Boring No.	DH-17		Date	July 1980
MANAGEMENT STUDY							
SILT OR CLAY							



C-9-5

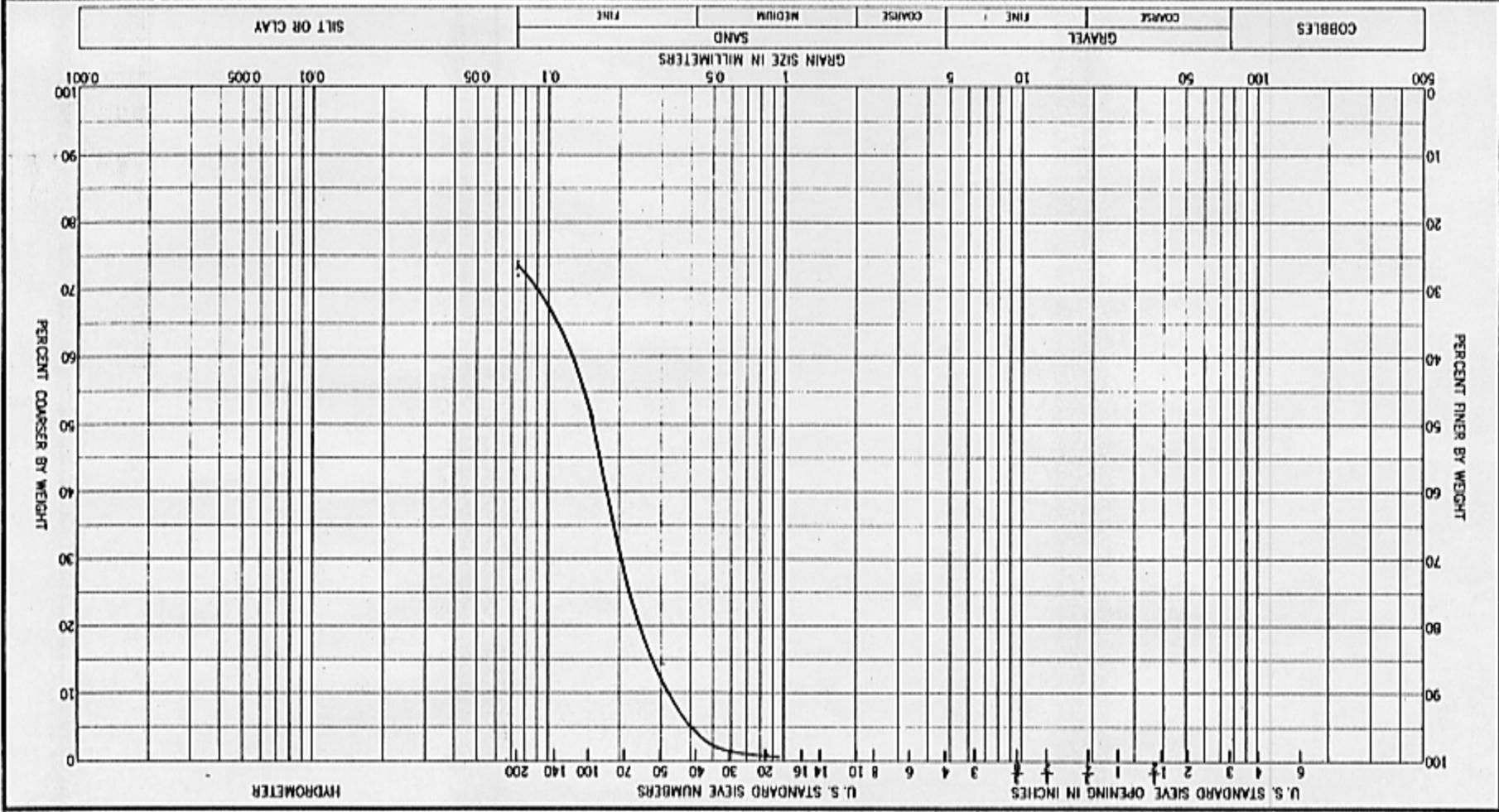
Date		GRADATION CURVES					
Boring No.							
Area		NORFOLK HARBOR					
Project		CRANEY ISLAND MANAGEMENT STUDY					
Sample No.	Elev or Depth	Classification	Nat W %	LL	PL	PI	
1	0'-2'	(SP-SM) fn-med SAND tr crs. shell frag.					



C-67

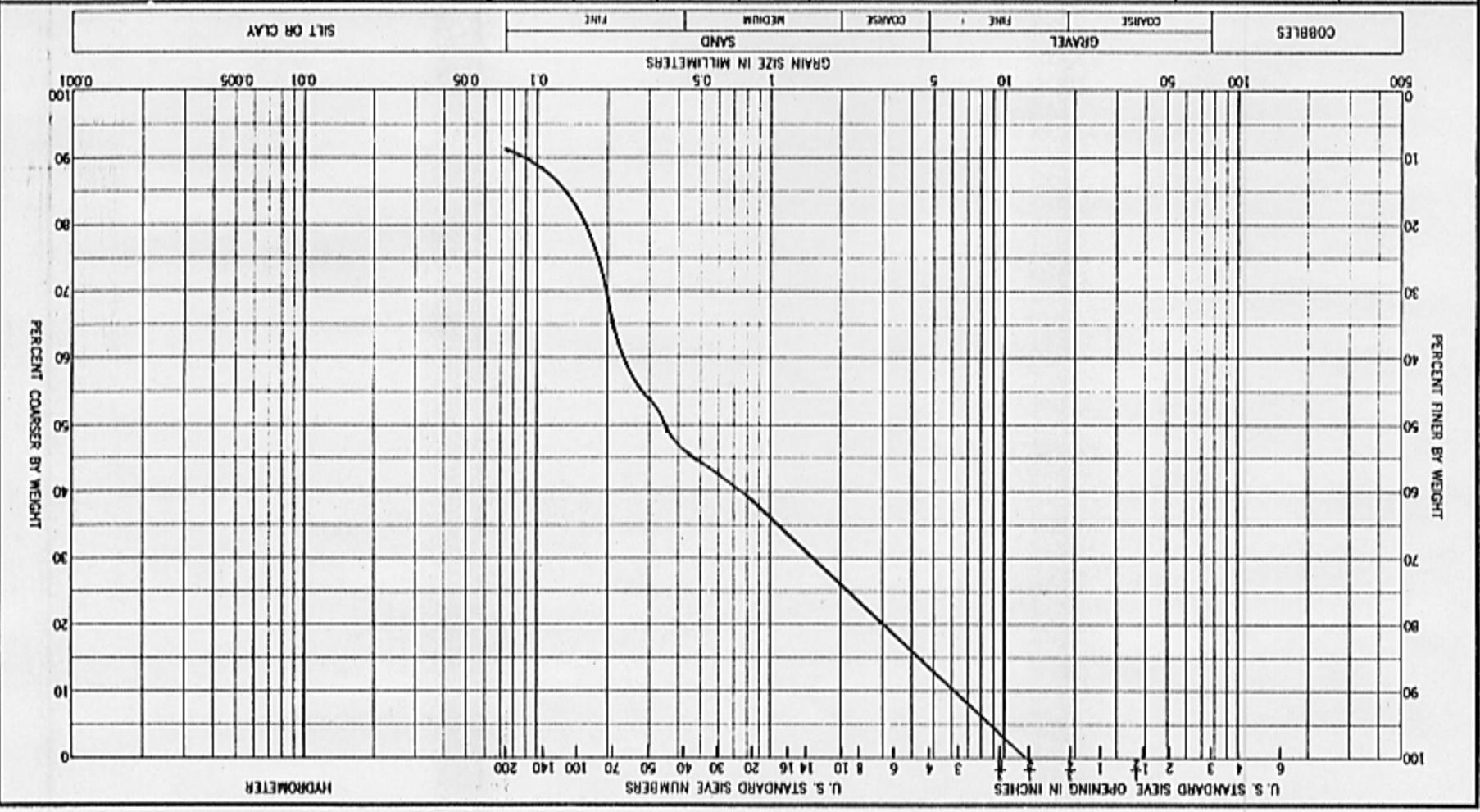
31

Date: JULY 1980		GRADATION CURVES					
Boring No. DH-18							
Area: NORFOLK HARBOR, VA							
Project: CRANEY ISLAND MANAGEMENT STUDY							
Sample No. 4	Elev or Depth 6'-8"	Classification (SC) fn SAND some marine organic fines		Nat W %	LL	PL	PI

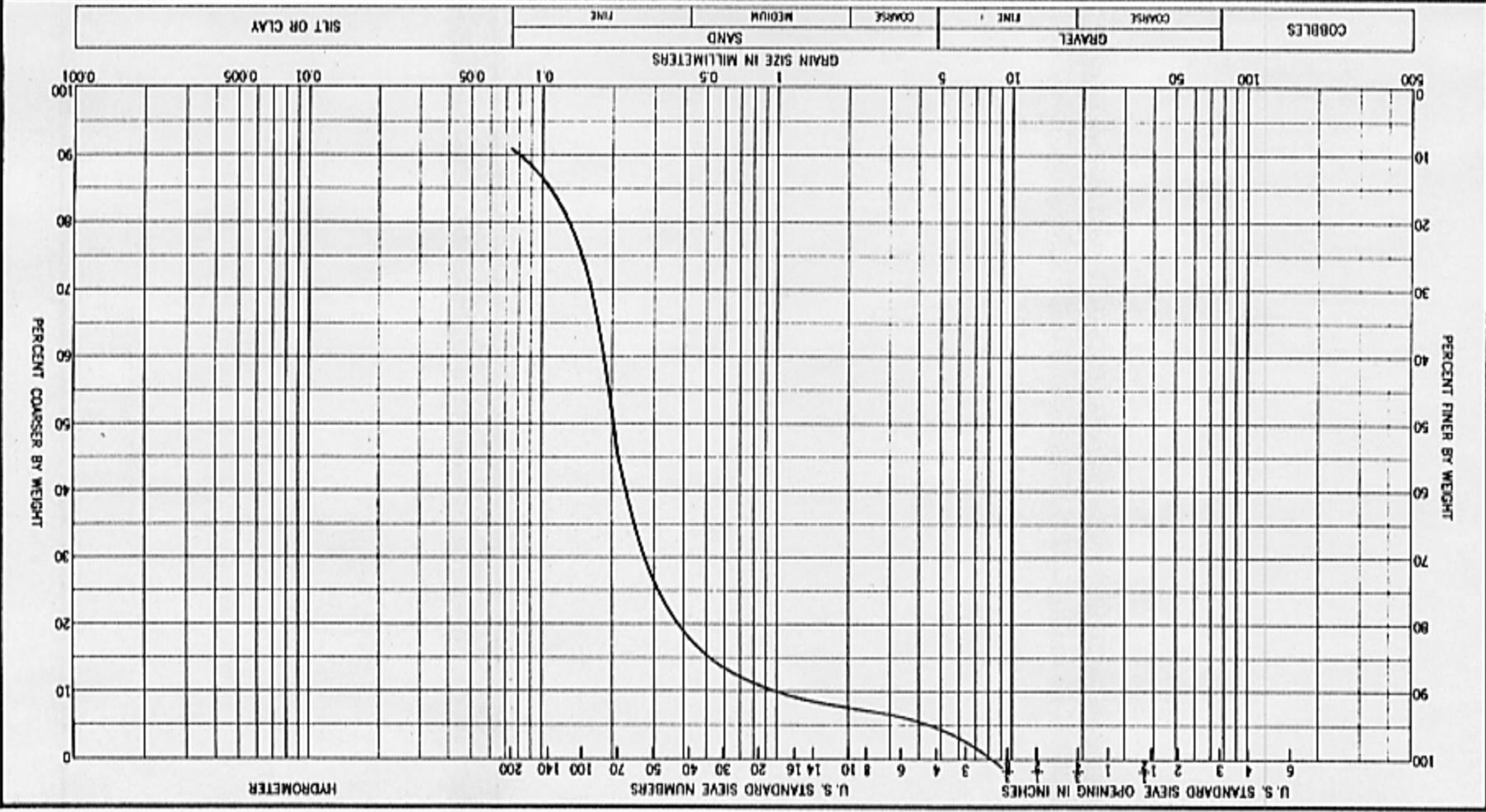


GRADATION CURVES

Sample No.	2	Elev or Depth	2'-4"	Classification	(SP-SM) f-n-crs SAND lt shell fr fines	Area	NORFOLK HARBOR, VA	Project	CRANEY ISLAND MANAGEMENT STUDY	Date	JULY 1980
				NaI %						Boring No.	DH-19
				LL							
				PL							
				PI							



GRADATION CURVES		Date: July 1980	
Sample No. 6		Boring No. DH-19	
Elev or Depth: 10'-12"		Area: NORFOLK HARBOUR, VA.	
Classification: (SP-SM) f-l med SAND f-l gravel f-l fines		Project: CRANEY ISLAND MANAGEMENT STUDY	
Nat W %		PI	
LL		PL	
PL		PI	



APPENDIX D: PHOTOGRAPHS

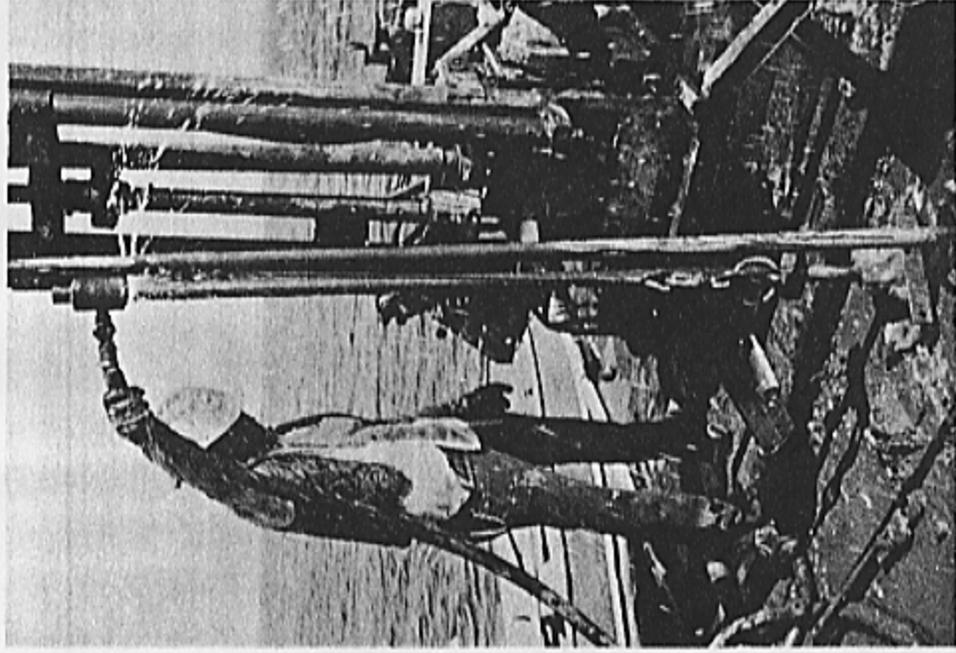


PHOTO 1: WASHING THE HOLE



PHOTO 2: WASH BIT

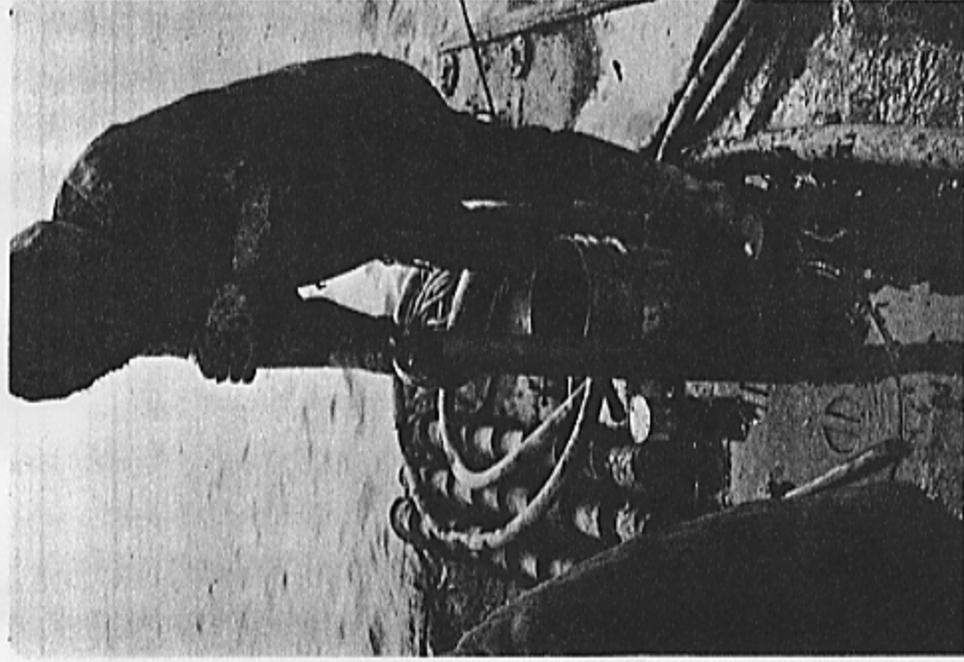


PHOTO 3: CLEANING AND ASSEMBLING PISTON HEAD



PHOTO 4: ASSEMBLED PISTON HEAD

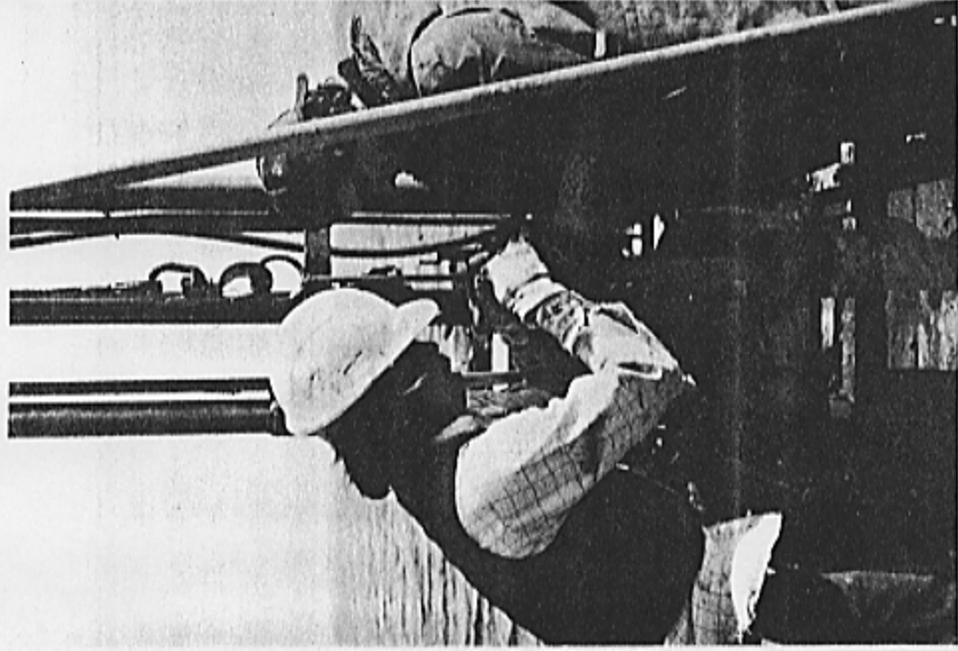


PHOTO 5: PUSHING TUBE

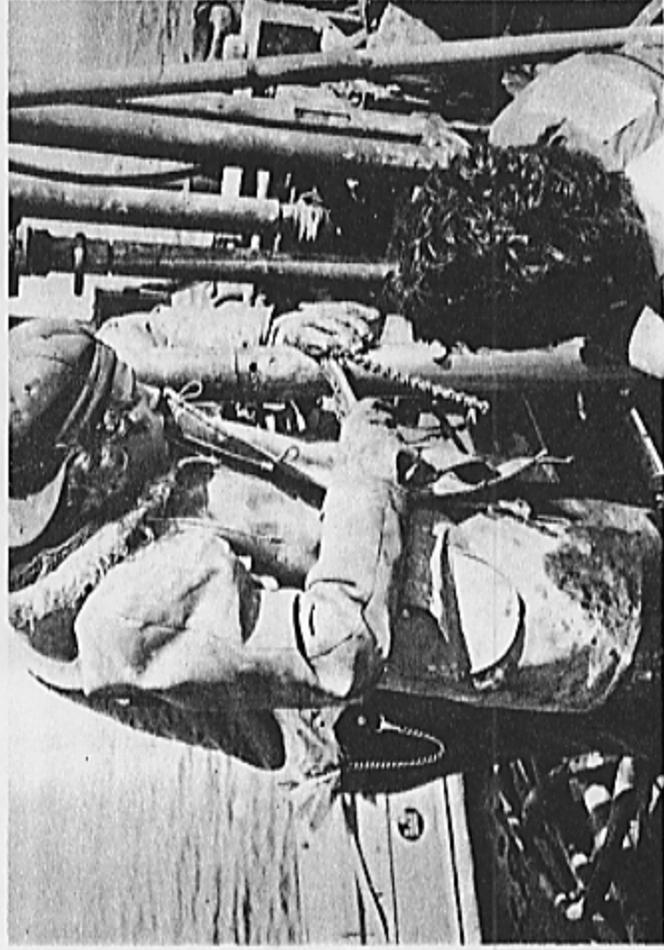


PHOTO 6: REMOVING TUBE

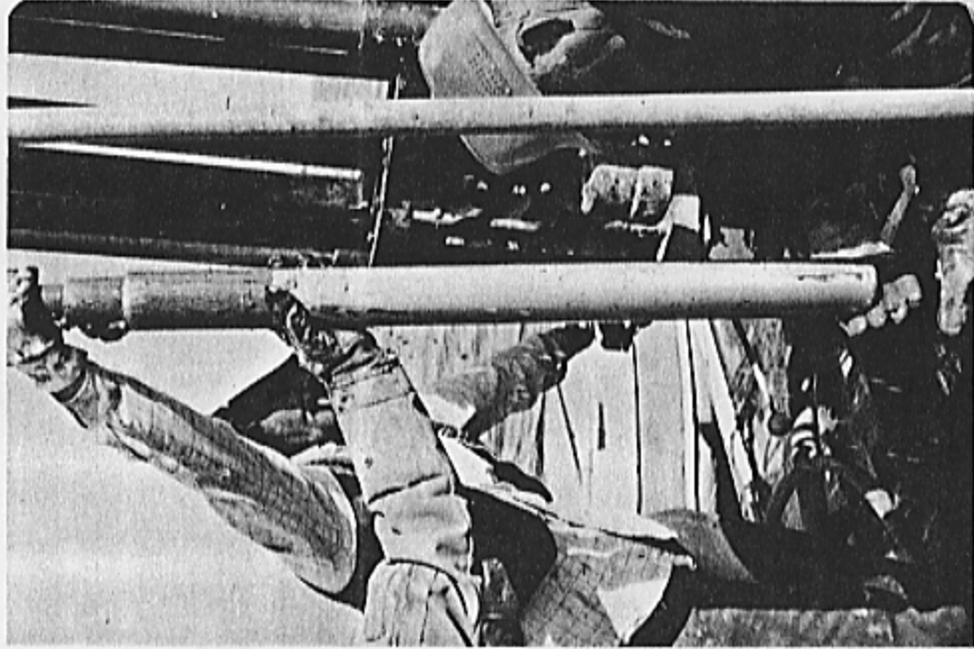


PHOTO 7:
WITHDRAWING TUBE



PHOTO 8:
CAPPED TUBE ON - DECK



PHOTO 9: WOODEN RACK USED TO STORE
SAMPLES ON THE BARGE.

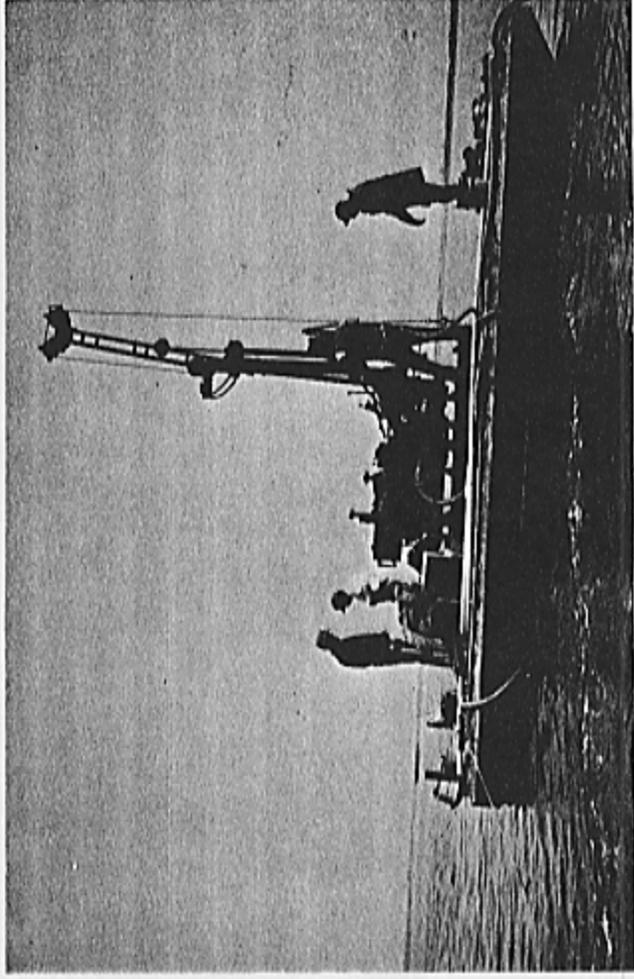


PHOTO 10: BARGE SET UP ON A HOLE



PHOTO 11: GENERAL VIEW OF AREA WHERE
SAMPLES WERE SEALED.

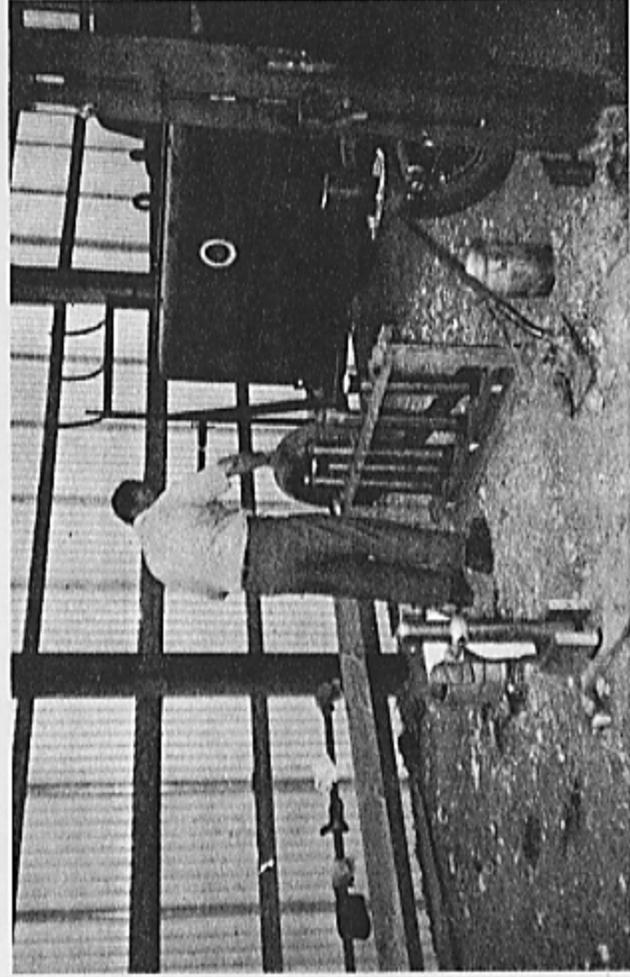


PHOTO 12: SEALING OPERATION

APPENDIX E: CONTRACT

GEOTECHNICAL ENGINEERING SERVICES
SCOPE OF WORK
CRANEY ISLAND MANAGEMENT STUDY
Norfolk Harbor, Virginia

1. Included Information
 - a. Specifications for subsurface exploration.
 - b. Boring location plan.
 - c. Project location plan.
 - d. Specifications for laboratory testing.

2. Required Submittals:
 - a. Boring logs.
 - b. Laboratory test results and evaluation.

3. Miscellaneous Requirements:
 - a. The subsurface exploration must be completed by 15 April 1980.
 - b. Hard hats and life vests will be required.
 - c. All field work must be coordinated through Dave Pezza
(804/441-3667).

Prepared by:
D.A. Pezza, P.E., Geotechnical Engineering Section
Design Branch
Norfolk District, Corps of Engineers
Norfolk, Virginia 23510
18 March 1980

GENERAL INFORMATION
SOURCE OF WORK
CRANEY ISLAND MANAGEMENT STUDY
NORFOLK DISTRICT, VIRGINIA

1. General Information
2. Objectives
3. Scope of Work
4. Methodology
5. Deliverables
6. Schedule
7. Budget
8. Risk Management
9. Reporting
10. Other

SPECIFICATIONS
FOR
SUBSURFACE EXPLORATION
CRANEY ISLAND MANAGEMENT STUDY
NORFOLK HARBOR, VIRGINIA

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK
803 FRONT STREET
NORFOLK, VIRGINIA 23510
MARCH 1980

PART I

GENERAL PROVISIONS

1. DESCRIPTION OF WORK: The work consists of furnishing all plant, labor, materials and equipment and performing all work in connection with the proposed Craney Island Management Study as indicated on the drawings and as specified herein. The proposed work will be at the Craney Island Disposal Area. The project is a 2500 acre confined dredged material disposal area located in Norfolk Harbor, Virginia. The site contains approximately 100 million cubic yards of fine grained dredged material. The purpose of the subsurface investigation is to sample the deposited dredge spoil to full depth. The work will consist of approximately 6 borings with continuous undisturbed sampling to full depth. The sampling will be advanced to a depth of approximately 36 feet at the locations shown on the drawings. Also, included in the work will be the installation of 4 open-standpipe piezometers. Two piezometers will be installed at the bottom of holes advanced to full depth, and two at the bottom of offset holes taken to mid-depth. All the borings will be located in the field by the Government. If it is found impractical to drill at the precise locations, or if further investigation indicates the desirability of changing the location and depth of holes, the location and depth will be varied as directed by the Government inspector.
2. SITE CONDITIONS: Craney Island is accessible by vehicle. However, the borings will be located within the containment area which is partially flooded and has a very soft mud bottom. The Government will limit its work to the flooded area. By controlling project sluice gates, the Government will provide an 18 to 24-inch standing pond in the work area. Also, the Government will make available a steel barge and other related support equipment at the job site. The barge is 25 feet long by 12 feet wide with a 12-inch draft. The drilling operation will have to be coordinated with the Government support work shift. Craney Island maintenance personnel work from 8:00 AM to 4:30 PM weekdays.
3. INSPECTION: The work will be conducted under the general direction of the Contracting Officer and is subject to inspection by an appointed inspector. The inspector will also serve as coordinator between the A-E and Government support.

PART II

TECHNICAL PROVISIONS

TP-1. General:

TP-1.1 Work Included: The work covered in these specifications consists of furnishing all labor, equipment, supplies and materials, in connection with the drilling as hereinafter specified.

TP-1.2 Mobilization and Demobilization

TP-1.1.1 Mobilization: Mobilization shall consist of the delivery at the site of all plant, equipment, materials and supplies to be furnished by the A-E; the complete assembly in satisfactory working order of all such plant and equipment on the job and the satisfactory storage at the site of all such materials and supplies.

TP-1.2.2 Demobilization: Demobilization shall consist of the removal from the site of all plant and equipment after completion of the work.

TP-1.3 Undisturbed Soil Samples

TP-1.3.1 Samples: Undisturbed soil samples shall be obtained with 3-inch O.D. by 30-inch long thin walled tubes in accordance with ASTM D-1587. The undisturbed sample tube shall be taken with a piston sampler. Unless otherwise directed, the length of the push shall be 24 inches. The space at both ends of the tube shall be filled with a non-shrinking petroleum wax such as Mobil Oil Company Wax Product #2305 or equal. The ends shall be capped and sealed with tape and wax. Except as otherwise directed, undisturbed samples shall be delivered to the Geotechnical Engineering Section, Norfolk District, Corps of Engineers, 803 Front Street, Norfolk, Virginia 23510. The intent is to sample cohesive soils for the purpose of performing shear tests and consolidation tests. Undisturbed samples shall be stored in an upright position in a place where they will not freeze and not be subjected to vibration.

TP-1.3.2 Borings: Casing shall be required to full depth in all borings with continuous undisturbed sampling. The holes shall be advanced with continuous casing by any method approved by the Government. A minimum four inch diameter hole will be necessary for the above work.

TP-1.3.3 Disturbed Samples: Prior to sealing undisturbed samples, a representative sample of material shall be scooped out of the top of each tube. For undisturbed samples at the bottom of every hole, one disturbed sample each shall be taken at the top and bottom of the last tube. The samples obtained shall be placed in clean, wide-mouth, screw-top, transparent, moisture-proof glass jars. The jar shall be at least 5 inches in height and shall have an inside diameter of at least 1-3/4 inches. Each jar shall be provided with a gummed outside label showing the job name and location, the date of sampling, boring number, sample number, and the depth below ground surface at which sample was taken. Jars shall be filled with sample material. The intent is to sample for moisture content and visual classification.

TP-1.4 Piezometers:

TP-1.4.1 Type: The piezometer shall consist of a 2-foot long, 2-inch O.D. PVC standard slotted well screen, with a 1 inch O.D. PVC riser pipe. All piezometers shall be plugged at the bottom. All couplings (or threaded joints) shall be sealed with glue or a joint compound.

TP-1.4.2 Installation: Immediately prior to installing the piezometer tip, the bottom of the hole shall be cleaned. Upon cleaning the hole, wet, clean, Ottawa sand shall be placed into the hole as the casing is pulled up to a level 1.5 feet above the bottom of the hole. The assembled piezometer tip and riser pipes shall be set at this elevation. Additional wet sand shall be placed into the hole, filling the annular space around the tip, and extending to a level 3-foot above the top of the well point. Construction of the entire sand filter shall be accomplished by raising the casing and placing the wet sand in increments not to exceed one (1) foot. The volume of sand needed for each increment shall be computed and closely controlled. The depth of the hole shall be sounded after sand has been added to insure that the filter is properly placed. A one foot layer of tamped bentonite pellets shall be placed above the sand filter to seal the hole. The rest of the hole need not be backfilled. The riser pipe shall extend no less than 4 feet above the existing mudline and capped.

TP-1.4.3 Boring: Casing shall be required to full depth in all borings to install piezometers. The holes shall be advanced as specified in paragraph TP-1.3.2.

TP-2 RECORDS

TP-2.1 General: Payment will not be made for any work for which the required records have not been furnished by the A-E.

TP-2.2 Samples: The A-E shall keep accurate driller's logs and records of all work accomplished under this contract and shall deliver complete, legible copies of these logs and records to the Contracting Officer upon completion of the work or at such other time or times as he may be directed. All logs shall be typed. Separate logs shall be made for each hole. The following information shall be included on the logs or in the records for each hole:

TP-2.2.1 Hole number or designation and elevation of top of hole.

TP-2.2.2 Make and manufacturer's model designation of drilling equipment.

TP-2.2.3 Type of drilling, and sampling by depth.

TP-2.2.4 Depth at bottom of hole.

TP-2.3 Water Level Readings: The A-E shall record the depth of water at the moment the casing is first set in the hole. The A-E shall also note to the nearest minute the time of day the depth of water was measured. This information is necessary to estimate elevations. Water levels in all piezometers shall be taken on completion, on the next working day, and at other times when so directed. All field logs and the final logs shall show all water level readings.

TP-3 MEASUREMENT AND PAYMENTS

TP-3.1 General: The contract unit price for each item shall constitute full compensation for furnishing all plant, labor, equipment, materials, and supplies, except as otherwise specified, and for performing all operations required for the completion of all work included under that item as specified herein, shown on the drawings, or directed. All measurements for payment shall be made by or in the presence of the Government inspector. Linear measurements for payment for boring through overburden will be made from the original ground surface. Measurement for payment for other items for which payment is provided will be made as specified under subsequent paragraphs applicable to those items. The contractor shall preserve all holes in good condition until final measurement and until the records and samples have been examined and accepted. Payment will be made only for drilling and those holes that are directed to be so drilled. Payment will not be made for any hole or testing for which satisfactory records and samples, as determined by the Government inspector, are not furnished.

TP-3.2 Mobilization and Demobilization: Payment for mobilization and demobilization will be made at the contract lump-sum price for "Mobilization and Demobilization."

TP-3.3 Undisturbed Soil Sample:

TP-3.3.1 Samples: Sampling for undisturbed samples will be measured for payment on the basis of the number of 3-inch undisturbed samples satisfactorily obtained. Payment will be made at the contract unit price per each sample for "Undisturbed Samples." The payment will include the work involved with taking disturbed samples.

TP-3.3.2 Borings: Advancement for these borings will be measured for payment on the basis of the linear feet of holes actually advanced for undisturbed sampling from the mudline to the bottom of casing. Payment will be made at the contract unit price per linear foot for "Casing for Undisturbed Samples and Piezometers."

TP-3.4 Piezometers:

TP-3.4.1 Installation: The installation of piezometers will be measured for payment on the basis of the linear feet of piezometer actually installed into the holes from the piezometer tip to the top of the cap. Payment will be made at the contract unit price per linear foot for "Piezometers."

TP-3.4.2 Borings: Advancement for these borings will be measured for payment on the basis of linear foot of offset holes advanced for piezometers measured from the mudline to the bottom of the hole. Payment will be made at the contract unit price per linear foot for "Casing for Undisturbed Samples and Piezometers."

TP-3.5 Stand-by Time: Include a price in the proposal for stand-by time. The definition of stand by time will be made during negotiations.

GOVERNMENT ESTIMATE

SUBSURFACE EXPLORATION

CRANEY ISLAND MANAGEMENT STUDY
 NORFOLK, HARBOR, VA

SCHEDULE

ITEM	QUANT	UNIT	UNIT PRICE	COST
1. Mobilization and Demobilization	<u>1</u>	LS	\$ <u>2525</u>	\$ <u>2525</u>
2. Undisturbed Soil Samples	<u>108</u>	EA	\$ <u>40</u>	\$ <u>4320</u>
3. Piezometer	<u>124</u>	LF	\$ <u>575</u>	\$ <u>713</u>
4. Casing for Undisturbed Soil Samples and Piezometers	<u>244</u>	LF	\$ <u>6</u>	\$ <u>1464</u>
5. Stand-by Time	<u>8</u>	HR	\$ <u>60</u>	\$ <u>480</u>
SUB TOTAL				\$ <u>9502</u>

3/21/60

GOVERNMENT ESTIMATE (CONT.)

SPECIFICATIONS
FOR
LABORATORY TESTING
CRANEY ISLAND MANAGEMENT STUDY
NORFOLK HARBOR, VIRGINIA

1. Required Testing:
 - a. Selected samples shall be tested for moisture content according to ASTM D-2216 and visually classified according to ASTM D-2488.
 - b. Selected samples shall be tested for Atterberg limits according to ASTM D-423 and 424. Samples selected will be based on moisture contents and classification.
2. Engineering: Evaluate each sample as a material suitable for structural fill.
3. Payment: Submit your proposal based on the following schedule:

<u>ITEM</u>	<u>QUANT</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>COST</u>
1. Moisture Content	54	EA	\$ 3	\$ 162
2. Visual Classification	27	EA	\$ 5	\$ 135
3. Prof. Engineer	1	LS	\$ 200	\$ 200

- Atterberg Limits C 25

SUB TOTAL \$ 497

3/21/50
[Signature]

TOTAL 9502
497
\$9999