A PRELIMINARY ASSESSMENT OF THE FEASIBILITY OF USING THE STANCILL'S INC. PROPERTY ON FURNACE BAY IN CECIL COUNTY AS A DREDGED MATERIAL CONTAINMENT FACILITY

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1.0 Executive Summary and Conclusions

Stancill's Inc. occupies a site in Cecil County that is currently used for extraction and processing of sand, gravels and other earthen materials. The mining and processing facility is located at 499 Mountain Hill Road, Perryville, Maryland 21903. The site is in the western part of Cecil County, adjacent to Principio Creek at the point where Principio Creek flows into Furnace Bay.

The site encompasses approximately 130 acres of land, portions of which are used for extraction, processing and stockpiling of sands, gravels, clay and other earth materials. The remaining portions of the site serve as buffer areas along the property boundaries and a wetland area along an unnamed tributary to Principio Creek. The processed materials produced at the site are commercially marketed in the Northeast U.S. region.

Principio Creek and Furnace Bay border the site on the west. Undeveloped private land borders the site on the south. Mountain Hill Road serves as the east boundary to the site, and the high-speed CSX railroad tracks border the site to the North. The site includes excavations resulting from the mining activities. A portion of the site adjacent to Principio Creek and Furnace Bay has been bermed off and is used to contain and treat the process water used in the mineral processing and washing phase of the operations.

The site is located 15 to 20 miles from the centroid of the Upper Bay navigation channels. This region of the Bay's navigation channels has an annual average maintenance dredging volume of approximately 400,000 cubic yards (CY). Based upon available analytical testing results, sediments dredged from this portion of the Chesapeake Bay are considered to be "clean" materials, with low levels of pollutants of concern.

A Federal navigation channel currently exists leading up the Bay from the C&D approaches requiring dredging. The navigation channel extends north and west to the Town of Perryville. Another natural navigation channel extends north from the C&D approach channels towards the North East River, potentially enabling barge access to within 4 to 4.5 miles of the site. Both channels, with mean low water depths of 13 feet as shown on navigation charts, can potentially accommodate barges transporting dredged materials. Bathymetric surveys of the current actual channel depths are needed to confirm suitability for vessel access in potential shoal areas. If bathymetry shows that barge access is not possible, the channels would need to be deepened in order to avoid extended pumping distances. Assuming that regulatory approvals could be obtained, additional costs would be incurred for environmental documentation, regulatory approvals and dredging of the natural channel and placement of the material.

The current and planned future topographic configuration of the site provides significant potential air space capacity. Preliminary calculations indicate a potential maximum air space volume of approximately 9.6 million cubic yards (MCY) could be achieved at the site if the site were filled to elevation +90, the approximate elevation of the contiguous property. Using a 30% reduction in volume for cut sediment after consolidation, approximately 13.6 MCY of cut quantity of dredged material could be placed into the site if the dikes could be raised to the +90 elevation. At the annual rate of maintenance dredging of the Upper Bay channels (400,000 CY per year), the 9.6 MCY of air space capacity could potentially provide 34 years of service. Somewhat less capacity would result with contouring to approximately correspond with topography that existed prior to mining.

Regional geologic maps show that the site is in the Atlantic Coastal Plain Physiographic Province. Soil borings taken in the area indicate show the presence of layers of sandy material, gravels and clays of the Raritan and Patapsco Formations of Cretaceous age, as well as those of the more recently formed Lowland Deposits of Quaternary age. These formations lie on top of the residual saprolite and bedrock of the Port Deposit Gneiss of the Paleozoic age. These Coastal Plain Deposits were found in all borings, indicating that they extend beneath the entire site, in variable thickness. Depths to the top of the bedrock ranged from about 40 feet to about 100 feet. The borings installed along Principio Creek also show the presence of a buried silt/peat deposit. Borings elsewhere on the property do not show evidence of the silt/peat deposit, indicating that the deposit is not present beneath the entire site.

The current soils exposed on the quarry bottom include Silty Sands and Gravels. The estimated permeability of these materials range from 10^{-6} in the gravels to 10^{-5} in Silty Sands. If this material were removed by continued mining, the underlying Claey Silt/ Sandy Silt would predominate. Tests performed on relatively undisturbed samples of materials extracted from soil borings indicate that the in-place permeability of the Claey Silt / Sandy Silt deposits beneath the site to be in the range of 10^{-6} cm/sec. Some of the clay that is extracted from this site has been found to be suitable for municipal solid waste landfill construction, exhibiting a permeability in the range of 10^{-7} to 10^{-8} cm/sec after compaction. Groundwater in the pit area was found about 2 feet beneath the quarry floor.

The preliminary hydrogeologic assessment shows the direction of groundwater flow beneath the site to be in a southwesterly direction, towards Principio Creek and Furnace Bay. The shallow aquifers in this area flow into Principio Creek and Furnace Bay. To assess the potential to affect groundwater resources in the area, MES reviewed an inventory of wells in the area surrounding the Stancill quarry, as provided by MDE. Within a five-mile radius of the site, MDE records show 2,600 well permits (not necessarily wells that were actually drilled). Within this five-mile radius, 112 wells were identified as Public or Industrial well that would be expected to have a large withdrawal rate. Most of these wells are located too far away from the Stancill site to have any impact or be impacted by site activities.

Within a one-half mile radius of the quarry, 17 wells have been permitted (two of which have not been built). One of the identified wells is located on the Stancill property and provides potable water for site activities. None of the off-site wells are located downgradient of the property, between the site and Principio Creek or Furnace Bay. The proximate wells located upgradient of the site are drilled into bedrock and do not include large capacity production wells. Therefore, because of their limited radius of influence, placement of clean dredged material from the Upper Bay channels at the site would pose little risk to contamination of potable wells in the vicinity. Similarly, dredged material return flows from the site to adjacent surface waters would pose little risk to public health or to the environment.

The property owner, Mr. Terry Stancill, President of Stancill's Inc., indicated that based on soil borings conducted on the site, at current mining and extraction rates, the site contains sufficient marketable material to sustain operations for another 5 to 7 years. Mr. Stancill indicated that all or a portion of the site could be made available for containment of dredged material. Placement of the dredged material could commence as soon as agreements are developed with respect to the property or be phased in as on-site mining operations continue.

Two potential unloader stations for hydraulic placement were considered. One location is the waterfront on the Susquehanna River at Perryville. The other potential unloader station location that was considered is an in-water location near Red Point, off of Elk Neck in Kent County. Based upon the potential unloader station locations, a preliminary dredging engineering assessment indicates that placement of dredged material into the Furnace Bay site is technically feasible using either hydraulic placement or mechanical placement means.

Preliminary dredging engineering cost opinions were developed to estimate the cost of placement of dredged material in the Furnace Bay site based upon these two potential unloader station locations, using both hydraulic and mechanical placement methods.

Cost estimates for material placement from the two identified potential unloader stations to the Furnace Bay site using hydraulic means range from $12.19 to $12.23 per cubic yard. This represents a partial cost, as discussed below. Each unloader station and pipeline to the Furnace Bay site includes one booster pump to transfer material. Offloading operations could be restricted or impaired by winter operating conditions.

Consideration was also given to siting a barge unloader station at the designated Perryville site location and using mechanical means to transfer the material from the barges to trucks. The trucks would then transport the dredged material to the site using the existing road system in the area. This would involve hauling the dredged material a distance of approximately 4.5 miles over public roads. The estimated cost of dredged material placement using a mechanical unloader stationed at the Perryville location and trucking the dredged material to the Furnace Bay site is $19.82 per cubic yard. Again, this represents a partial cost, as discussed below.

Neither of the unit cost estimates includes a site utilization fee or an estimate of the cost associated with purchase of the property. Other costs that were not considered include the cost to obtain the necessary regulatory approvals for operating a dredged material containment facility on the site, and the annual site operating and monitoring costs. These additional costs would need to be defined in order to determine the overall unit cost to place dredged material at the site.

Based upon the results of the preliminary site reconnaissance studies, MES concludes that the site geology, which includes a base material consisting predominantly of low permeability clays and residual soils, and its accessibility by hydraulic pipeline combine to make the site potentially suitable for containment of dredged sediments. The preliminary studies were unable to identify any obvious conditions that would by themselves preclude use of the site as a dredged material containment facility.

More in-depth studies would be needed before a final determination on site suitability could be made. These studies include the following:

- Current bathymetric information pertaining to the approach channels to the proposed barge unloader stations should be obtained to confirm suitability for access by barges loaded with dredged material;

- A more detailed site geotechnical assessment should be conducted to confirm the thickness, uniformity and in-situ permeability of the underlying confining soil layers.

- An environmental study including collection and analysis of data needed for permitting, and an assessment of the affects on receiving waters as a result of dredged material return flows resulting from placement of Upper Bay sediments at the site.

- Environmental documentation, design, regulatory approvals and implementation of channel improvements, if needed.

- Assessment of mechanical dewatering and flocculent technologies to facilitate larger annual inflow rates and stacking.

- Assessment of the comparative costs of mechanical placement following mechanical dewatering.

- Assessment of the boundaries of the peat deposit in relation to the perimeter berms and its potential to affect berm stability needs to be determined.

- Classification and analyses of on-site materials is needed to determine their suitability for potential use during future dike construction.

- Preparation of a groundwater contour map of the area and determination of the groundwater gradient in the area.

- Determination of the rate and direction of groundwater flow, and the location and radius of influence of wells in the proximate area of the site needs to be determined to better assess the potential for groundwater contamination as a result of placement of dredged material at the site.

- Collection of current site topographic information to more accurately determine air space capacity potentially available within the site boundaries.

In addition to site geotechnical studies, negotiations and/or discussions with the property owner are necessary to determine the additional costs associated with either purchase of the site or payment of a site utilization fee. Other costs, which would need to be developed, include any site development or preparation cost, the cost of obtaining necessary permits or other authorizations, and site operations and monitoring costs. These costs would be added to the estimates developed for placement of material in the site to determine an overall unit cost for dredged material management.

The scope of this assessment was limited to a preliminary reconnaissance effort to determine the potential suitability of the site to serve as a dredged material containment facility. The assessment did not address the potential of the site for use as a processing facility for innovative use of dredged material through processing or blending with other materials for marketing.

2.0 Introduction

The Stancill's Inc. property at Furnace Bay is located approximately 15 to 20 miles from the centroid of the Upper Bay navigation channels. This reach of channels extends from a point approximately 3 miles south of Handy's Point in Kent County to a location 1 mile north of

Figure 2.1 – Stancill's Inc. Site at the Head of Furnace Bay

Courthouse Point in Cecil County, at the mouth of the C&D Canal. This is a distance of approximately 32 nautical miles. These Upper Bay channels require routine maintenance dredging to maintain navigational use by larger commercial vessels that traverse the C&D Canal traveling to or from Baltimore Harbor and other ports in the Chesapeake Bay region.

The MPA has identified a need for containment capacity for the management of materials dredged from the Upper Bay channels that are within the jurisdiction of the Baltimore District, U. S. Army Corps of Engineers. Based upon records of prior years of dredging in the Chesapeake Bay, the average annual volume of maintenance dredging in this region is approximately 400,000 CY.

This maintenance dredging material requires management through use of approved overboard disposal sites or other dredged material management methods. Use of upland sites has been encouraged over placement in aquatic sites, where practicable.

In 1999, Mr. Terry Stancill, president of Stancill's, Inc. approached the MPA to determine if there was interest in considering the Furnace Bay site as an upland containment site or as a site where dredged material might be blended with other on-site or out-sourced material for commercial marketing.

The most recent topographic survey of the site was performed in 1993. Since that time, additional material has been excavated, processed and marketed from the site. Based upon air space calculations performed using the 1993 topographic information, the Stancill's Inc. site at Furnace Bay can provide up to 9.6 MCY of air space capacity if the dikes can be raised to elevation +90. With a 30% reduction in volume for cut dredged material, which consolidates after placement and dewatering through a crust management program, this 9.6 MCY of air space capacity offers the potential to accommodate approximately 13.6 MCY of cut material. This air space capacity represents the identified maintenance dredging material containment needs for up to 34 years, at an annual rate of 400,000 CY. The air space volume available in the Stancill pit as a function of elevation is shown in Table 2.1, below.

As a result of the expressed interest on the part of the property owner, the potentially available capacity at the site, and continued interest in the concept of reclamation of quarries, MPA authorized a preliminary reconnaissance of the concept and site without making any commitment to actual site utilization. The preliminary reconnaissance would include a dredging engineering assessment component and a geotechnical testing component to identify any potential conditions that would by themselves preclude further consideration of the site as an upland containment site for dredged material.

Table 2.1
Air Space Volume Calculations
Furnace Bay Site

Elevation Datum	Area SF	Volume Acres	Volume CY	Cummulative Volume CY
-70	236,600	5		
-60	375,100	9	113,278	113,278
-50	513,600	12	164,574	277,852
-40	652,100	15	215,870	493,722
-30	790,500	18	267,148	760,870
-20	929,000	21	318,426	1,079,296
-10	1,067,500	25	369,722	1,449,018
0	1,206,000	28	421,019	1,870,037
5	1,358,650	31	237,468	2,107,505
10	1,511,300	35	265,736	2,373,241
15	1,750,550	40	302,023	2,675,264
20	1,989,800	46	346,329	3,021,593
22	2,032,200	47	148,963	3,170,556
25	2,095,800	48	229,333	3,399,889
30	2,201,800	51	397,926	3,797,815
32	2,285,367	52	166,191	3,964,006
36	2,452,500	56	350,953	4,314,959
38	2,683,400	62	190,219	4,505,178
40	2,812,400	65	203,548	4,708,726
43	3,177,400	73	332,767	5,041,493
45	2,134,492	49	196,737	5,238,230
47	2,178,159	50	159,728	5,397,958
50	2,243,660	52	245,657	5,643,615
54	2,333,627	54	339,058	5,982,673
57	2,401,103	55	263,041	6,245,714
60	2,468,579	57	270,538	6,516,252
63	2,538,324	58	278,161	6,794,413
66	2,608,069	60	285,911	7,080,324
68	2,654,566	61	194,912	7,275,236
70	2,701,063	62	198,357	7,473,593
73	2,772,768	64	304,102	7,777,695
76	2,844,473	65	312,069	8,089,764
78	2,892,277	66	212,472	8,302,236
80	2,940,080	67	216,013	8,518,249
83	3,013,482	69	330,753	8,849,002
86	3,086,884	71	338,909	9,187,911
88	3,135,819	72	230,470	9,418,381
90	3,233,688	74	235,908	9,654,289

Data Source : Gahagan & Bryant Associates, Inc.

3.0 Stancill's Inc. Site at Furnace Bay

Stancill's Inc. is a commercial sand, gravel and earthen material mining facility located in Cecil County. The facility is located at 499 Mountain Hill Road, Perryville, Maryland 21903. The site is in the western part of Cecil County, adjacent to Principio Creek, at the point where Principio Creek flows into Furnace Bay. Shallow water on the order of 2 to 4 feet in depth ranges from Principio Creek to the nearest deep water potentially useable by barges, a distance of approximately 4 to 4.5 miles.

The site has been used for mining of earthen materials on a continuous basis commencing in November 1972 until the present. Prior to that time, the former property owners conducted intermittent mining at the site. Based upon conversations with Terry Stancill, President of Stancill's Inc., recent soil borings on the site indicate that the site has approximately 5 to 7 years of projected future life at the current rate of material excavation. Additional marketable material exists on the site, but excavation depths would increase production costs and reduce competitive marketability of the finished product.

Figure 3.1 shows an aerial view of the site in its approximate current configuration.

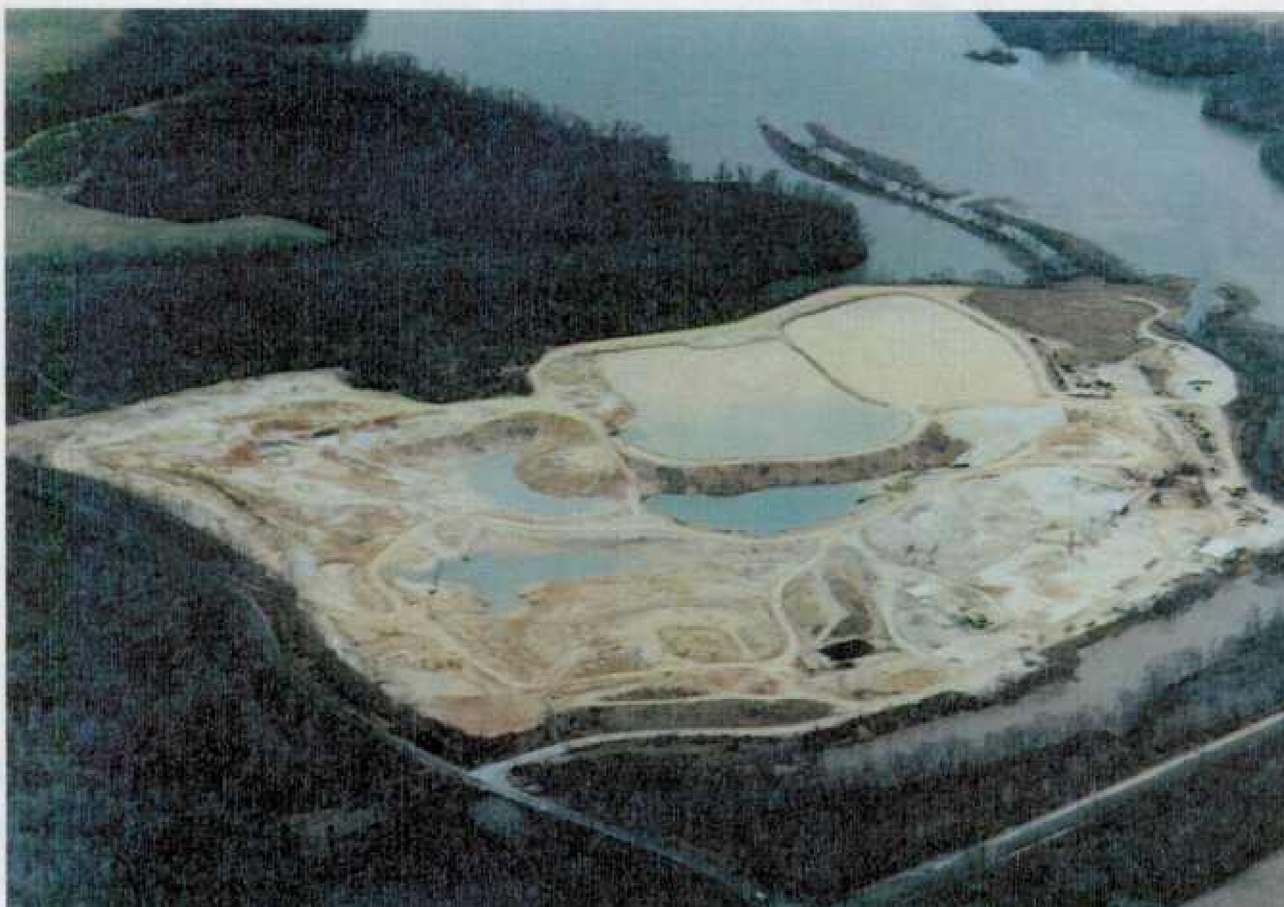

Figure 3.1. – Aerial View of Stancill's Inc., Furnace Bay Site

The site includes excavated areas that are the result of the mining of sand, gravel, clay and other earthen materials, which are present on the site. The site includes approximately 130 acres of land. Approximately 100 acres is currently used for extraction and processing of sands, gravels, clay and other earth materials, and for the stockpiling of finished materials for marketing. The remaining portion of the site includes buffer areas to adjoining properties, Principio Creek and a wetland area between the high speed railroad tracks and the mining area. The wetland is fed by an unnamed tributary to Principio Creek, which flows across the property parallel to the railroad lines. The processed materials are commercially marketed throughout the Northeast U.S. region. The site is bordered on the west by Principio Creek, and Furnace Bay, undeveloped private land to the south; Mountain Hill Road to the East, and the high-speed railroad tracks to the North.

Current on-site operations include mining, washing, screening, grading and stockpiling of the various excavated materials for sale as product. Facilities are also available on-site for blending and mixing different materials to meet the specifications for a customer order. The site also has an on-site truck scale and office building. Buffer areas have been maintained along Mountain Hill Road and along the southern property boundary. Processing facilities are shown in Figure 3.2.

Figure 3.2 – Washing and Grading Facilities

The site includes a series of ponds and impoundments used to contain and treat the water used in the mining and mineral processing operations. That portion of the site adjacent to Principio Creek and Furnace Bay has been bermed off and is used to contain and treat the process water used in the processing and washing phase of the operations. This bermed area is shown in the upper center section of Figure 3.1, above. The berms were constructed exclusively from on-site materials excavated at the site. The pond also receives precipitation that falls on the site as well as some groundwater, which seeps into deeper excavations at lower elevations on the site. This water is pumped from the excavated area to the upper pond.

The series of ponds is shown in Figure 3.3. Water needed for the processing operations is pumped from the lower elevation pond, which is shown in the upper center in Figure 3.3. The pumping facility used to transfer water from the lower pit area to the processing equipment is shown in Figure 3.4.

After use in the materials processing steps, the effluent from the processing operations is then pumped to the upper elevation pond. This pond is used for removal of suspended particulates through gravity separation. No flocculents are used in the gravity separation process. Clear effluent from the upper settling pond is discharged by gravity to the lower elevation pond, where the pumping facilities return the water to the processing plant. The on-site materials processing operations completely reuses all water on site. There is no discharge to surface waters of the State from the Furnace Bay site.

The fines and other materials, which are produced during the materials processing operations, accumulate in the upper settling pond. This settled material is periodically removed from the upper pond by means of a dragline or excavator. This periodic removal of accumulated material from the upper pond is necessary to restore its settling capacity. The removed material is placed as fill in lower elevation excavated areas on the site.

Figure 3.3 – Settling Ponds at the Furnace Bay Site

The remaining life expectancy of the mining site is dependent upon the rate at which mineral materials are removed. This, in turn, is dependent upon market conditions. The current boom in construction activities has resulted in favorable market conditions for mineral products produced at the site. The facility owner has indicated a potential life of between 5 and 7 years at the current rate of production, but has indicated a willingness to make the property available for containment of dredged material. The filling of the site using dredged material may provide an acceptable site reclamation alternative.

Under the provisions of the Surface Mining Permit issued by MDE, which regulates mining activities at the site, once commercial mining activities cease, reclamation of the site becomes necessary. The approved site reclamation plan includes the option of re-contouring the site using fill material. Dewatered dredged material can potentially serve as suitable fill material. Annual placement of dewatered material in the site, or dewatering material placed in the site by hydraulic placement methods, would eventually provide sufficient material to fill the site to an acceptable closure configuration. Testing results from samples collected from the Upper Bay area maintenance dredging projects do not show the presence of potential contaminants at concentrations that would be deemed to pose undue risk to public health or to the environment if placed in an upland containment site. Therefore, use of the site as a containment site for managing clean dredged material from the Upper Bay channels appears to be an acceptable means for reclaiming the site after mining activities cease.

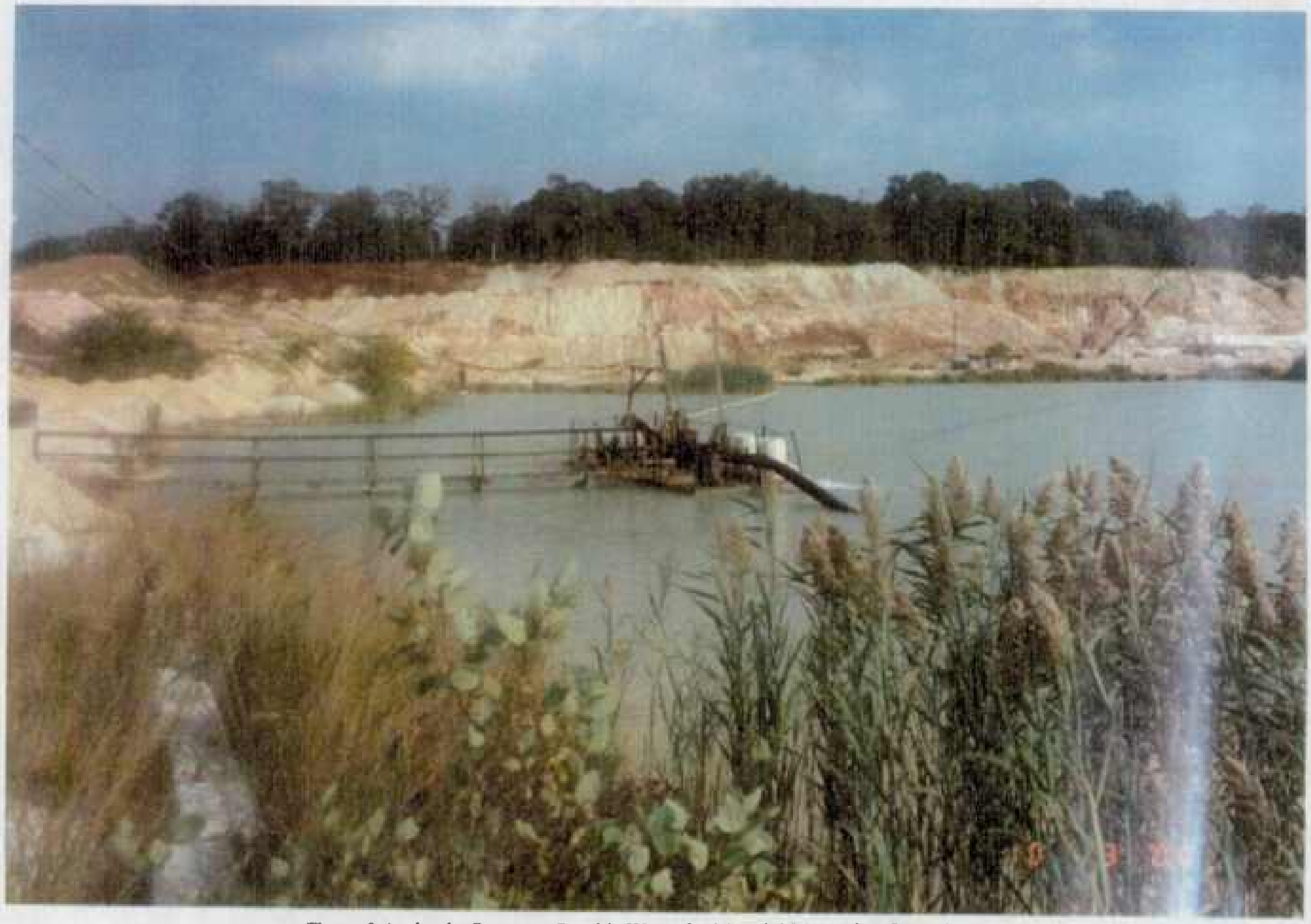

Figure 3.4 – Intake Pumps to Provide Water for Material Processing Operations

Upland placement of dredged material offers the potential to affect ground and surface waters in the vicinity, as pollutants in the dredged material may be mobilized and released to the environment as a result of the disturbance of the sediments. Hydraulic placement of dredged material requires large quantities of water to slurry and transport the dredged material via pipeline. Hydraulic placement projects require a discharge to surface waters to manage dredged material return flows. Mechanical placement of dredged material obviates the need to hydraulically slurry and transport the material, and results in lesser quantities of water to manage. Any site which is proposed for use as a dredged material placement site, whether hydraulic or mechanical placement methods are proposed, must be studied to determine the potential for adverse effects to groundwater and surface water in the area.

Soil borings independently conducted on the site by the property owner and by a geotechnical-testing firm (E2CR) under contract to MES confirm the presence of clay material beneath the Furnace Bay site. This is typical of marine deposit geologic formations found in Coastal Plain formations. Silts and clays, because of their small particle size and dense structure when compacted, have the ability to retard the flow of groundwater. The presence of such materials on the site may provide a level of protection to groundwater beneath the site, and serve to contain on site any pollutants that may potentially be present in the dredged material placed in the site.

Some of the clays found on this site have been determined to be suitable for use in constructing the prepared subbase in a sanitary landfill. Current Federal and State regulations pertaining to the design and construction of sanitary landfills specify that material that is deemed acceptable landfill subbase material must possess an in-place permeability less than or equal to 1 x 10^{-7} cm/sec. This site is currently providing clay material for use in the construction of the subbase of Cell #5, Phase II at the Cecil County Landfill. Figure 3.5 shows clay excavated from the Furnace Bay site that is being used in the landfill construction project.

Figure 3.5 – Clay Material For The Cecil County Landfill

The discharge of water from a dredged material containment site has the potential to affect water quality in the receiving surface waters. Discharges from this site would enter Principio Creek or Furnace Bay, depending upon the location selected for the outfall structure. Because the site would be expected to receive only clean sediments dredged from the Upper Bay Channels, the potential for the presence of pollutants at levels that would constitute a risk to public health or to the environment is reduced.

The discharge of dredged material return flow from this site to surface waters of the State would require the issuance of a Water Quality Certification from the Maryland Department of the Environment (MDE) under Section 401 of the Clean Water Act. The discharge authorization would include effluent restrictions and monitoring requirements deemed necessary by MDE to protect downstream water quality. In addition, since this facility would receive material from Corps of Engineers projects, which is considered to be a major Federal action, full NEPA documentation and studies would need to be performed.

During discussions with the property owner, and upon review of aerial photography of the site and field observations, MES learned that in August 1989, a catastrophic failure of the earthen berm along Principio Creek occurred. This resulted in the loss of a portion of the material contained in within the dike structure. In addition, the deposited materials resulted in the relocation of the point where Principio Creek enters Furnace Bay, with the creation of a remnant non-flowing section of Principio Creek. The relocated junction of Principio Creek and Furnace Bay and the remnant section of Principio Creek are visible in the upper right section of Figure 3.1. The perimeter berm was subsequently reconstructed and the impoundment placed back in service to treat the effluent from the materials processing equipment for recycling back into the processing plant. Construction materials for rebuilding the earthen berm were obtained from on-site.

Continued operation of the facility has not resulted in any observed problems with the berms. Visual inspection of the outer surfaces of the berms did not show any indication of seepage, slumping or other sign of a potential structural problem. However, if the site is intended for placement of dredged material using hydraulic placement methods, a more in-depth study of the structural integrity of the berms should be conducted. If mechanical placement of dewatered dredged material is selected, berm integrity issues are not a factor of concern.

Some of the soil borings installed during the geotechnical reconnaissance of the site performed by E2CR shows the presence of an organic Silt/ peat deposit along Principio Creek. These borings are all outside of the perimeter of the bermed area. The deposit was not observed in the borings within the mined area of the site. Thus, the deposit does not extend beneath the entire site. There is the potential that the organic Silt/peat formation, if it extends beneath the berm, could potentially serve as a slip surface or unsuitable foundation in the event that berm raising to the maximum elevation of +90, as proposed by GBA to accommodate up to 13.6 MCY. If a decision is made to proceed with considering the site for dredged material containment, the extent of the deposit and its potential to effect the maximum feasible height of constructed berms will need to be defined.

To assess the potential for impacts to off-site wells in the vicinity of the site that may occur as a result of placement of dredged material in the Stancill pit, MES reviewed well permit information obtained from MDE records. An inventory of wells in the area was obtained to determine the actual number and location of wells that are known to exist in the vicinity of the site. The inventory records document that 2,600 well have been permitted within five (5) miles of the Stancill property. Not all permitted wells were actually constructed. Of the total number, 112 wells are identified as industrial or public wells. The remaining wells serve individual residences or farms. A total of seventeen (17) wells were identified as being located within one-half (1/2) mile of the site. However, two of the well permits were cancelled, indicating that the wells were not installed. Therefore, fifteen (15) wells actually exist within one-half mile of the site. One of these wells is the potable water well that provides water used at the Stancill site. This well was drilled to a depth of 210 feet, which is well into bedrock beneath the site. The other wells listed in the inventory range in depth. One well is listed with a depth of 70 feet. The depth of the remaining wells ranges from 124 feet to 600 feet.

From a review of the well inventory information, eight wells are located at sites with North Maryland grid coordinates between 630,000 and 632,000. The Stancill property well is identified with a North grid coordinate of 633,000. This would indicate that the eight wells are located south and east of the Stancill property, along Mountain Hill Road. Because the direction of groundwater flow is to the south and west, these wells are outside of any groundwater influence from the site.

The remaining listed wells have North grid coordinates 634,000 or higher. This indicates that they are sited north of the CSX railroad tracks, upgradient of the Stancill site. All of these wells show depths ranging from 181 to 600 feet. This depth indicates that the wells were drilled into bedrock.

From the well depth information and the soil boring logs, MES concludes that none of the wells are located in the surficial sand/clay/silt formations, which are being excavated at the Stancill site.

The inventory information also includes well production rates and drawdown information. This information is useful in assessing the potential for a well to be influenced as a result of an activity occurring on the Stancill property. The specified well production rates for the wells located closest to the Stancill site are low. Four of the wells produce one to three gallons per minute, which is adequate for a single family residence. The inventory shows that the remaining two wells produce twenty-five and thirty gallons per minute, respectively. With low water production rates, the radius of influence of these identified wells would be expected to be very limited in extent. Therefore, there is little probability that any of these wells would be impacted by activities at the Stancill site.

A copy of the well inventory information is found in Appendix C.

4.0 Site Feasibility Technical Issues

When MES was directed to evaluate the feasibility of the potential use of the site as a dredged material containment facility, various technical issues were identified, which would need to be adequately assessed before a final recommendation could be made. These technical issues include the following:

1. Site Location Relative To Upper Bay Channels Needing Dredging. The site is located in Cecil County at the headwaters of Furnace Bay where Principio Creek enters Furnace Bay. This site location is approximately 15 to 20 miles from the centroid of the Upper Bay Channels, which are part of the annual maintenance dredging program. Any anticipated new channel work as well as the annual maintenance dredging schedule and the annual dredged material placement needs for this region of Upper Bay channels must be defined to determine the ability of the site to contain all or a portion of that quantity. This schedule is also needed in order to predict the life expectancy of the site for containing dredged material, given the potentially available air space of the site and the annual volume of dredged material that proposed for deposition in the facility.

2. Hydraulic Placement Issues. Using hydraulic placement methods would necessitate locating potential sites for an unloader barge station, and installing miles of pipeline. Because of the distances involved from the unloading point to the site, the hydraulic placement of material may possibly require one or more booster pumps. Alternate offloading sites should be considered to evaluate options for pipe length and access routes to the site to minimize potential environmental effects and project cost. Depending upon the selected barge unloader location, the pipeline, which would be needed to pump material into the site, may need to be installed across shallow water areas along the Upper Bay. This could potentially impact recreational and commercial boating and fishing over a large area. Barge access, pipelines and offloading operations could be restricted or impaired by winter operating conditions, including ice. The annual placement and ultimate capacity of the site may be reduced if hydraulic placement is selected due to the inability to mound up hydraulically placed material. Implementing an on-site mechanical dewatering effort or an aggressive crust management program could mitigate this lost capacity issue. The annual placement capacity of the site would be limited due to the required pond size and depth, which may be necessary in order to limit the concentration of suspended solids in the dredged material return flow to Furnace Bay. In addition, exceeding the optimum lift thickness in any given year reduces the operator's ability to dewater the material delivered, thus reducing the ultimate potential containment capacity of the site. Use of underdrains and pumped removal of trapped water may be feasible to minimize lost air space capacity associated with thick lifts during early years of placement activity at the site.

3. Mechanical Placement Issues. The existing navigation channel system in the Upper Bay extends north up the Susquehanna River as far as the town of Port Deposit, Maryland. Barging mechanically dredged material to the Havre de Grace, Perryville or Port Deposit area is technically feasible. However, locating potential sites for a barge unloading and transfer facility would be required. The material would need to be off-loaded from the barges, placed in trucks, and then transported to the site via the existing road network in Cecil County. Depending upon the volume of material being handled on an annual basis, this could potentially result in a significant increase in heavy truck traffic between the unloading area and the site. The increased truck traffic could potentially result in an adverse transportation related impacts and significant increased transport/disposal costs.

4. Navigation Issues. The natural navigation channel extending towards the North East River has limited visual aids to navigation. This could restrict or impair barges during night operations or during inclement weather. In addition, the identification of potential shoals along that route raises the issue of the potential need to dredge a portion of the route to the identified barge offloader station off of Red Point.

5. Site Physical Characteristics Considerations. The site is an active sand and gravel mining and processing facility. On-site excavations to extract materials for processing have resulted in creation of some pits, which may extend below groundwater elevations in the area. Sections of the site are bermed off and are employed to serve as settling areas for on-site water used in the sand and gravel washing and processing operations. Water in the ponds is a combination of collected rainwater and groundwater that seeps into the pits. The pond water is used in the processing of extracted minerals and then discharged back into the pond system for settling to reduce the level of suspended particulates. The treated water is then reused in processing additional materials. The ponds are in active use as part of a mining and mineral processing operation and do not appear to support wetland vegetation or use as habitat by migratory birds. Currently, because of evaporative losses and drag-out of water with processed materials, there is no discharge of process wastewater from the site to adjacent surface waters. The feasibility of establishing one or more discharge points from the facility to adjacent surface waters to accommodate and dredged material return flow needs to be determined.

6. Groundwater Issues. The depth of some on-site excavations may be below mean low water elevations in Furnace Bay, and possibly below the elevation of the surficial unconfined aquifer at the site location. These deep excavations on the property could potentially serve as groundwater "sinks," resulting in the flow of groundwater into the site. Placement of dredged material by either hydraulic or mechanical methods in the site could potentially result in effects on groundwater beneath the property and in the vicinity of the site. In addition, depending upon the depth of the excavation and the number of aquifers breached by the mineral extraction operations, the potential exists for inter-aquifer movement of groundwater. A site geotechnical assessment is necessary to adequately assess site conditions and the hydrogeologic suitability of the site to serve as a containment facility, and the potential to effect groundwater resources in the area that may result from placement of dredged material.

7. Previous Dike Failure. During site visits, MES observed and inquired about visual evidence of a catastrophic dike failure along the Principio Creek portion of the site. Discussions with the property owner revealed that a major dike failure occurred in the past while the site was in active use as a sand and gravel processing facility. The dike failure resulted in the loss of water and some contained material to adjacent surface waters, Principio Creek and Furnace Bay. This flow and material deposition resulted in the relocation of Principio Creek at the point where it enters Furnace Bay. The cause of the dike failure needs to be determined to ascertain the stability of the existing berm that borders the upper end of Furnace Bay and Principio Creek. In addition, the suitability of the on-site material for dike construction needed for hydraulic placement of material at the site needs to be determined. Mechanical placement of dredged material in the site would offer the potential to reduce or eliminate the requirement to construct earthen dikes to contain the material.

5.0 Preliminary Feasibility Study Approach

MES developed a plan for the preliminary assessment of the Furnace Bay site to determine the feasibility of using the property as a dredged material containment facility. The plan was subsequently reviewed and approved by the MPA and the task authorized through the provisions of an existing Intergovernmental Agreement between MES and MPA. This study plan includes the following component elements:

1. A preliminary dredging engineering reconnaissance of the site to identify critical issues related to placement of material in the site using either hydraulic or mechanical placement methods. The reconnaissance would also serve to identify potential site locations for a barge unloader, and alternate pipeline routes to deliver material to the site. The dredging engineering assessment would also identify any site features or characteristics, which could potentially preclude use of the site as a dredged material containment facility.

2. A preliminary geotechnical reconnaissance of the site to determine subsurface geologic conditions. The study effort would include installation of soil borings to locate and identify groundwater aquifers beneath the site, to determine the direction of groundwater flow in the vicinity of the site, and to determine the in-situ permeability of the confining clay layers beneath the site. This information would be needed to assess the potential for groundwater impacts due to placement of dredged material at the site

3. An assessment of the results of the preliminary dredging engineering and geotechnical reconnaissance efforts to determine the feasibility of using the Stancill's, Inc. site as a dredged material containment facility.

MES contracted with Gahagan & Bryant Associates (GBA) to perform the preliminary dredging reconnaissance task. The scope of work included an assessment of the feasibility and cost estimates for material placement using either hydraulic or mechanical placement methods. In addition, GBA evaluated site characteristics and determined volume estimates for potential air space capacity at the site.

MES contracted with E2CR, Inc., a geotechnical-testing firm, to perform the preliminary geotechnical reconnaissance of the site. The scope of work included a site reconnaissance, installation of six (6) soil borings through the quarry floor, and collection of undisturbed clay samples using a Dension sampler. Piezometers were installed to determine groundwater elevations and flow directions. Laboratory testing was performed to classify subsurface soils and to estimate the in-situ permeability of the clay materials underlying the site.

The preliminary dredging engineering and geotechnical reconnaissance reports were completed by the contractors and provided to MES. MES staff then reviewed the results of the reconnaissance efforts to assess the feasibility of using the site as a dredged material containment facility.

6.0 Preliminary Dredging Engineering Reconnaissance

MES contracted with Gahagan & Bryant Associates (GBA) to perform the preliminary dredging reconnaissance task. The scope of work included an assessment of the feasibility and cost estimates for material placement using either hydraulic or mechanical placement methods. In addition, GBA evaluated site characteristics and determined volume estimates for potential air space capacity at the site. The specific scope of work included the following:

1. Determine the available containment capacity for dredged material based upon the current topographic configuration of the site;
2. Perform a preliminary assessment of the feasibility of placing dredged material on the site using conventional hydraulic placement methods. The assessment shall include:
   - feasible location(s) for any necessary barge unloading station, booster pumps or other ancillary facilities necessary to successfully place material in the site using hydraulic methods;
   - an estimate of the site's annual placement capacity, assuming both hydraulic placement of the sediments with natural dewatering, and mechanical dewatering after hydraulic placement;
   - determination of any necessary site improvements to accommodate hydraulic placement of dredged material in the site; and
3. Develop a preliminary generic estimate of the cost (total capital cost and unit cost) associated with hydraulic placement of dredged material at the site.
4. Perform a preliminary assessment of the feasibility of placing dredged material in the site using mechanical placement methods. The assessment shall include:
   - feasible location(s) for any necessary barge unloading and truck loading stations or other ancillary facilities necessary to successfully place material in the site using mechanical methods;
   - determination of any necessary site improvements to accommodate mechanical placement of dredged material in the site; and
5. Develop a preliminary generic estimate of the cost (total capital cost and unit cost) associated with mechanical placement of dredged material at the site, including transportation as well as placement of material.
6. Identify and characterize any site features, design or operational issues that would preclude the potential use of the site as an upland containment facility for dredged material.

MES issued notice to proceed to GBA, effective March 31, 2000. The final report on the results of the preliminary dredging engineering reconnaissance was delivered to MES on October 3, 2000.

The GBA effort did not identify any obvious site deficiencies or technical issues, which would preclude use of the site as a containment site for dredged material.

A copy of the GBA preliminary dredging reconnaissance is included as Appendix A to this report.

7.0 Preliminary Geotechnical Reconnaissance

MES contracted with a geotechnical-testing firm (E2CR, Inc.) to perform the necessary preliminary geotechnical reconnaissance of the site. The scope of work for assessing the site included a site reconnaissance, installation of six (6) soil borings through the quarry floor to define subsurface soils, and collection of undisturbed clay samples using a Dension sampler to enable the in-situ permeability of any underlying clay to be estimated. Piezometers were installed to determine groundwater elevations and flow directions. Laboratory testing was performed to classify subsurface soils and to estimate the in-situ permeability of the clay materials underlying the site.

The specific scope of work for the preliminary geotechnical site reconnaissance includes the following tasks:

1. Review current site data provided by MES;

2. Conduct a field site reconnaissance;

3. Install at least six (6) soil borings at the floor of the quarry, each boring extending to a depth of approximately 40 feet.

4. Obtain three (3) undisturbed samples of the clay that underlies the site, using a Dension sampler;

5. Install temporary 2-inch PVC pipes in three borings to determine the groundwater profile;

6. Perform soil tests on collected samples, including Atterberg Limits, sieve analysis, and permeability.

7. Evaluate all available data and prepare a preliminary report regarding the potential for groundwater contamination at the site as a result of dredged material containment.

The project was phased in such a manner so that authorization from MPA to proceed with the geotechnical reconnaissance was delayed pending receipt of the preliminary results of the dredging engineering reconnaissance effort by GBA. If the preliminary dredging engineering reconnaissance appeared favorable, the preliminary geotechnical reconnaissance of the site by E2CR would be authorized to proceed.

Based upon the results of the preliminary dredging reconnaissance, MES issued notice to proceed to E2CR effective September 12, 2000. Field reconnaissance activities commenced on September 22, 2000.

Figure 7.1 shows E2CR's field staff and drilling rig installing soil borings on the site for the site reconnaissance and sample collection effort. This effort involved collecting soil samples for laboratory testing.

Figure 7.1 – Obtaining Soil Borings at the Furnace Bay Site

The report and laboratory analyses regarding the preliminary geotechnical reconnaissance were completed by E2CR and submitted to MES on November 8, 2000.

The E2CR geotechnical assessment failed to identify any obvious site deficiencies or technical issues, which would preclude use of the site as a containment site for dredged material.

The results of the E2CR preliminary geotechnical reconnaissance of the Furnace Bay site are found in Appendix B to this report.

8.0 Conclusions and Recommendations

MES has reviewed the results of the preliminary assessments performed by GBA and E2CR. In addition, MES obtained and evaluated information pertaining to industrial or public wells that have been installed in the vicinity of the site to determine if containment of dredged material on the site would pose a risk to the groundwater supply in the area. Based on this assessment, MES concludes the following:

1. The potential exists to place dredged material in the site using either hydraulic or mechanical placement methodologies. The distances required for pumping or otherwise transporting the dredged material to be placed in the site are greater than distances currently experienced in managing material from Upper Bay channels. These channels are the prospective sources for material that could potentially be placed at the Furnace Bay site. Estimated costs for placement of material from the Upper Bay channels in the site using hydraulic or mechanical placement methods ranges from $12.19 to $19.82 per cubic yard of dredged material.

2. No obvious site physical constraints were noted which would preclude use of the site to contain dredged material from Upper Bay channels. The on site soils include materials that are suitable for use in construction of earthen dikes to contain dredged material placed via hydraulic means. Existing topographic information indicate a potential of up to 9.6 MCY of air space capacity could be made available at the site with dikes raised to the elevation of the highest contiguous land. Using a 30% reduction in volume for cut sediments after consolidation and dewatering, the 9.6 MCY of air space capacity can potentially accommodate up to 13.6 MCY of cut material. Since this topography dated, and excavation activities have continued, additional but unknown air space capacity is potentially available at the site.

3. Based upon the results presented in the preliminary geotechnical report prepared by E2CR, MES concludes that the permeability of the in-situ silts and clays beneath the Furnace Bay site are in the range of 10^{-6} cm/sec. This natural low permeability provides a level of protection to groundwater in the vicinity of the site. Placement of clean sediments from the Upper Bay channels at a site with such soil characteristics should not pose undue risk to public health or to the environment.

4. Based upon the well inventory information provided by MDE, MES concludes that the 15 permitted wells which are known to exist in the vicinity of the Stancill site are predominantly domestic wells supplying water to single family dwellings. The wells appear to be drilled into the bedrock, which is known to exist beneath the surficial mineral deposits and the weathered saprolite. Because of their location in relation to the Stancill site, their depth and low production rates, MES concludes that none of these wells are at risk as a result of placement of dredged material at the site.

The preliminary dredging reconnaissance and the preliminary geotechnical reconnaissance do not provide a sufficient level of detail to fully support decision-making regarding the utility of the Furnace Bay site as a dredged material placement facility. The purpose of the preliminary reconnaissance work was to provide a first level of site assessment in order to identify any potential conditions that may exist that would preclude further consideration of the site for the specific use. No such conditions were identified.

Technical and other issues, which would need to be explored in more dètail during any subsequent study on the feasibility of using the site to contain dredged material. If the preliminary cost information indicates that the site is economically the following additional studies would be needed to more accurately assess site suitability:

- Current bathymetric information pertaining to the approach channels to the proposed barge unloader stations should be obtained to confirm suitability for access by barges loaded with dredged material;
- A more detailed site geotechnical assessment should be conducted to confirm the thickness, uniformity and in-situ permeability of the underlying confining soil layers.
- An environmental study including collection and analysis of data needed for permitting, and an assessment of the affects on receiving waters as a result of dredged material return flows resulting from placement of Upper Bay sediments at the site.
- Design and permitting and implementation of channel improvements, if needed.
- Mechanical dewatering and flocculent technologies to facilitate larger annual inflow rates and stacking.
- The comparative costs of mechanical placement following mechanical dewatering.
- The boundaries of the peat deposit in relation to the perimeter berms and its potential to affect berm stability needs to be determined.
- On site materials need to be classified and analyzed to determine their suitability for potential use during future dike construction.
- A groundwater contour map of the area and groundwater gradient should be developed.
- The rate and direction of groundwater flow, and the location and radius of influence of wells in the proximate area of the site needs to be determined to better assess the potential for groundwater contamination as a result of placement of dredged material at the site.
- Current site topographic information should be obtained to more accurately determine potentially available air space capacity within the site boundaries.

Further, the preliminary assessment was intended to provide a considered estimate, based upon identified constraints, of the potential cost associated with placement of dredged material in the site. MPA may then compare these estimated costs to cost estimates developed for alternative sites and dredged material management strategies. The range of estimated costs for placement of dredged material in the Furnace Bay site using hydraulic or mechanical placement methods is $12.19 to $19.82 per cubic yard. Other cost elements that were not considered during the preliminary reconnaissance work need to be considered and defined in order to develop an overall cost estimate associated with use of the Furnace Bay site. To determine the total cost of using the site to contain dredged material, MES recommends that the following cost elements be determined:

- A site use tipping fee or purchase price for the Furnace Bay property;
- Estimated costs associated with performing required studies and obtaining the required permits or other authorizations for operating a dredged material containment facility on the site.
- Annual site management and operating costs, which include sampling and analysis costs associated with a Water Quality Certificate or State Discharge Permit authorizing discharge of dredged material return flow to surface waters of the state.

Appendix A

Dredging Engineering Preliminary Feasibility Analysis Furnace Bay Sand And Gravel Quarry For Use As A Placement Site

Gahagan & Bryant Associates, September, 2000

DREDGING ENGINEERING

PRELIMINARY FEASIBILITY ANALYSIS

FURNACE BAY SAND AND GRAVEL QUARRY

FOR USE AS PLACEMENT SITE

Prepared for:

Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, MD 21401

Prepared by:

GBA
ENGINEERS ★ SURVEYORS

Gahagan & Bryant Associates, Inc.

Baltimore, MD

September 2000

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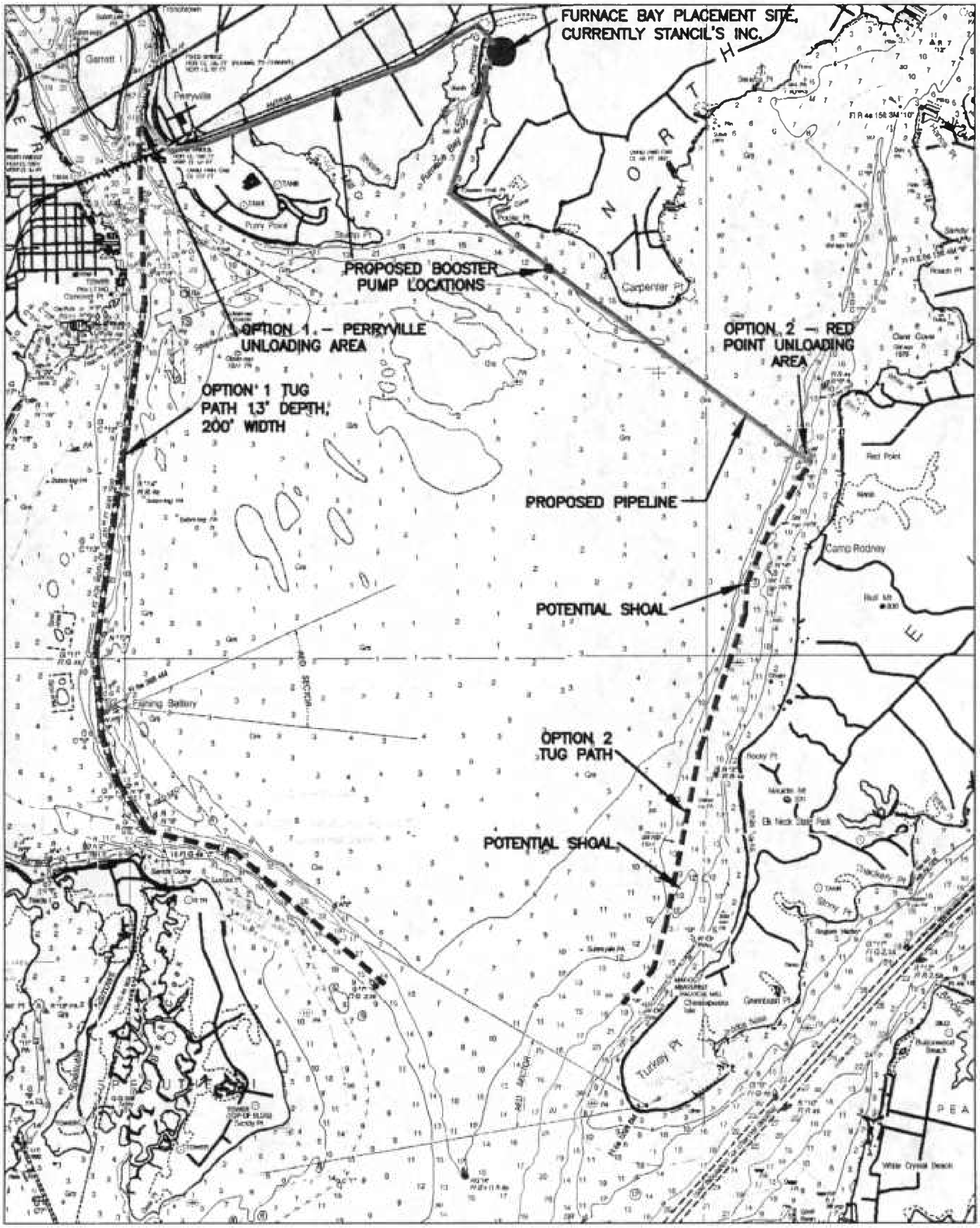
1.0 PROJECT BACKGROUND

The Maryland Environmental Service (MES), under sponsorship by the Maryland Port Administration (MPA), is examining the feasibility and suitability of certain sites for the placement of dredged material.

Furnace Bay (See Figure 1) is one site being studied for placement of dredged material. It is located approximately 20 nautical miles from the C&D (Chesapeake & Delaware) Canal approach channels. The placement site is an existing sand and gravel quarry in Cecil County, Maryland. Gahagan & Bryant Associates, Inc. (GBA), was retained by MES to provide a dredging engineering assessment for the placement of dredged material from the C&D Canal and its approach channels at the Furnace Bay site.

GBA's scope is to evaluate the suitability of this site to accommodate dredged material from the C&D Canal approach channels. The estimated yearly volume of dredged material in the channel to be placed at the Furnace Bay site is 400,000 cubic yards (CY). This report outlines the findings of our assessment.

Figure 1 – Furnace Bay Placement Site



2.0 PROJECT OBJECTIVES

GBA was tasked to provide a dredging engineering assessment for the feasibility of placement of fine grain dredged material at the Furnace Bay Site. Specifically, GBA's tasks are comprised of the following:

Task 1 - Determination of the available containment capacity for dredged material based upon topographic data (provided by others) and the existing configuration of the site.

Task 2 - Preliminary assessment of the feasibility of placing dredged material at the site using conventional hydraulic placement methods. The assessment shall include:

- Feasible location(s) for the barge unloading station, booster pumps or other ancillary facilities necessary to successfully place material in the site using hydraulic methods;
- An estimate of the site's annual placement capacity, assuming both hydraulic placement of the sediments with natural dewatering, and mechanical dewatering after hydraulic placement;
- Determination of any necessary site improvements to accommodate hydraulic placement of dredged material in the site; and a preliminary generic estimate of the cost (total capital cost and unit cost) associated with hydraulic placement of dredged material at the site.
- Dredging engineering and cost analysis for placing dredged material from the C&D Canal Approach Channels.

Task 3 - Preliminary assessment of the feasibility of placing dredged material in the site using mechanical placement methods.

Task 4 - Identification and characterization of any site features, design or operational issues that would potentially preclude the use of the site as an upland containment facility for dredged material.

3.0 SITE CHARACTERISTICS

Stancill's Inc. sand and gravel quarry, at 499 Mountain Hill Road, Perryville MD 21903, is adjacent to Furnace Bay and is the upland placement site to be evaluated for placement operations. Once the final mining elevations are met by the current site operator, the site could potentially provide 13.6 million CY of placement volume over its life. All volumes and capacities for this feasibility study were computed from existing topography and proposed mining contours provided by the owner of the quarry. Existing topography was established by aerial survey from 1992. The vertical datum is not defined on the topographic drawings.

The proposed placement site will be contained by existing high ground on the east, and dikes on the north, south and west. The site area is variable, from about 5 acres at the –70 elevation (bottom of the mined pit), to about 72 acres at a raised dike elevation of +88. Because of this variability in available placement area, the 400,000 CY cut yearly will result in different lift thicknesses, especially during the first few years. Groundwater on site appears to be at elevation –4.3. Any dewatering of the site would have to be done using pumps below this elevation. (See Figure 2 for site layout and topographic contours).

Dredged material capacity potential at the site is determined by final dike elevations. If there were no dike construction, we estimate that the site could be used for 7 years (±3mcy) and place material up to about elevation +12' which would consolidate back to about +8' (see Table 1). However, because most of the existing perimeter dikes are at elevation +45', building the remaining dikes to +45' will require a minimal effort. We estimate 140,000 CY in a 2,000 ft. long dike is required to achieve a +45' dike elevation. If the dikes are raised to +45 we estimate that the site could be used for 17 years (±7mcy) and place material up to about elevation +43' which would consolidate back to about +41'

Beyond the initial +45 dike construction, the site could potentially support dike raising to +90, which is the approximate elevation of the existing high ground along the east property line. Assuming the dikes are raised to +90 all at once, 1.3 MCY of suitable fill would be required. The resulting cell will provide an additional 6.8 MCY of capacity, enough for an additional 17 years. Therefore the total site capacity using an annual average placement volume of 400,000 CY is approximately 13.6 MCY over 34 years. (See Table 1 for estimated annual placement elevations and site capacity).

Incremental dike raising from +45 to +90 may be an issue for future study if the site is used for the placement of dredged material. Stockpiled coarse material from current mining operations (or other source) mixed with dried crust material to construct incrementally raised dikes to +90 should be investigated during feasibility/design. Increased setbacks may decrease capacity, but smaller dikes may increase capacity. Smaller dikes will also lower the cost of raising dikes.

Figure 2 – Stancil's Inc. Sand and Gravel Quarry

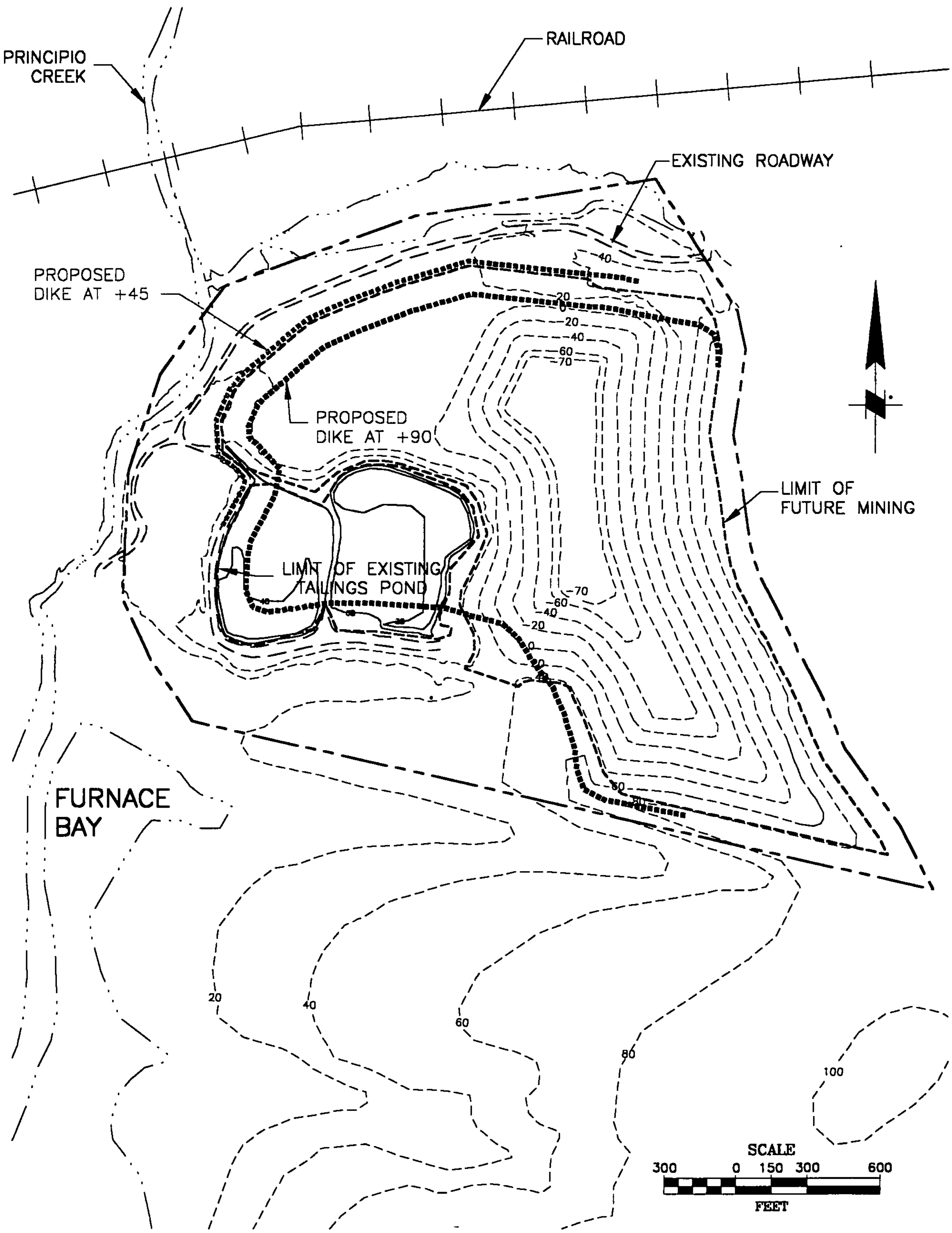


TABLE 1 - DREDGED MATERIAL PLACEMENT POTENTIAL AT FURNACE BAY
400,000 CY per Year Cut from Channels

Year	Pre-Fill Material Elevation	Surface Area (acres)	Post-Fill Material Elevation	Bulked Lift Thickness (feet)	Consolidated Lift Thickness (feet)	Capacity Used (MCY)
1	-70.0	5.4	-39.0	31.0	22.9	0.4
2	-47.1	12.7	-27.1	20.1	14.1	0.8
3	-33.0	17.2	-16.9	16.1	11.2	1.2
4	-21.9	20.7	-7.9	13.9	9.5	1.6
5	-12.4	23.7	0.1	12.5	8.4	2.0
6	-4.0	26.4	7.0	11.0	6.6	2.4
7	2.6	29.5	12.3	9.7	5.1	2.8
8	7.7	33.1	16.3	8.6	4.6	3.2
9	12.3	37.2	20.0	7.8	4.2	3.6
10	16.5	41.8	23.6	7.1	3.8	4.0
11	20.2	45.8	27.0	6.8	3.4	4.4
12	23.7	47.5	30.2	6.6	3.3	4.8
13	27.0	49.1	33.3	6.3	3.3	5.2
14	30.3	50.8	36.3	6.0	3.0	5.6
15	33.3	53.7	38.9	5.6	3.0	6.0
16	36.3	57.0	41.3	5.1	2.6	6.4
17	38.9	62.9	43.7	4.9	2.5	6.8
18	41.4	68.6	46.8	5.4	2.5	7.2
19	43.9	62.4	50.2	6.3	2.9	7.6
20	46.7	49.9	53.0	6.2	3.1	8.0
21	49.9	51.5	56.0	6.1	3.1	8.4
22	53.0	53.0	58.9	5.9	3.0	8.8
23	56.0	54.6	61.7	5.7	2.9	9.2
24	58.9	56.1	64.5	5.6	2.8	9.6
25	61.7	57.6	67.2	5.5	2.8	10.0
26	64.5	59.1	69.8	5.3	2.7	10.4
27	67.2	60.5	72.4	5.2	2.6	10.8
28	69.8	61.9	74.9	5.1	2.6	11.2
29	72.4	63.3	77.4	5.0	2.5	11.6
30	74.9	64.7	79.8	4.9	2.5	12.0
31	77.4	66.1	82.2	4.8	2.4	12.4
32	79.8	67.4	84.5	4.7	2.4	12.8
33	82.2	68.7	86.8	4.6	2.3	13.2
34	84.5	70.0	89.0	4.5	2.4	13.6

4.0 PLACEMENT METHODS

This study assumes that all dredging and transport of dredged material will be performed by a 21 cy clamshell dredge and 6000 cy scows.

Further, GBA evaluated two hydraulic placement options and one mechanical placement option to be utilized at the Furnace Bay site. The two hydraulic placement options are shown in Figure 1 in Section 1.

Option 1 (Hydraulic Placement) has the unloader pumping from a site in Perryville along the railroad right of way to the placement site. Option 2 (Hydraulic Placement) locates the unloader at the northern end of a natural channel formed by the Northeast River. From there the pipeline to Furnace Bay is submerged in 2 to 5 feet of water. Each option requires one booster pump to help overcome 3 to 4 miles of pipeline losses. Equipment required for hydraulic placement include, a hydraulic unloader and booster pump along with 3 to 4 miles of pipeline.

Option 3 (Mechanical Placement) involves two 7 CY clamshells that transfer the dredged material to trucks at the Perryville offloading site. Each clamshell fills a 12 CY dump truck with watertight sealed doors for a three mile haul to Furnace Bay.

The assumptions for our study of transport and placement options are as follows:

1. Maximum draft of barges is 13 feet.
2. Submerged pipeline at the Red Point unloader and the land pipeline for the Perryville unloader site shall be 24" plastic pipe, and will be removed after dredging operations each year.
3. The MPA will be able to obtain a discharge permit or water quality certification to remove dredge process water from the Furnace Bay placement site.
4. The barge access channel to the Perryville unloader is maintained to 200' wide and at least 13' deep.
5. The natural barge access channel to Red Point has not shoaled to less than 13' deep.
6. Marine operators are able to operate during the winter, except during heavy ice conditions.

Access to the unloader areas by tug and barge should be assessed for navigational issues during future studies. The channel to Red Point is natural and is not marked with ranges to aid tug and barge traffic during heavy weather and at night. Both navigation routes could potentially constrain barge and tug traffic, especially during heavy ice conditions. Further assessment of these potential operating constraints would be appropriate as part of future feasibility studies.

Hydraulic unloader and booster pumping characteristics, along with anticipated dredged material characteristics are listed in Table 2.

TABLE 2 - 24" HYDRAULIC UNLOADER AND BOOSTER CHARACTERISTICS

RATED MAIN PUMP HORSEPOWER	3,000	
RATED MAIN ENGINE SPEED	720	RPM
MAXIMUM MAIN PUMP SPEED	400	RPM
MAIN PUMP IMPELLER DIAMETER	80	INCHES
LADDER PUMP HORSEPOWER	600	
LADDER PUMP SPEED	330	RPM
LADDER PUMP IMPELLER DIAMETER	42	INCHES
BOOSTER PUMP HORSEPOWER	3,000	
BOOSTER PUMP SPEED	350	RPM
BOOSTER PUMP IMPELLER DIAMETER	80	INCHES
PIPELINE DIAMETER	24	INCHES
SYSTEM LIFT	45	Feet
PERCENT SOLIDS PUMPED	20	%
UNIT WEIGHT OF MATERIAL	110	PCF
MATERIAL PUMPING FACTOR	1.1	
SLURRY SPECIFIC GRAVITY	1.15	

A summary of the two hydraulic placement scenarios is presented in Table 3.

TABLE 3 - HYDRAULIC PLACEMENT OPTIONS

24" Pumpout with one Booster from Perryville to Furnace Bay Placement Site

LENGTH OF PIPELINE, Steel	16,500	Feet
TOTAL DISCHARGE PRESSURE	271.5	PSI
TOTAL HEAD DEVELOPED	644.5	Feet of water
DISCHARGE VELOCITY	15.6	FT/SEC.
SYSTEM PRODUCTION	1,308	CY/HR
MAIN ENGINE SPEED	685	RPM
MAIN PUMP SPEED	381	RPM
MAIN PUMP OPERATING AT	2,891	HP
LADDER PUMP OPERATING AT	571	HP
BOOSTER PUMP OPERATING AT	2,480	HP
TOTAL SYSTEM OPERATING AT	5,943	HP
VELOCITY HEAD	4.36	Feet of water
ENTRANCE LOSS	13.1	Feet of water
LADDER PUMP HEAD	61.5	Feet of water
MAIN PUMP HEAD	315.8	Feet of water
FRICTION LOSS PER 100 FEET	3.46	Feet of water
TOTAL FRICTION LOSS	570.7	Feet of water
BOOSTER PUMP HEAD	267.1	Feet of water

24" Pumpout with one Booster from Red Point to Furnace Bay Placement Site

LENGTH OF PIPELINE, Steel	23,900	Feet
TOTAL DISCHARGE PRESSURE	290.3	PSI
TOTAL HEAD DEVELOPED	681.5	Feet of water
DISCHARGE VELOCITY	13.3	FT/SEC.
SYSTEM PRODUCTION	1,115	CY/HR
MAIN ENGINE SPEED	720	RPM
MAIN PUMP SPEED	400	RPM
MAIN PUMP OPERATING AT	2,763	HP
LADDER PUMP OPERATING AT	518	HP
BOOSTER PUMP OPERATING AT	2,115	HP
TOTAL SYSTEM OPERATING AT	5,396	HP
VELOCITY HEAD	3.17	Feet of water
ENTRANCE LOSS	11.2	Feet of water
LADDER PUMP HEAD	65.5	Feet of water
MAIN PUMP HEAD	348.9	Feet of water
FRICTION LOSS PER 100 FEET	2.57	Feet of water
TOTAL FRICTION LOSS	615.4	Feet of water
BOOSTER PUMP HEAD	267.1	Feet of water

5.0 COST ANALYSIS

This section outlines the estimated cost to mobilize/demobilize, dredge, transport, and place 400,000 CY of dredged material at the Furnace Bay site. As described in section 4, dredging and transport will be performed by clamshell and scow/tug. The 3 placement options reviewed for this cost analysis are: Option 1 - Hydraulic Placement at Perryville, Option 2 - Hydraulic Placement at Northeast River, and Option 3 - Mechanical Placement at Perryville.

Because this analysis is an initial Site Assessment, the following items are costs not considered in this report, however, they should be identified as part of the feasibility/design of this project:

- Site monitoring requirements (spillways, environmental, groundwater/stormwater)
- Site acquisition or utilizations costs
- Site preparation costs
- Spreading and compacting (mechanical placement)
- Dewatering below mean low water as part of crust management
- Additional crust management and continual operation to maximize site capacity

Costs for mechanically unloading scows and truck hauling (mechanical placement option 3 only) are shown in table 4.

TABLE 4 - MECHANICAL UNLOADING AND HAULING COSTS

Amt	Item	Quantity	Units	Unit Price	Cost
2	150 Ton Crane - 7 CY Clamshell	1.33	month	$20,000	$53,333
4	Crane Operator	40	day	$350	$56,000
60	12 CY Dump Trucks	1.33	month	$18,500	$1,480,000
120	Truck Drivers	40	day	$400	$1,920,000
2	Superintendant	40	day	$500	$40,000
6	Utility Personnel	40	day	$260	$62,400
1	Engineering & Supervision	40	day	$1,200	$48,000
					$3,659,733
	Overhead @	15%			$548,960
				Subtotal	**$4,208,693**
	Contingency @	10%			$420,869
	Profit @	10%			$420,869
				Subtotal	**$5,050,431**
	Bond @	0.5%			$25,252
	Unloading and Truck Hauling Costs*				**$5,075,683**
			Unit Rate -	**$12.69/ CY**	

**Note: Truck Haul and Placement Costs do not include dredging and transport costs, site acquisition or utilization costs, or site preparation costs.*

Table 5 is an estimate of the yearly operational cost of crust management. During the first 6 years, crust management and dewatering may be limited as the material will be below sea level. Dewatering during the first 6 years will be reviewed in future studies; to identify feasibility as needed to maximize capacity.

TABLE 5 - CRUST MANAGEMENT COSTS

Amt	Item	Quantity	Units	Unit Price	Cost
	Mob/Demob		LS	$40,000	$40,000
1	½ CY Bucket Dragline rental	0.33	month	$20,000	$6,667
1	300 HP Dozer rental	0.33	month	$12,000	$4,000
1	Pontoon Trencher	0.67	month	$100,000	$67,000
1	Superintendant	20	day	$500	$10,000
1	Dragline Operator	10	day	$375	$3,750
1	Dozer Operator	10	day	$350	$3,500
2	Utility Personnel	20	day	$280	$11,200
1	Engineering & Supervision	20	day	$1,200	$24,000
					$170,117

Table 6 summarizes the estimated yearly cost to mobilize, dredge, transport, place and dewater 400,000 CY of dredged material at Furnace Bay, and demobilize from the site. The costs in table 6 are outlined for the following 3 options:

- Option 1 - Hydraulic Placement at Perryville
- Option 2 - Hydraulic Placement at Red Point in Northeast River
- Option 3 - Mechanical Placement at Perryville

Detailed cost estimates for hydraulic placement (provided in the appendix) are broken down into mobilization / demobilization, dredging, transport and placement. Dredging will take place from October 1st to March 31st. One 21 CY clamshell dredge will dredge and place material into scows at a rate of 10,000 CY per day. Tugs will transport the scows to one of the two previously mentioned unloader locations

The estimated cost to build the dikes is $10 per CY or $1.4 million for the initial +45' dike. Assuming one dike raising from elevation +45 to +90, an additional $13 million would be required. Incremental dike raising and dried crust mixing (should be a future study) will reduce this cost substantially. One initial spillway (23ft high) and approximately 3 future spillways will be needed for discharge water, and will cost about $125,000 each.

TABLE 6 - COST SUMMARY

Option 1 - Perryville to Furnace Bay Site - Hydraulic Unloader

	COST	$/CY
Mobilization / Demobilization Costs	$1,030,93	$2.58
Dredging Costs	$836,20	$2.09
Transport Costs	$1,453,06	$3.63
Hydraulic Placement Costs	$1,387,47	$3.47
Crust Management Costs (1)	$170,11	$0.43
TOTAL COST	$4,877,80	$12.19

Option 2 - Red Point to Furnace Bay Site - Hydraulic Unloader

	COST	$/CY
Mobilization / Demobilization Costs	$1,481,22	$3.70
Dredging Costs	$815,31	$2.04
Transport Costs	$976,49	$2.44
Hydraulic Placement Costs	$1,449,05	$3.62
Crust Management Costs (1)	$170,11	$0.43
TOTAL COST	$4,892,20	$12.23

Option 3 - Perryville to Furnace Bay Site - Mechanical Placement

	COST	$/CY
Mob / Demob Dredge & Barges	$175,00	$0.44
Dredging Costs	$836,20	$2.09
Transport Costs	$1,453,06	$3.63
Mob / Demob Excavators & Trucks	$390,00	$0.98
Mechanical Placement Costs (2)	$5,075,68	$12.69
TOTAL COST	$7,929,95	$19.82

Notes:

1. Crust Management Costs are zero until year seven due to the small surface area at lower elevations of the mined pit.
2. Mechanical placement consists of unloading barges with an excavator and loading sealed trucks that haul the wet material to the site.

6.0 FEASIBILITY, SUMMARY & CONCLUSIONS

This preliminary feasibility analysis indicates that placement of dredged material from the C&D Canal approach channels is feasible. Estimates show that the cost for dredging, transport and placement using hydraulic placement of material at the Furnace Bay site is approximately $12/CY. The estimated cost for mechanical placement of material at the site is approximately $20/CY.

Issues and recommendations are as follows:

1. The two unloader location options were chosen by studying nautical charts to find water deep enough (12 to 13 feet) for barges as close as possible to Furnace Bay. Maintaining the channels at 13' deep may be an additional cost if the channels are not maintained by the federal or local government agencies. This may be a concern if the Perryville site is selected for unloading, since the channel is not naturally deep.

2. For hydraulic option 2 (Red Point), locating the unloader south of the potential shoals would add an additional 3 miles of submerged pipeline, which would increase the cost of material placement.

3. Of the $1 million or $1.5 million cost for mobilization and demobilization for the hydraulic placement options, about half is setting and removing the shore or submerged pipeline. A permanent pipeline from the Perryville unloading area to the site could save almost $400,000 ($1/CY) per year for option 1. Setting a permanent submerged pipeline in the shallow water from the Red Point area to Furnace Bay for option 2, may present maintenance, safety and environmental issues. Also, setting a temporary submerged pipeline in shallow water each dredging season may present enough of a technical difficulty to keep contractors from bidding on the project.

4. Mechanical placement could potentially be used to substantially reduce effluent discharges.

5. Location of a mechanical loader at the Perryville site may be useful because there may be the potential to also utilize placement volumes available at other sites known to exist in the area.

6. Mechanical placement would require 2 cranes with clamshells and more than 60 trucks to place material around the clock to keep up with dredging operations. Finding a hauling company that can supply that many trucks around the clock for more than a month may not be feasible.

APPENDIX A

COST ESTIMATE

COST SUMMARY - OPTION 1 - UNLOADER AT PERRYVILLE

						Total Cost $	Dredging Cost $	Transport Cost $	Placement Cost $
Operating Costs									
1	Clamshell Dredge	0.88	Months @ $	272,757	240,026		240,026		
1	Hydraulic Unloader	0.88	Months @ $	413,694	364,051				364,051
1	Shore Booster	0.88	Months @ $	136,249	119,899				119,899
3	Towing Tug	0.88	Months @ $	249,736	659,304			659,304	
2	Tending Tug	0.88	Months @ $	69,970	123,148		61,574		61,574
1	Survey/Crewboat	0.88	Months @ $	62,920	55,370		55,370		
4	Dump Scows	0.88	Months @ $	23,411	82,405		20,925	45,661	15,819
1	Derrick Barge	0.88	Months @ $	56,480	49,703				49,703
2	Deck Barge	0.88	Months @ $	1,969	3,465				3,465
1	Fuel Barge	0.88	Months @ $	2,563	2,255				2,255
1	Shore Crew	0.88	Months @ $	196,863	173,239				173,239
1	Superv/Engrg	0.88	Months @ $	72,356	63,673		12,848	23,967	26,858
				Total Operating Costs $		**1,936,538**	390,742	728,932	816,864
Ownership Costs									
1	Clamshell Dredge	0.88	Months @ $	176,079	154,950		154,950		
1	Hydraulic Unloader	0.88	Months @ $	98,040	86,275				86,275
1	Shore Booster	0.88	Months @ $	9,603	8,451				8,451
3	Towing Tug	0.88	Months @ $	75,547	199,444			199,444	
2	Tending Tug	0.88	Months @ $	12,248	21,556		10,778		10,778
1	Survey/Crewboat	0.88	Months @ $	8,252	7,262		7,262		
4	Dump Scows	0.88	Months @ $	87,012	306,282		77,773	169,711	58,798
1	Derrick Barge	0.88	Months @ $	5,989	5,270				5,270
2	Deck Barge	0.88	Months @ $	7,503	13,205				13,205
1	Fuel Barge	0.88	Months @ $	9,780	8,606				8,606
				Total Ownership Costs $	811,301		250,763	369,155	191,383
	Market Factor @	75%				**608,476**	**188,072**	**276,866**	**143,537**
				Total Direct Costs $		**2,545,014**	**578,815**	**1,005,798**	**960,401**
	Overhead @	15%				381,752	86,822	150,870	144,060
				Sub Total $		2,926,766	665,637	1,156,668	1,104,461
	Contingency @	10%				292,677	66,564	115,667	110,446
	Profit @	15%				439,015	99,846	173,500	165,669
				Sub Total $		3,658,458	832,046	1,445,835	1,380,576
	Bond @	0.5%				18,292	4,160	7,229	6,903
				Total Dredge Price $		**3,676,750**	**836,206**	**1,453,064**	**1,387,479**

3,676,750 Dredge Price $ / 400,000 Pay Cubic Yards	= $/CY	**9.19**	**2.09**	**3.63**	**3.47**

COST SUMMARY - OPTION 2 - UNLOADER AT RED POINT

						Total Cost $	Dredging Cost $	Transport Cost $	Placement Cost $
Operating Costs									
1	Clamshell Dredge	0.88	Months @ $	272,757	240,026		240,026		
1	Hydraulic Unloader	0.88	Months @ $	413,694	364,051				364,051
1	Booster Barge	0.88	Months @ $	175,489	154,430				154,430
2	Towing Tug	0.88	Months @ $	249,736	439,536			439,536	
2	Tending Tug	0.88	Months @ $	69,970	123,148		61,574		61,574
1	Survey/Crewboat	0.88	Months @ $	62,920	55,370		55,370		
3	Dump Scows	0.88	Months @ $	23,411	61,804		16,730	31,333	13,741
1	Derrick Barge	0.88	Months @ $	56,480	49,703				49,703
2	Deck Barge	0.88	Months @ $	1,969	3,465				3,465
1	Fuel Barge	0.88	Months @ $	2,563	2,255				2,255
1	Shore Crew	0.88	Months @ $	196,863	173,239				173,239
1	Superv/Engrg	0.88	Months @ $	72,356	63,673		14,274	17,985	31,414
			Total Operating Costs $			1,730,700	387,974	488,854	853,872
Ownership Costs									
1	Clamshell Dredge	0.88	Months @ $	176,079	154,950		154,950		
1	Hydraulic Unloader	0.88	Months @ $	98,040	86,275				86,275
1	Booster Barge	0.88	Months @ $	26,885	23,659				23,659
2	Towing Tug	0.88	Months @ $	75,547	132,963			132,963	
2	Tending Tug	0.88	Months @ $	12,248	21,556		10,778		10,778
1	Survey/Crewboat	0.88	Months @ $	8,252	7,262		7,262		
3	Dump Scows	0.88	Months @ $	87,012	229,712		62,183	116,459	51,071
1	Derrick Barge	0.88	Months @ $	5,989	5,270				5,270
2	Deck Barge	0.88	Months @ $	7,503	13,205				13,205
1	Fuel Barge	0.88	Months @ $	9,780	8,606				8,606
			Total Ownership Costs $		683,458		235,173	249,422	198,864
	Market Factor @	75%				**512,594**	**176,379**	**187,066**	**149,148**
			Total Direct Costs $			**2,243,294**	**564,353**	**675,921**	**1,003,020**
	Overhead @	15%				336,494	84,653	101,388	150,453
			Sub Total $			2,579,788	649,006	777,309	1,153,473
	Contingency @	10%				257,979	64,901	77,731	115,347
	Profit @	15%				386,968	97,351	116,596	173,021
			Sub Total $			3,224,735	811,258	971,636	1,441,841
	Bond @	0.5%				16,124	4,056	4,858	7,209
			Total Dredge Price $			**3,240,859**	**815,314**	**976,494**	**1,449,050**

		Total	Dredging	Transport	Placement
3,240,859 Dredge Price $ / 400,000 Pay Cubic Yards	= $/CY	**8.10**	**2.04**	**2.44**	**3.62**

MOBILIZATION AND DEMOBILIZATION COSTS

SUMMARY

	Opt. 1	Opt. 2
21 CY Clamshell Dredge	96,481	192,962
6000 CY Scows	54,616	40,962
Hydraulic Unloader	259,980	259,980
Booster Pumps	57,645	158,935
Pipeline	432,723	698,898
Supervision & Survey	129,489	129,489
Total Mob & Demob $	1,030,934	1,481,226
SAY $	**1,031,000**	**1,481,000**

21 CY CLAMSHELL DREDGE

Labor: Dredge	4	Days	@ $	6,143	$	24,572
Towing Tug	4	Days	@ $	3,252		13,008
Tender Tug	4	Days	@ $	1,688		6,752
Fuel:	6,000	Gal	@ $	0.80		4,800
Materials and Supplies						4,000
Hotel, Travel, Freight						2,000
	Mobilization Cost				$	55,132
	Demobilization Cost @ 75 %					41,349
	Total for 1 Clamshell Dredge				$	**96,481**

6000 CY BOTTOM DUMP SCOWS

Labor: Scow	2	Days	@ $	249	$	498
Towing Tug	2	Days	@ $	3,252		6,504
Fuel:	1,000	Gal	@ $	0.80		800
	Mobilization Cost				$	7,802
	Demobilization Cost @ 75 %					5,852
	Total for 1 Industry Scow				$	**13,654**

MOBILIZATION AND DEMOBILIZATION COSTS

30" HYDRAULIC UNLOADER:

Labor: Unloader	10	Days	@ $	5,573	$	55,730
Towing Tug	10	Days	@ $	3,252		32,520
Tender Tug	10	Days	@ $	1,688		16,880
Derrick	10	Days	@ $	843		8,430
Fuel:	10,000	Gal	@ $	0.80		8,000
Materials and Supplies						15,000
Hotel, Travel, Freight						12,000
	Mobilization Cost				$	148,560
	Demobilization Cost @ 75 %					111,420
	Total for 1 Hydraulic Unloader				$	**259,980**

30" BOOSTER PUMP BARGE:

Labor: Booster	10	Days	@ $	2,542	$	25,420
Towing Tug	10	Days	@ $	3,252		32,520
Tender Tug	10	Days	@ $	1,688		16,880
Fuel:	5,000	Gal	@ $	0.80		4,000
Materials and Supplies						8,000
Hotel, Travel, Freight						4,000
	Mobilization Cost				$	90,820
	Demobilization Cost @ 75 %					68,115
	Total for 1 Booster Pump Barge				$	**158,935**

30" SHORE BOOSTER PUMP:

Labor: Booster	10	Days	@ $	1,794	$	17,940
Fuel:	5,000	Gal	@ $	0.80		4,000
Transport						5,000
Materials and Supplies						4,000
Hotel, Travel, Freight						2,000
	Mobilization Cost				$	32,940
	Demobilization Cost @ 75 %					24,705
	Total for 1 Shore Booster Pump				$	**57,645**

MOBILIZATION AND DEMOBILIZATION COSTS

PIPELINE (Option 1 - Perryville):

Labor: Shore	10	Days @ $	4,747	$	47,470
Fuel:	3,000	Gal @ $	0.80		2,400
Transport Pipe	21,300	Lin. Ft. @	3.00		63,900
Pontoon Line	500	Lin. Ft. @	4.00		2,000
Lay Sub Line	500	Lin. Ft. @	10.00		5,000
Lay Shore Line	20,300	Lin. Ft. @	5.00		101,500
Materials and Supplies					15,000
Hotel, Travel, Freight					10,000
	Mobilization Cost			$	247,270
	Demobilization Cost @ 75 %				185,453
	Total for Perryville Pipeline			$	**432,723**

PIPELINE (Option 2 - Red Point):

Labor: Shore	10	Days @ $	4,747	$	47,470
Fuel:	3,000	Gal @ $	0.80		2,400
Transport Pipe	25,000	Lin. Ft. @	3.00		75,000
Pontoon Line	500	Lin. Ft. @	4.00		2,000
Lay Sub Line	24,000	Lin. Ft. @	10.00		240,000
Lay Shore Line	500	Lin. Ft. @	5.00		2,500
Materials and Supplies					20,000
Hotel, Travel, Freight					10,000
	Mobilization Cost			$	399,370
	Demobilization Cost @ 75 %				299,528
	Total for Red Point Pipeline			$	**698,898**

SUPERVISION AND SURVEY

Labor: Supervision	10	Days @ $	1,629	$	16,290
Survey	10	Days @ $	1,688		16,880
Set Up Field Office					25,000
Materials and Supplies					10,000
Hotel, Travel, Freight					8,000
	Mobilization Cost			$	76,170
	Demobilization Cost @ 75 %				53,319
	Total Supervision and Survey			$	**129,489**

MONTHLY OPERATING COSTS OF DREDGING SYSTEMS

These expenses represent the costs of operating the equipment and include payroll costs, usage, repai and maintenance, wear costs, marine insurance, operating supplies, and engineering and supervision required for the operation of the various pieces of plant.

This estimate considers the operating costs of one basic type of dredging system, a clamshell dredge with attendant plant.
The operating costs are based on utilization of certain sizes and configurations of plant for these syste Other sizes or types of plant might be used, but the system selected will yield a representative economi result.

MONTHLY OPERATING COST SUMMARY

	Number Required	Unit Cost/Mo	Total Cost/Mo
Option 1 - Perryville Unloader:			
21 CY Clamshell Dredge	1	272,757	272,757
24" Hydraulic Unloader	1	413,694	413,694
Shore Booster Pump	1	136,249	136,249
4500 HP Towing Tug	3	249,736	749,209
800 HP Tender Tug	2	69,970	139,940
Survey/Crewboat	1	62,920	62,920
6000 CY Dump Scow	4	23,411	93,642
Derrick Barge	1	56,480	56,480
Fleeting Barge	2	1,969	3,938
Fuel Barge	1	2,563	2,563
Shore Crew	1	196,863	196,863
Supervision & Engineering	1	72,356	72,356
		Total $	2,200,610
Option 2 - Red Point Unloader:			
21 CY Clamshell Dredge	1	272,757	272,757
24" Hydraulic Unloader	1	413,694	413,694
Booster Pump Barge	1	175,489	175,489
4500 HP Towing Tug	2	249,736	499,472
800 HP Tender Tug	2	69,970	139,940
Survey/Crewboat	1	62,920	62,920
6000 CY Dump Scow	3	23,411	70,232
Derrick Barge	1	56,480	56,480
Fleeting Barge	2	1,969	3,938
Fuel Barge	1	2,563	2,563
Shore Crew	1	196,863	196,863
Supervision & Engineering	1	72,356	72,356
		Total $	1,966,704

21 CY CLAMSHELL DREDGE
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits	186,739
Travel and Subsistence	10,920
Commissary Losses	None
Fuel and Lube	29,736
Repair and Maintenance	8,500
Supplies and Consumables	20,500
Wear Costs	1,362
Marine Insurance	15,000
Total Monthly Operating Cost	**272,757**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	21	Man Months @	$520	=	10,920
Total Travel and Subsistence Cost per Month				$	**10,920**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
16 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	2,000	50%	1,000	486	29,160	23,328
Auxilliaries	200	60%	120	730	5,256	4,205
			1,120		34,416	27,533
		Lubricants at 8 Percent of Fuel Costs				2,203
		Total Fuel and Lube Cost per Mo			$	**29,736**

REPAIR AND MAINTENANCE:

Diesel Parts		5,000
Haul Gear, Shafting and Sheaves		2,500
Miscellaneous		1,000
Total Cost per Month	$	**8,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope	10,000
Welding	2,500
Deck	2,000
Engine Room	2,000
Civil Engineering	2,500
Miscellaneous	1,500
Total Cost per Month	**20,500**

21 CY CLAMSHELL DREDGE
MONTHLY OPERATING COST ESTIMATE

WEAR COSTS:

Material: Maintenance Material
456,000 CY per Month, Production Rate

Description	Quantity	Unit Rate $	Total Value $	Useful Life MCY	Cost per CY	Cost per Month
Bucket	1	80,000	80,000	30,000	0.0027	1,216
Edges/Teeth (Set)	1	1,600	1,600	5,000	0.0003	146
			81,600			
			Total Wear Cost per Month			**1,362**

MARINE INSURANCE:

$ 8,000,000 Equipment Value 1.50% Annual Percentage Rate

8 Average Use Months per Year = **15,000**

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
B	Master		25.22	0	0	0	0
C	Captain	1	21.32	5,914	1,890	1,503	9,307
A	Operator	1	27.18	7,539	2,409	1,685	11,633
B	Operator II	2	22.45	12,454	3,980	3,210	19,644
C	Mate	3	21.17	17,616	5,628	4,500	27,744
C	Welder	1	22.32	6,191	1,978	1,520	9,689
C	Welder Helper		17.69	0	0	0	0
D	Deckhand	7	17.26	33,516	10,710	9,443	53,669
C	Chief Engineer	1	25.22	6,995	2,235	1,484	10,714
B	Engineer	2	24.02	13,326	4,258	3,262	20,846
C	Maint. Engineer		22.67	0	0	0	0
D	Oiler	3	17.69	14,721	4,704	4,068	23,493
C	Steward		22.39	0	0	0	0
D	Assistant Cook		17.14	0	0	0	0
D	Night Cook		17.14	0	0	0	0
D	Messman		16.66	0	0	0	0
D	Janitor or Porter		16.66	0	0	0	0
	Total Labor	21	$	118,272	37,792	30,675	186,739
				Total Labor Cost per Month			**186,739**

24" HYDRAULIC BARGE UNLOADER
MONTHLY OPERATING COST ESTIMATE
(Option 1 - Perryville Unloader)

SUMMARY:

Labor and Benefits		169,404
Travel and Subsistence		9,880
Commissary Losses		None
Fuel and Lube		66,006
Repair and Maintenance		17,500
Supplies and Consumables		19,000
Wear Costs		124,404
Marine Insurance		7,500
Total Monthly Operating Cost	$	**413,694**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	19	Man Months @	$520	=		9,880
Total Travel and Subsistence Cost per Month					$	**9,880**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
14 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	3,000	60%	1,800	426	46,008	34,506
Ladder Pump	600	60%	360	426	9,202	6,901
Auxilliaries	1,000	60%	600	730	26,280	19,710
			2,760		81,490	61,117
Lubricants at 8 Percent of Fuel Costs						4,889
Total Fuel and Lube Cost per Month					$	**66,006**

REPAIR AND MAINTENANCE:

Diesel Parts		10,000
Hydraulics		1,000
Haul Gear, Shafting and Sheaves		2,500
Miscellaneous		4,000
Total Cost per Month	$	**17,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		5,000
Welding		2,500
Deck		5,000
Engine Room		5,000
Miscellaneous		1,500
Total Cost per Month	$	**19,000**

24" HYDRAULIC BARGE UNLOADER
MONTHLY OPERATING COST ESTIMATE
(Option 1 - Perryville Unloader)

WEAR COSTS:

Material: Maintenance Material
456,000 CY per Month, Production Rate

Description	Quantity	Unit Rate $	Total Value $	Useful Life MCY	Cost per CY	Cost per Month
Pumpshell	2	50,000	100,000	3,000	0.0333	15,200
Impeller	2	12,000	24,000	1,500	0.0160	7,296
Liner (Set)	2	11,000	22,000	1,000	0.0220	10,032
Suct/Disch Pipe	1	150,000	150,000	10,000	0.0150	6,840
Floating Pipe (Ft)	500	150	75,000	6,000	0.0125	5,700
Submerged Pipe (Ft)	500	70	35,000	6,000	0.0058	2,660
Shore Pipe (Ft)	20,300	40	812,000	5,000	0.1624	74,054
Ball Joints	10	3,500	35,000	20,000	0.0018	798
Swivel Joints	3	20,000	60,000	15,000	0.0040	1,824
			1,313,000			

Total Wear Cost per Month $ **124,404**

MARINE INSURANCE:

$ 4,000,000 Equipment Value 1.50% Annual Percentage Rate
8 Average Use Months per Year = **7,500**

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
A	Lead Dredgman		26.68	0	0	0	0
A	Leverman	1	26.68	7,400	2,364	1,677	11,441
B	Leverman II	2	22.45	12,454	3,980	3,210	19,644
C	Captain	1	24.34	6,751	2,157	1,554	10,462
B	Chief Mate		23.18	0	0	0	0
C	Mate		21.17	0	0	0	0
B	Derrick Operator		23.51	0	0	0	0
B	Chief Welder		23.80	0	0	0	0
C	Dredge Welder	1	22.31	6,188	1,977	1,520	9,685
C	Welder Helper	1	17.69	4,907	1,568	1,441	7,916
D	Deckhand	6	17.04	28,356	9,060	8,070	45,486
C	Chief Engineer	1	24.69	6,848	2,188	1,560	10,596
B	Engineer	3	23.51	19,563	6,249	4,869	30,681
C	Maint. Engineer		22.67	0	0	0	0
C	Oiler	3	17.69	14,721	4,704	4,068	23,493
B	Electrician		22.82	0	0	0	0
C	Steward		22.39	0	0	0	0
D	Assistant Cook		17.14	0	0	0	0
D	Night Cook		17.14	0	0	0	0
D	Messman		16.66	0	0	0	0
D	Janitor or Porter		16.66	0	0	0	0
	Total Labor	19	$	107,188	34,247	27,969	169,404

Total Labor Cost per Month $ **169,404**

24" HYDRAULIC BARGE UNLOADER
MONTHLY OPERATING COST ESTIMATE
(Option 2 - Red Point Unloader)

SUMMARY:

Labor and Benefits		169,404
Travel and Subsistence		9,880
Commissary Losses		None
Fuel and Lube		83,398
Repair and Maintenance		17,500
Supplies and Consumables		19,000
Wear Costs		175,978
Marine Insurance		7,500
Total Monthly Operating Cost	$	**482,660**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	19	Man Months @	$520	=	9,880
Total Travel and Subsistence Cost per Month				$	**9,880**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
14 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	4,400	60%	2,640	426	67,478	50,609
Ladder Pump	600	60%	360	426	9,202	6,901
Auxilliaries	1,000	60%	600	730	26,280	19,710
			3,600		102,960	77,220
Lubricants at 8 Percent of Fuel Costs						6,178
Total Fuel and Lube Cost per Month					$	**83,398**

REPAIR AND MAINTENANCE:

Diesel Parts		10,000
Hydraulics		1,000
Haul Gear, Shafting and Sheaves		2,500
Miscellaneous		4,000
Total Cost per Month	$	**17,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		5,000
Welding		2,500
Deck		5,000
Engine Room		5,000
Miscellaneous		1,500
Total Cost per Month	$	**19,000**

24" HYDRAULIC BARGE UNLOADER
MONTHLY OPERATING COST ESTIMATE
(Option 2 - Red Point Unloader)

WEAR COSTS:

Material: Maintenance Material
456,000 CY per Month, Production Rate

Description	Quantity	Unit Rate $	Total Value $	Useful Life MCY	Cost per CY	Cost per Month
Pumpshell	2	50,000	100,000	3,000	0.0333	15,200
Impeller	2	12,000	24,000	1,500	0.0160	7,296
Liner (Set)	2	11,000	22,000	1,000	0.0220	10,032
Suct/Disch Pipe	1	150,000	150,000	10,000	0.0150	6,840
Floating Pipe (Ft)	500	150	75,000	6,000	0.0125	5,700
Submerged Pipe (Ft)	24,000	70	1,680,000	6,000	0.2800	127,680
Shore Pipe (Ft)	500	40	20,000	5,000	0.0040	1,824
Ball Joints	10	3,500	35,000	20,000	0.0018	798
Swivel Joints	1	20,000	20,000	15,000	0.0013	608
			2,126,000			

Total Wear Cost per Month $ **175,978**

MARINE INSURANCE:

$ 4,000,000 Equipment Value 1.50% Annual Percentage Rate
———————————————— = **7,500**
8 Average Use Months per Year

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Wages (Monthly Costs)	Taxes and Liabilities (Monthly Costs)	Welfare Pension Vacation (Monthly Costs)	Totals (Monthly Costs)
A	Lead Dredgman		26.68	0	0	0	0
A	Leverman	1	26.68	7,400	2,364	1,677	11,441
B	Leverman II	2	22.45	12,454	3,980	3,210	19,644
C	Captain	1	24.34	6,751	2,157	1,554	10,462
B	Chief Mate		23.18	0	0	0	0
C	Mate		21.17	0	0	0	0
B	Derrick Operator		23.51	0	0	0	0
B	Chief Welder		23.80	0	0	0	0
C	Dredge Welder	1	22.31	6,188	1,977	1,520	9,685
C	Welder Helper	1	17.69	4,907	1,568	1,441	7,916
D	Deckhand	6	17.04	28,356	9,060	8,070	45,486
C	Chief Engineer	1	24.69	6,848	2,188	1,560	10,596
B	Engineer	3	23.51	19,563	6,249	4,869	30,681
C	Maint. Engineer		22.67	0	0	0	0
C	Oiler	3	17.69	14,721	4,704	4,068	23,493
B	Electrician		22.82	0	0	0	0
C	Steward		22.39	0	0	0	0
D	Assistant Cook		17.14	0	0	0	0
D	Night Cook		17.14	0	0	0	0
D	Messman		16.66	0	0	0	0
D	Janitor or Porter		16.66	0	0	0	0
	Total Labor	19	$	107,188	34,247	27,969	169,404

Total Labor Cost per Month $ **169,404**

24" BOOSTER PUMP BARGE
MONTHLY OPERATING COST ESTIMATE
(Option 2 - Red Point Unloader)

SUMMARY:

Labor and Benefits		77,286
Travel and Subsistence		4,680
Commissary Losses		None
Fuel and Lube		56,016
Repair and Maintenance		6,000
Supplies and Consumables		12,000
Wear Costs		17,632
Marine Insurance		1,875
Total Monthly Operating Cost	$	**175,489**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	9	Man Months @	$520	=		4,680
Total Travel and Subsistence Cost per Month					$	**4,680**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
14 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	5,000	50%	2,500	426	63,900	47,925
Auxilliaries	200	60%	120	730	5,256	3,942
			2,620		69,156	51,867
Lubricants at 8 Percent of Fuel Costs						4,149
Total Fuel and Lube Cost per Month					$	**56,016**

REPAIR AND MAINTENANCE:

Diesel Parts		5,000
Miscellaneous		1,000
Total Cost per Month	$	**6,000**

SUPPLIES AND CONSUMABLES:

Wire and Rope		1,000
Welding		2,500
Deck		2,000
Engine Room		5,000
Miscellaneous		1,500
Total Cost per Month	$	**12,000**

24" BOOSTER PUMP BARGE
MONTHLY OPERATING COST ESTIMATE
(Option 2 - Red Point Unloader)

WEAR COSTS:

Material: Maintenance Material
456,000 CY per Month, Production Rate

Description	Quantity	Unit Rate $	Total Value $	Useful Life MCY	Cost per CY	Cost per Month
Pumpshell	1	50,000	50,000	3,000	0.0167	7,600
Impeller	1	12,000	12,000	1,500	0.0080	3,648
Liner (Set)	1	11,000	11,000	1,000	0.0110	5,016
Suct/Disch Pipe	1	30,000	30,000	10,000	0.0030	1,368
			103,000			

Total Wear Cost per Month $ **17,632**

MARINE INSURANCE:

$ 1,000,000 Equipment Value 1.50% Annual Percentage Rate / 8 Average Use Months per Year = **1,875**

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
B	Chief Mate		23.18	0	0	0	0
C	Mate		21.17	0	0	0	0
D	Deckhand	3	17.04	14,178	4,530	4,035	22,743
C	Chief Engineer	1	24.69	6,848	2,188	1,560	10,596
B	Engineer	2	23.51	13,042	4,166	3,246	20,454
C	Oiler	3	17.69	14,721	4,704	4,068	23,493
	Total Labor	9	$	48,789	15,588	12,909	77,286

Total Labor Cost per Month $ **77,286**

24" SHORE BOOSTER PUMP
MONTHLY OPERATING COST ESTIMATE
(Option 1 - Perryville Unloader)

SUMMARY:

Labor and Benefits		54,543
Travel and Subsistence		3,120
Commissary Losses		None
Fuel and Lube		51,759
Repair and Maintenance		6,000
Supplies and Consumables		4,000
Wear Costs		16,264
Marine Insurance		563
Total Monthly Operating Cost	$	**136,249**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	6	Man Months @	$520	=	3,120
Total Travel and Subsistence Cost per Month				$	**3,120**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
14 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	5,000	50%	2,500	426	63,900	47,925
			2,500		63,900	47,925
		Lubricants at 8 Percent of Fuel Costs				3,834
		Total Fuel and Lube Cost per Month			$	**51,759**

REPAIR AND MAINTENANCE:

Diesel Parts		5,000
Miscellaneous		1,000
Total Cost per Month	$	**6,000**

SUPPLIES AND CONSUMABLES:

Welding		2,500
Miscellaneous		1,500
Total Cost per Month	$	**4,000**

24" SHORE BOOSTER PUMP
MONTHLY OPERATING COST ESTIMATE
(Option 1 - Perryville Unloader)

WEAR COSTS:

Material: Maintenance Material
456,000 CY per Month, Production Rate

Description	Quantity	Unit Rate $	Total Value $	Useful Life MCY	Cost per CY	Cost per Month
Pumpshell	1	50,000	50,000	3,000	0.0167	7,600
Impeller	1	12,000	12,000	1,500	0.0080	3,648
Liner (Set)	1	11,000	11,000	1,000	0.0110	5,016
			73,000			

Total Wear Cost per Month $ **16,264**

MARINE INSURANCE:

$ 300,000 Equipment Value 1.50% Annual Percentage Rate
——————————————————————— = **563**
8 Average Use Months per Year

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Monthly Costs: Taxes and Liabilities	Monthly Costs: Welfare Pension Vacation	Monthly Costs: Totals
C	Chief Engineer	1	24.69	6,848	2,188	1,560	10,596
B	Engineer	2	23.51	13,042	4,166	3,246	20,454
C	Oiler	3	17.69	14,721	4,704	4,068	23,493
	Total Labor	6	$	34,611	11,058	8,874	54,543

Total Labor Cost per Month $ **54,543**

4500 HP TOWING TUG
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		98,863
Travel and Subsistence		5,720
Commissary Losses		None
Fuel and Lube		130,528
Repair and Maintenance		4,500
Supplies and Consumables		4,500
Wear Costs		None
Marine Insurance		5,625
Total Monthly Operating Cost	$	**249,736**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	11	Man Months @	$520	=		5,720
Total Travel and Subsistence Cost per Month					$	**5,720**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
22 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Propulsion	4,500	80%	3,600	669	144,504	115,603
Auxilliaries	300	50%	150	730	6,570	5,256
			3,750		151,074	120,859
Lubricants at 8 Percent of Fuel Costs						9,669
Total Fuel and Lube Cost per Month					$	**130,528**

REPAIR AND MAINTENANCE:

Diesel Parts		2,500
Propellers, Shafts and Bearings		1,000
Miscellaneous		1,000
Total Cost per Month	$	**4,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		2,000
Deck		500
Engine Room		1,000
Miscellaneous		1,000
Total Cost per Month	$	**4,500**

4500 HP TOWING TUG
MONTHLY OPERATING COST ESTIMATE

MARINE INSURANCE:

$ 3,000,000 Equipment Value   1.50% Annual Percentage Rate
-- = 5,625
8 Average Use Months per Year

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
B	Master	1	23.99	6,654	2,126	1,631	10,411
B	Captain	2	23.06	12,792	4,088	3,230	20,110
D	Deckhand	4	17.26	19,152	6,120	5,396	30,668
C	Chief Engineer	1	22.07	6,122	1,956	1,516	9,594
C	Engineer	2	21.63	12,000	3,834	3,016	18,850
D	Oiler		17.69	0	0	0	0
C	Steward	1	21.12	5,858	1,872	1,500	9,230
	Total Labor	11	$	62,578	19,996	16,289	98,863

Total Labor Cost per Month $ **98,863**

800 HP TENDER TUG
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		51,330
Travel and Subsistence		3,120
Commissary Losses		None
Fuel and Lube		11,970
Repair and Maintenance		1,700
Supplies and Consumables		1,100
Wear Costs		None
Marine Insurance		750
Total Monthly Operating Cost	$	**69,970**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	6	Man Months @	$520	=		3,120
Total Travel and Subsistence Cost per Month					$	**3,120**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
16 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Propulsion	800	50%	400	486	11,664	9,331
Auxilliaries	100	50%	50	730	2,190	1,752
			450		13,854	11,083
Lubricants at 8 Percent of Fuel Costs						887
Total Fuel and Lube Cost per Month					$	**11,970**

REPAIR AND MAINTENANCE:

Diesel Parts		600
Propellers, Shafts and Bearings		600
Miscellaneous		500
Total Cost per Month	$	**1,700**

SUPPLIES AND CONSUMABLES:

Wire and Rope	300
Deck	400
Engine Room	200
Miscellaneous	200
Total Cost per Month $	**1,100**

800 HP TENDER TUG
MONTHLY OPERATING COST ESTIMATE

MARINE INSURANCE:

$ 400,000 Equipment Value 1.50% Annual Percentage Rate
--- = 750
8 Average Use Months per Year

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
C	Master	1	22.39	6,210	1,984	1,521	9,715
C	Captain	2	21.32	11,828	3,780	3,006	18,614
D	Deckhand	3	17.26	14,364	4,590	4,047	23,001
	Total Labor	6	$	32,402	10,354	8,574	51,330

Total Labor Cost per Month $ **51,330**

SURVEY/CREWBOAT
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		51,330
Travel and Subsistence		3,120
Commissary Losses		None
Fuel and Lube		6,489
Repair and Maintenance		900
Supplies and Consumables		800
Wear Costs		None
Marine Insurance		281
Total Monthly Operating Cost	$	**62,920**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	6	Man Months @	$520	=	3,120
Total Travel and Subsistence Cost per Month				$	**3,120**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
16 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Propulsion	440	50%	220	486	6,415	5,132
Auxilliaries	50	50%	25	730	1,095	876
			245		7,510	6,008
Lubricants at 8 Percent of Fuel Costs						481
Total Fuel and Lube Cost per Month					$	**6,489**

REPAIR AND MAINTENANCE:

Diesel Parts		400
Propellers, Shafts and Bearings		300
Miscellaneous		200
Total Cost per Month	$	**900**

SUPPLIES AND CONSUMABLES:

Wire and Rope	100
Deck	200
Engine Room	200
Miscellaneous	300
Total Cost per Month $	**800**

SURVEY/CREWBOAT
MONTHLY OPERATING COST ESTIMATE

MARINE INSURANCE:

$ 150,000 Equipment Value	1.50% Annual Percentage Rate		=	281
8 Average Use Months per Year				

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Monthly Costs: Taxes and Liabilities	Monthly Costs: Welfare Pension Vacation	Monthly Costs: Totals
C	Master	1	22.39	6,210	1,984	1,521	9,715
C	Captain	2	21.32	11,828	3,780	3,006	18,614
D	Deckhand	3	17.26	14,364	4,590	4,047	23,001
	Total Labor	6	$	32,402	10,354	8,574	51,330

Total Labor Cost per Month $ **51,330**

6000 CY BOTTOM DUMP SCOW
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		7,578
Travel and Subsistence		520
Commissary Losses		None
Fuel and Lube		500
Repair and Maintenance		6,500
Supplies and Consumables		1,000
Wear Costs		None
Marine Insurance		7,313
Total Monthly Operating Cost	$	**23,411**

TRAVEL & SUBSISTENCE:

Hotel and Travel						
Subsistence	1	Man Months @	$520	=		520
Total Travel and Subsistence Cost per Month					$	**520**

FUEL & LUBE:

Total Fuel and Lube Cost per Month $ **500**

REPAIR AND MAINTENANCE:

Coamings, Doors and Seals		5,000
Diesel Parts		200
Winches/Hydraulics		1,000
Miscellaneous		300
Total Cost per Month	$	**6,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		500
Miscellaneous		500
Total Cost per Month	$	**1,000**

6000 CY BOTTOM DUMP SCOW
MONTHLY OPERATING COST ESTIMATE

MARINE INSURANCE:

$ 3,900,000 Equipment Value	1.50% Annual Percentage Rate	=	**7,313**
	8 Average Use Months per Year		

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
D	Scowman	1	17.03	4,724	1,509	1,345	7,578
	Total Labor	1	$	4,724	1,509	1,345	7,578
				Total Labor Cost per Month		$	**7,578**

25 TON DERRICK BARGE
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		25,639
Travel and Subsistence		1,560
Commissary Losses		None
Fuel and Lube		0
Repair and Maintenance		8,500
Supplies and Consumables		20,500
Wear Costs		None
Marine Insurance		281
Total Monthly Operating Cost	$	**56,480**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	3	Man Months @	$520	=		1,560
Total Travel and Subsistence Cost per Month					$	**1,560**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
0 Work Hours per Day. 30.4 Work Days per Month

Description	Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
Main Engines	1,000	50%	500	0	0	0
Auxilliaries	200	60%	120	0	0	0
			620		0	0
Lubricants at 8 Percent of Fuel Costs						0
Total Fuel and Lube Cost per Month					$	**0**

REPAIR AND MAINTENANCE:

Diesel Parts		5,000
Haul Gear, Shafting and Sheaves		2,500
Miscellaneous		1,000
Total Cost per Month	$	**8,500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		10,000
Welding		2,500
Deck		2,000
Engine Room		2,000
Civil Engineering		2,500
Miscellaneous		1,500
Total Cost per Month	$	**20,500**

25 TON DERRICK BARGE
MONTHLY OPERATING COST ESTIMATE

MARINE INSURANCE:

$ 150,000 Equipment Value 1.50% Annual Percentage Rate
---
8 Average Use Months per Year = 281

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Monthly Costs: Taxes and Liabilities	Monthly Costs: Welfare Pension Vacation	Monthly Costs: Totals
B	Derrick Operator	1	23.51	6,521	2,083	1,623	10,227
C	Mate		21.17	0	0	0	0
D	Deckhand	1	17.04	4,726	1,510	1,345	7,581
D	Oiler	1	17.69	4,907	1,568	1,356	7,831
	Total Labor	3	$	16,154	5,161	4,324	25,639

Total Labor Cost per Month $ **25,639**

140 X 40 FLEETING BARGE
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		None
Travel and Subsistence		None
Commissary Losses		None
Fuel and Lube		None
Repair and Maintenance		500
Supplies and Consumables		1,000
Wear Costs		None
Marine Insurance		469
Total Monthly Operating Cost	$	**1,969**

REPAIR AND MAINTENANCE:

Deck		200
Miscellaneous		300
Total Cost per Month	$	**500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		500
Miscellaneous		500
Total Cost per Month	$	**1,000**

MARINE INSURANCE:

$$\frac{\$\ 250{,}000 \text{ Equipment Value} \quad 1.50\% \text{ Annual Percentage Rate}}{8 \text{ Average Use Months per Year}} = \mathbf{469}$$

5000 BBL FUEL BARGE
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		None
Travel and Subsistence		None
Commissary Losses		None
Fuel and Lube		500
Repair and Maintenance		500
Supplies and Consumables		1,000
Wear Costs		None
Marine Insurance		563
Total Monthly Operating Cost	$	**2,563**

FUEL & LUBE:

Total Fuel and Lube Cost per Month	$	**500**

REPAIR AND MAINTENANCE:

Diesel Parts		200
Miscellaneous		300
Total Cost per Month	$	**500**

SUPPLIES AND CONSUMABLES:

Wire and Rope		500
Miscellaneous		500
Total Cost per Month	$	**1,000**

MARINE INSURANCE:

$ 300,000 Equipment Value 1.50% Annual Percentage Rate
—————————————————————— = **563**
8 Average Use Months per Year

SHORE CREW
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		144,323
Travel and Subsistence		8,320
Commissary Losses		None
Fuel and Lube		6,470
Repair and Maintenance		20,000
Supplies and Consumables		5,500
Miscellaneous Rentals		12,250
Total Monthly Operating Cost	$	**196,863**

TRAVEL & SUBSISTENCE:

Hotel and Travel Subsistence	16	Man Months @	$520	=	8,320
Total Travel and Subsistence Cost per Month				$	**8,320**

FUEL & LUBE:

0.06 Gal/HP Hour, Fuel Consumption Rate.
$0.80 per Gallon, Diesel Fuel Cost.
14 Work Hours per Day. 30.4 Work Days per Month

Number and Description		Rated Horse Power	Percent Used	Average HP Used	Monthly Operating Hours	Gals. Fuel per Month	Cost per Month
1	400A Welder	55	50%	28	426	703	527
1	D8 Bulldozer	200	75%	150	426	3,834	2,876
	Air Compressor			0	426	0	0
	4 CY Backhoe/Loader	200		0	426	0	0
	12 CY Dump Truck	750		0	426	0	0
	75T Crane	300		0	426	0	0
1	Pickup Truck	180	75%	135	426	3,451	2,588
				313		7,988	5,991
	Lubricants at 8 Percent of Fuel Costs						479
	Total Fuel and Lube Cost per Month					$	**6,470**

REPAIR AND MAINTENANCE:

Diesel Parts		5,000
Hydraulics		1,500
Tracks, Sprockets and Idlers		12,000
Haul Gear, Shafting and Sheaves		500
Miscellaneous		1,000
Total Cost per Month	$	**20,000**

SUPPLIES AND CONSUMABLES:

Wire and Rope		1,500
Welding		1,000
Machinery		1,000
Civil Engineering		1,000
Miscellaneous		1,000
Total Cost per Month	$	**5,500**

SHORE CREW
MONTHLY OPERATING COST ESTIMATE

MISCELLANEOUS RENTALS:

Description	Quantity	Unit	Unit Rate $ per Mo.	Cost per Month
Change Trailer	1	Each	250	250
Welder	1	Each	300	300
Bulldozer	1	Each	11,000	11,000
Air Compressor	0	Each		0
Backhoe/Loader	0	Each	6,000	0
Dump Truck	0	Each	3,000	0
Crane	0	Each	15,000	0
Pickup Truck	1	Each	700	700
Total Miscellaneous Rental Cost per Month				**12,250**

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

	Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
B	Fill Placer	1	23.18	6,430	2,054	1,617	10,101
B	Asst. Fill Placer	2	21.29	11,810	3,774	3,170	18,754
D	Shoreman	6	17.04	28,356	9,060	8,070	45,486
C	Welder	1	22.31	6,188	1,977	1,520	9,685
C	Welder Helper	1	17.69	4,907	1,568	1,441	7,916
A	Dozer Operator	3	26.68	22,200	7,092	5,031	34,323
A	Loader Operator		26.68	0	0	0	0
A	Crane Operator		26.68	0	0	0	0
C	Truck Driver		21.17	0	0	0	0
B	Mechanic	1	23.51	6,521	2,083	1,623	10,227
D	Oiler	1	17.69	4,907	1,568	1,356	7,831
	Total Labor	16	$	91,319	29,176	23,828	144,323

Total Labor Cost per Month $ **144,323**

SUPERVISION AND ENGINEERING
MONTHLY OPERATING COST ESTIMATE

SUMMARY:

Labor and Benefits		49,516
Travel and Subsistence		5,640
Commissary Losses		None
Fuel and Lube		1,200
Repair and Maintenance		600
Supplies and Consumables		2,000
Miscellaneous Rentals		13,400
Total Monthly Operating Cost	$	**72,356**

TRAVEL & SUBSISTENCE:

Hotel and Travel						2,000
Subsistence	7	Man Months @	$520	=		3,640
Total Travel and Subsistence Cost per Month					$	**5,640**

FUEL & LUBE:

Land Vehicles		1,000
Water Craft		200
Total Fuel and Lube Cost per Month	$	**1,200**

REPAIR AND MAINTENANCE:

Land Vehicles		500
Water Craft		100
Total Cost per Month	$	**600**

SUPPLIES AND CONSUMABLES:

Phones		750
Office Supplies		150
Civil Engineering		300
Miscellaneous		800
Total Cost per Month	$	**2,000**

SUPERVISION AND ENGINEERING
MONTHLY OPERATING COST ESTIMATE

MISCELLANEOUS RENTALS:

Description	Quantity	Unit	Unit Rate $ per Mo.	Cost per Month
Field Office	1	Each	500	500
Computers	1	Each	1,000	1,000
Pickup Truck	1	Each	800	800
Van	1	Each	600	600
4 Door Sedan	1	Each	600	600
Skiffs	1	Each	100	100
Outboards	1	Each	200	200
Fathometer	1	Each	2,000	2,000
Positioning System	1	Each	7,000	7,000
Portable Radios	6	Each	100	600
Total Miscellaneous Rental Cost per Month				**13,400**

LABOR AND BENEFITS:

64 Hours per Week, including Overtime Allowance

Classification and Description	No. of Men	Dollars per Hour	Monthly Costs: Wages	Taxes and Liabilities	Welfare Pension Vacation	Totals
Salaried Employees:						
Project Manager	1		5,200	1,661	364	7,225
Superintendent	1		4,600	1,470	322	6,392
Asst. Supt.			4,300	0	0	0
Office Manager			3,600	0	0	0
Civil Engineer	1		4,200	1,342	294	5,836
Total Salaried	3	$	21,900	4,473	980	19,453
Hourly Employees:						
D Clerk	1	12.00	3,329	1,064	1,260	5,653
C Party Chief		21.17	0	0	0	0
D Rodman	2	17.04	9,452	3,020	2,690	15,162
C Truck Driver	1	21.17	5,872	1,876	1,500	9,248
Total Hourly	4	$	18,653	5,960	5,450	30,063
Total Labor	7	$	40,553	10,433	6,430	49,516

Total Labor Cost per Month $ **49,516**

OWNERSHIP COSTS OF DREDGING SYSTEMS

These expenses represent the costs of owning and maintaining the equipment and include amortization of equipment (depreciation and interest on capital invested), major repairs, periodic dry docking, machinery overhauls, taxes, storage yard expense, "maintenance while idle", crew costs and insurance.

This cost estimate considers one basic type of dredging system, a clamshell dredge with attendant plant.

The ownership costs are based on utilization of certain sizes and configurations of plant for each of thes systems. Other sizes or types of plant might be used, but the system selected will yield a representative economic result.

The values shown for the equipment are present day purchase prices and represent current replacemen costs.

Note that the ownership costs are calculated as annual costs and pro-rated over the estimated operatin time per year, for the various pieces of equipment.

"Industry Market Factors" shown on the cost estimate summary sheets refer to an evaluation of the stat of the competition in the market place. This allows for a discretionary adjustment to be made to the computed ownership costs.

MONTHLY OWNERSHIP COST SUMMARY

	Number Required	Unit Cost/Mo	Total Cost/Mo
Option 1 - Perryville Unloader:			
21 CY Clamshell Dredge	1	176,079	176,079
24" Hydraulic Unloader	1	98,040	98,040
Shore Booster	1	9,603	9,603
4500 HP Towing Tug	3	75,547	226,641
800 HP Tender Tug	2	12,248	24,496
Survey/Crewboat	1	8,252	8,252
6000 CY Dump Scow	4	87,012	348,048
Derrick Barge	1	5,989	5,989
Fleeting Barge	2	7,503	15,006
Fuel Barge	1	9,780	9,780
		Total $	**921,934**
Option 2 - Red Point Unloader:			
21 CY Clamshell Dredge	1	176,079	176,079
24" Hydraulic Unloader	1	98,040	98,040
Booster Pump Barge	1	26,885	26,885
4500 HP Towing Tug	2	75,547	151,094
800 HP Tender Tug	2	12,248	24,496
Survey/Crewboat	1	8,252	8,252
6000 CY Dump Scow	3	87,012	261,036
Derrick Barge	1	5,989	5,989
Fleeting Barge	2	7,503	15,006
Fuel Barge	1	9,780	9,780
		Total $	**776,657**

21 CY CLAMSHELL DREDGE
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	848,634
Periodic Drydocking & Painting		80,000
Machinery Overhaul		60,000
Maintenance While Idle		60,000
Yard and Plant in Yard		40,000
Taxes, Storage and Insurance		320,000
Annual Ownership Cost	$	**1,408,634**

8 Average Use Months per Year.

Total Monthly Ownership Cost $ **176,079**

AMORTIZATION:

$ 8,000,000	Total equipment value.		
10.00%	Annual percentage rate.		
30	Year life span.		
	Total Annual Amortization Cost	$	848,634

PERIODIC DRYDOCKING & PAINTING:

$ 160,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Drydocking & Painting Cost	$	80,000

MACHINERY OVERHAUL:

$ 120,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Machinery Overhaul Cost	$	60,000

MAINTENANCE WHILE IDLE:

$ 3,000	Cost per man per month.		
5	Men required.		
4	Idle months per year.		
	Total Annual Maintenance While Idle Cost	$	60,000

TAXES STORAGE AND INSURANCE:

$ 8,000,000	Total equipment value.		
4.00%	Annual percentage rate		
	Total Annual Taxes, Storage & Insur. Cost	$	320,000

24" HYDRAULIC UNLOADER
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	424,317
Periodic Drydocking & Painting		60,000
Machinery Overhaul		40,000
Maintenance While Idle		60,000
Yard and Plant in Yard		40,000
Taxes, Storage and Insurance		160,000
Annual Ownership Cost	$	**784,317**

8	Average Use Months per Year.		
	Total Monthly Ownership Cost	$	**98,040**

AMORTIZATION:

$	4,000,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	30	Year life span.		
		Total Annual Amortization Cost	$	424,317

PERIODIC DRYDOCKING & PAINTING:

$	120,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	60,000

MACHINERY OVERHAUL:

$	80,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	40,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	5	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	60,000

TAXES STORAGE AND INSURANCE:

$	4,000,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	160,000

24" BOOSTER PUMP BARGE
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	106,079
Periodic Drydocking & Painting		25,000
Machinery Overhaul		20,000
Maintenance While Idle		12,000
Yard and Plant in Yard		12,000
Taxes, Storage and Insurance		40,000
Annual Ownership Cost	$	**215,079**
8 Average Use Months per Year.		
Total Monthly Ownership Cost	$	**26,885**

AMORTIZATION:

$ 1,000,000	Total equipment value.		
10.00%	Annual percentage rate.		
30	Year life span.		
	Total Annual Amortization Cost	$	106,079

PERIODIC DRYDOCKING & PAINTING:

$ 50,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Drydocking & Painting Cost	$	25,000

MACHINERY OVERHAUL:

$ 40,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Machinery Overhaul Cost	$	20,000

MAINTENANCE WHILE IDLE:

$ 3,000	Cost per man per month.		
1	Men required.		
4	Idle months per year.		
	Total Annual Maintenance While Idle Cost	$	12,000

TAXES STORAGE AND INSURANCE:

$ 1,000,000	Total equipment value.		
4.00%	Annual percentage rate		
	Total Annual Taxes, Storage & Insur. Cost	$	40,000

24" SHORE BOOSTER PUMP
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	31,824
Periodic Drydocking & Painting		0
Machinery Overhaul		25,000
Maintenance While Idle		0
Yard and Plant in Yard		8,000
Taxes, Storage and Insurance		12,000
Annual Ownership Cost	$	**76,824**

8 Average Use Months per Year.

Total Monthly Ownership Cost $ **9,603**

AMORTIZATION:

$	300,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	30	Year life span.		
		Total Annual Amortization Cost	$	31,824

PERIODIC DRYDOCKING & PAINTING:

$	0	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	0

MACHINERY OVERHAUL:

$	50,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	25,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	0	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	0

TAXES STORAGE AND INSURANCE:

$	300,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	12,000

4500 HP TOWING TUG
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	352,379
Periodic Drydocking & Painting		40,000
Machinery Overhaul		70,000
Maintenance While Idle		12,000
Yard and Plant in Yard		10,000
Taxes, Storage and Insurance		120,000
Annual Ownership Cost	$	**604,379**
8 Average Use Months per Year.		
Total Monthly Ownership Cost	$	**75,547**

AMORTIZATION:

$ 3,000,000	Total equipment value.		
10.00%	Annual percentage rate.		
20	Year life span.		
	Total Annual Amortization Cost	$	352,379

PERIODIC DRYDOCKING & PAINTING:

$ 40,000	Cost per occurrence.		
1	Year frequency.		
	Total Annual Drydocking & Painting Cost	$	40,000

MACHINERY OVERHAUL:

$ 70,000	Cost per occurrence.		
1	Year frequency.		
	Total Annual Machinery Overhaul Cost	$	70,000

MAINTENANCE WHILE IDLE:

$ 3,000	Cost per man per month.		
1	Men required.		
4	Idle months per year.		
	Total Annual Maintenance While Idle Cost	$	12,000

TAXES STORAGE AND INSURANCE:

$ 3,000,000	Total equipment value.		
4.00%	Annual percentage rate		
	Total Annual Taxes, Storage & Insur. Cost	$	120,000

800 HP TENDER TUG
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	46,984
Periodic Drydocking & Painting		10,000
Machinery Overhaul		10,000
Maintenance While Idle		12,000
Yard and Plant in Yard		3,000
Taxes, Storage and Insurance		16,000
Annual Ownership Cost	$	**97,984**

8 Average Use Months per Year.

Total Monthly Ownership Cost $ **12,248**

AMORTIZATION:

$ 400,000	Total equipment value.		
10.00%	Annual percentage rate.		
20	Year life span.		
	Total Annual Amortization Cost	$	46,984

PERIODIC DRYDOCKING & PAINTING:

$ 20,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Drydocking & Painting Cost	$	10,000

MACHINERY OVERHAUL:

$ 20,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Machinery Overhaul Cost	$	10,000

MAINTENANCE WHILE IDLE:

$ 3,000	Cost per man per month.		
1	Men required.		
4	Idle months per year.		
	Total Annual Maintenance While Idle Cost	$	12,000

TAXES STORAGE AND INSURANCE:

$ 400,000	Total equipment value.		
4.00%	Annual percentage rate		
	Total Annual Taxes, Storage & Insur. Cost	$	16,000

SURVEY/CREWBOAT
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	22,014
Periodic Drydocking & Painting		10,000
Machinery Overhaul		12,000
Maintenance While Idle		12,000
Yard and Plant in Yard		4,000
Taxes, Storage and Insurance		6,000
Annual Ownership Cost	$	**66,014**
8 Average Use Months per Year.		
Total Monthly Ownership Cost	$	**8,252**

AMORTIZATION:

$	150,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	12	Year life span.		
		Total Annual Amortization Cost	$	22,014

PERIODIC DRYDOCKING & PAINTING:

$	10,000	Cost per occurrence.		
	1	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	10,000

MACHINERY OVERHAUL:

$	12,000	Cost per occurrence.		
	1	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	12,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	1	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	12,000

TAXES STORAGE AND INSURANCE:

$	150,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	6,000

6000 CY DUMP SCOW
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	458,093
Periodic Drydocking & Painting		35,000
Machinery Overhaul		7,000
Maintenance While Idle		0
Yard and Plant in Yard		40,000
Taxes, Storage and Insurance		156,000
Annual Ownership Cost	$	**696,093**
8 Average Use Months per Year.		
Total Monthly Ownership Cost	$	**87,012**

AMORTIZATION:

$	3,900,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	20	Year life span.		
		Total Annual Amortization Cost	$	458,093

PERIODIC DRYDOCKING & PAINTING:

$	70,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	35,000

MACHINERY OVERHAUL:

$	7,000	Cost per occurrence.		
	1	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	7,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	0	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	0

TAXES STORAGE AND INSURANCE:

$	3,900,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	156,000

25 TON DERRICK BARGE
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	15,912
Periodic Drydocking & Painting		10,000
Machinery Overhaul		10,000
Maintenance While Idle		0
Yard and Plant in Yard		6,000
Taxes, Storage and Insurance		6,000
Annual Ownership Cost	$	**47,912**

8	Average Use Months per Year.		
	Total Monthly Ownership Cost	$	**5,989**

AMORTIZATION:

$	150,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	30	Year life span.		
		Total Annual Amortization Cost	$	15,912

PERIODIC DRYDOCKING & PAINTING:

$	20,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	10,000

MACHINERY OVERHAUL:

$	20,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	10,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	0	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	0

TAXES STORAGE AND INSURANCE:

$	150,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	6,000

140 X 40 FLEETING BARGE
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	26,520
Periodic Drydocking & Painting		12,500
Machinery Overhaul		10,000
Maintenance While Idle		0
Yard and Plant in Yard		1,000
Taxes, Storage and Insurance		10,000
Annual Ownership Cost	$	**60,020**

8 Average Use Months per Year.

Total Monthly Ownership Cost	$	**7,503**

AMORTIZATION:

$ 250,000	Total equipment value.		
10.00%	Annual percentage rate.		
30	Year life span.		
	Total Annual Amortization Cost	$	26,520

PERIODIC DRYDOCKING & PAINTING:

$ 25,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Drydocking & Painting Cost	$	12,500

MACHINERY OVERHAUL:

$ 20,000	Cost per occurrence.		
2	Year frequency.		
	Total Annual Machinery Overhaul Cost	$	10,000

MAINTENANCE WHILE IDLE:

$ 3,000	Cost per man per month.		
0	Men required.		
4	Idle months per year.		
	Total Annual Maintenance While Idle Cost	$	0

TAXES STORAGE AND INSURANCE:

$ 250,000	Total equipment value.		
4.00%	Annual percentage rate		
	Total Annual Taxes, Storage & Insur. Cost	$	10,000

5000 BBL FUEL BARGE
MONTHLY OWNERSHIP COST ESTIMATE

SUMMARY:

Amortization	$	35,238
Periodic Drydocking & Painting		20,000
Machinery Overhaul		6,000
Maintenance While Idle		0
Yard and Plant in Yard		5,000
Taxes, Storage and Insurance		12,000
Annual Ownership Cost	$	**78,238**
8 Average Use Months per Year.		
Total Monthly Ownership Cost	$	**9,780**

AMORTIZATION:

$	300,000	Total equipment value.		
	10.00%	Annual percentage rate.		
	20	Year life span.		
		Total Annual Amortization Cost	$	35,238

PERIODIC DRYDOCKING & PAINTING:

$	40,000	Cost per occurrence.		
	2	Year frequency.		
		Total Annual Drydocking & Painting Cost	$	20,000

MACHINERY OVERHAUL:

$	6,000	Cost per occurrence.		
	1	Year frequency.		
		Total Annual Machinery Overhaul Cost	$	6,000

MAINTENANCE WHILE IDLE:

$	3,000	Cost per man per month.		
	0	Men required.		
	4	Idle months per year.		
		Total Annual Maintenance While Idle Cost	$	0

TAXES STORAGE AND INSURANCE:

$	300,000	Total equipment value.		
	4.00%	Annual percentage rate		
		Total Annual Taxes, Storage & Insur. Cost	$	12,000

PRODUCTION CALCULATIONS

PROJECT DESCRIPTION

This conceptual cost estimate for maintenance dredging of the C&D Canal channel reaches is based on the use of Clamshell dredging with 6000 cy scows and hydraulic unloaders for placement at the Furnace Bay placement site.

The materials to be dredged consist mainly of soft mud (maintenance material).

The production rates were estimated on the basis of the operating characteristics of existing equipment similar to that selected.

CLAMSHELL DREDGE WITH SCOWS

The production rate of the clamshell dredge was determined by considering the excavating and loading characteristics of the material, the depth of bank, the haul distance to the disposal site, the capacity of the scows, the speed of the tow in making the round trip to the unloader, the pumping capabilities of the unloader and environmental conditions.

SUMMARY OF PRODUCTION CALCULATIONS

	Production CY/Hour	Production CY/Day	Production CY/Mo.
21 CY Clamshell Dredge	939	15,000	456,000
Option 1 - Perryville Unloader	1,183	16,600	504,640
Option 2 - Red Point Unloader	1,090	15,300	465,120

OPERATING HOURS AND DAYS

For the following selected dredging methods, the average operating hours and days are estimated to be:

Clamshell Dedge - Production Cut	16	Hrs/Day
Hydraulic Unloader & Boosters	14	Hrs/Day
Towing Tug	22	Hrs/Day
Working days per week	7	Days/Week
Working days per month at 4.34 weeks per month	30.4	Days/Month

HAUL DISTANCES TO UNLOADER SITES FROM C&D CANAL

Option 1 - Perryville Unloader	20.0	N. Miles
Option 2 - Red Point Unloader	17.0	N. Miles

PIPELINE LENGTHS

	Floating Line (Ft.)	Submerged Line (Ft.)	Shore Line (Ft.)	Total Line (Ft.)	No. of Boosters
Option 1 - Perryville Unloader	500	500	20,300	21,300	1
Option 2 - Red Point Unloader	500	24,000	500	25,000	1

TUG AND SCOW REQUIREMENTS

	Haul Dist. (N. Miles)	Size Scows	Type of Tow	No. of Scows	No. of Tugs
Option 1 - Perryville Unloader	20.0	6000	Single	4	3
Option 2 - Red Point Unloader	17.0	6000	Single	3	2

SCOW UTILIZATION

	Option 1 - Perryville		Option 2 - Red Port	
	Hours	Percent	Hours	Percent
Load Scow	2.91	25.4%	2.91	27.1%
Transport Scow	6.35	55.4%	5.45	50.7%
Unload Scow	2.20	19.2%	2.39	22.2%
Totals	11.46	100.0%	10.75	100.0%

MATERIAL QUANTITIES

Option 1 and 2 - C&D Canal 400,000 Cubic Yards

TIME REQUIRED - 21 CY CLAMSHELL DREDGE

	CY to Dredge	CY per Day	Dredge Days	Dredge Months
Option 1 - Perryville Unloader	400,000	15,000	26.7	0.88
Option 2 - Red Point Unloader	400,000	15,000	26.7	0.88

CLAMSHELL DREDGE - PRODUCTION CALCULATIONS
(Production Cut)

Project:	Conceptual Study for MPA
Dredge Site:	C&D Canal
Disposal Site:	Furnace Bay
Materials:	Maintenance Material
Bank:	Production Cut, average depth = 5 feet or greater.

Production Factors :

21	CY, Bucket Size	60	Degrees, Swing Angle
50	Ft, Average Digging Depth	2	Rpm, Swing Speed
10	Ft, Average Scow Freeboard	85	Percent, Full Bucket
60	Ft, Lifting Distance	50	Working Minutes per Hour
200	Ft/Min, Hoisting Speed		

Cycle Time :

	Seconds	
Load Bucket	8	
Lift Load	18	
Swing Load	5	
Dump Load	2	
Return Swing	5	
Lower Bucket	9	
Lost Time (accelerating, positioning, stepping ahead)	10	
Total Cycle Time	57	sec/load

Cycles per Hour :

$$\frac{50 \text{ Working Min/Hr} \times 60 \text{ Sec/Min}}{57 \text{ Sec/Load (Cycle Time)}} = 52.6 \text{ cycles/hr}$$

Volume per Hour :

Bucket Size x Percent Full x Cycles/Hr = 939 cy/hr

Lost Time :

Weather, greasing, mechanical repairs, shifting scows, changing wires, etc. 8 hours

Average Daily Operating Time:

24 Hours - 8 Lost Time (Hrs) = 16 hours

Average Daily Production:

16 Hrs/Day x 939 CY per Hour = 15,024 cy/day

USE **15,000** cy/day

TUG AND DUMP SCOW REQUIREMENTS
(Option 1 - Perryville Unloade)

Project:	Conceptual Study for MPA
Dredge Site:	C&D Canal
Disposal Site:	Furnace Bay
Materials:	Maintenance Material

Production Factors:

939	CY/Hr, Clamshell Digging Rate	20.0	Naut. Miles, Minimum Haul
6,000	CY, Nominal Scow Capacity	20.0	Naut. Miles, Maximum Haul
2,600	CY, Effective Scow Capacity	20.0	Naut. Miles, Average Haul
95.0%	Clamshell Retention Ratio	5.0	Knots, Sailing Speed Full
22	Tug Operating Hours per Day	10.0	Knots, Sailing Speed Empty

Loading Rate:

939 CY/Hour x 95.0% Retention = 892 cy/hr

Scow Loading Time:

2,600 Cubic Yards per Load
-- = 2.91 hrs/load
892 CY/Hr x 1 Dredge

Scows Loaded per Day:

16.0 Dredge Operating Hours per Day
-- = 5.5 loads/day
2.91 Hours per Load

Scow Transport Time:

	Hours
Haul Time to Disposal	4.00
Pump Out Scow	2.20
Sailing Time to Cut	2.00
Repositioning & Maneuvering	0.35
Total Transport Time	8.55 hrs/load

Total Towing Hours Required per Day:

5.5 Scows at 8.55 Hours, Transport Time/Scow = 47.00 tow hours

Tugs and Scows in Tow:

47.00 Total Towing Hours per Day
-- = 2.1 no. scows and no. tugs
22 Tug Operating Hours per Day

Scows Required to Utilize Dredge Capacity:

Scows in Tow	3 in Tow
Scows being loaded	1
Scows being unloaded	0
Spare	0
Total Scows Required	**4**

Tugs Required at 1 per Scow in Tow **3**

TUG AND DUMP SCOW REQUIREMENTS
(Option 2 - Red Point Unloader)

Project:	Conceptual Study for MPA
Dredge Site:	C&D Canal
Disposal Site:	Furnace Bay
Materials:	Maintenance Material

Production Factors:

939	CY/Hr, Clamshell Digging Rate	17.0	Naut. Miles, Minimum Haul
6,000	CY, Nominal Scow Capacity	17.0	Naut. Miles, Maximum Haul
2,600	CY, Effective Scow Capacity	17.0	Naut. Miles, Average Haul
95.0%	Clamshell Retention Ratio	5.0	Knots, Sailing Speed Full
22	Tug Operating Hours per Day	10.0	Knots, Sailing Speed Empty

Loading Rate:

939 CY/Hour x 95.0% Retention = 892 cy/hr

Scow Loading Time:

2,600 Cubic Yards per Load
-- = 2.91 hrs/load
892 CY/Hr x 1 Dredge

Scows Loaded per Day:

16.0 Dredge Operating Hours per Day
-- = 5.5 loads/day
2.91 Hours per Load

Scow Transport Time:

	Hours	
Haul Time to Disposal	3.40	
Pump Out Scow	2.39	
Sailing Time to Cut	1.70	
Repositioning & Maneuvering	0.35	
Total Transport Time	7.84	hrs/load

Total Towing Hours Required per Day:

5.5 Scows at 7.84 Hours, Transport Time/Scow = 43.00 tow hours

Tugs and Scows in Tow:

43.00 Total Towing Hours per Day
-- = 2.0 no. scows and no. tugs
22 Tug Operating Hours per Day

Scows Required to Utilize Dredge Capacity:

Scows in Tow	2	in Tow
Scows being loaded	1	
Scows being unloaded	0	
Spare	0	
Total Scows Required	**3**	

Tugs Required at 1 per Scow in Tow **2**

HYDRAULIC UNLOADER - PRODUCTION CALCULATIONS

(Option 1 - Perryville Unloader at Furnace Bay)

Project:	Conceptual Study for MPA
Dredge Site:	C&D Canal
Disposal Site:	Option 1 - Perryville Unloader at Furnace Bay
Materials:	Maintenance Material

Production Factors:

3,000	Horsepower, 24" Unloader	3,000	Horsepower, 24" Booster
1,183	CY/Hr, Average Pumping Rate	1	No. of Boosters
21,300	Feet, Avg. Length of Pipeline	20	% Solids by Volume
14.00	Hrs, Avg. Daily Operating Time	20	Ft., Average Water Depth
6,000	CY, Nom. Scow Capacity	24	Inch, Pipeline Diameter
		45	Ft., Total System Lift

Cubic Yards per Scow Load (Bin Measure):

43 Percent x Bin Capicity = 2,600 cy/load

Scow Unloading Time:

2,600 CY (Bin Measure) per Load / 1,183 Cy/Hr Pumping Rate = 2.20 hrs/load

Scows per Day:

14.00 Hours per Day / 2.20 Hours per Load = 6.4 loads/day

Effective CY/Day Pump Out Capacity (Bin Measure):

CY per Hour x Average Hours per Day = 16,600 cy/day

Clear pipeline at end of day 1 hrs/day

HYDRAULIC UNLOADER - PRODUCTION CALCULATIONS
(Option 2 - Red Point Unloader at Furnace Bay)

Project:	Conceptual Study for MPA
Dredge Site:	C&D Canal
Disposal Site:	Option 2 - Red Point Unloader at Furnace Bay
Materials:	Maintenance Material

Production Factors:

3,000	Horsepower, 24" Unloader	3,000	Horsepower, 24" Booster
1,090	CY/Hr, Average Pumping Rate	1	No. of Boosters
25,000	Feet, Avg. Length of Pipeline	20	% Solids by Volume
14.00	Hrs, Avg. Daily Operating Time	16	Ft., Average Water Depth
6,000	CY, Nom. Scow Capacity	24	Inch, Pipeline Diameter
		45	Ft., Total System Lift

Cubic Yards per Scow Load (Bin Measure):

43 Percent x Bin Capicity = 2,600 cy/load

Scow Unloading Time:

2,600 CY (Bin Measure) per Load
-- = 2.39 hrs/load
1,090 Cy/Hr Pumping Rate

Scows per Day:

14.00 Hours per Day
-- = 5.9 loads/day
2.39 Hours per Load

Effective CY/Day Pump Out Capacity (Bin Measure):

CY per Hour x Average Hours per Day = 15,300 cy/day

Clear pipeline at end of day 1 hrs/day

TOWING & UNLOADING TIME REQUIRED TO HANDLE CLAMSHELL PRODUCTION

Based on the Clamshell Dredge production, the number of tugs and the haul distances shown, the number of hours required for the tugs and the unloader to work in order to maintain parity with the dredge production are shown below.

$$\text{Required Hours per Tug} = \frac{\text{Scows Loaded/Day} \times \text{R/T Towing Hours/Scow}}{\text{Number of Tugs}}$$

$$\text{Required Unloader Hours} = \text{Scows Loaded/Day} \times \text{Unloading Hours/Scow}$$

	Scows Loaded per Day	Number of Tugs	R/T Tow (Hours)	Unloading Hours per Scow	Required Hours per Day	
					Ea. Tug	Unloader
Option 1 - Perryville Unloader	5.5	3	8.6	2.20	15.7	12.1
Option 2 - Red Point Unloader	5.5	2	7.8	2.39	21.6	13.1

Note: Towing time includes standby time at unloader.

Dredge Controls, Unloaders must work 12.1 to 13.1 hours per day to maintain parity with the dredge. Say 1

Appendix B

Geotechnical Report For: Stancill Sand And Gravel Quarry, Cecil County, Maryland
E2CR, Inc., November 6, 2000

ENGINEERING · CONSTRUCTION · CONSULTING · REMEDIATION

GEOTECHNICAL REPORT

FOR:

STANCILL SAND AND GRAVEL QUARRY

CECIL COUNTY, MARYLAND

PREPARED FOR:

MARYLAND ENVIRONMENTAL SERVICES

2011 COMMERCE PARK DRIVE

ANNAPOLIS, MD 21401

BY:

E2CR, INC.

9004 YELLOW BRICK ROAD, SUITE-E

BALTIMORE, MARYLAND 21237

PHONE: 410-574-4393

FAX: 410-574-7970

NOVEMBER 6, 2000

ENGINEERING • CONSULTATION •
E2CR inc.
CONSTRUCTION • REMEDIATION •

9004 Yellow Brick Road, Suite E
Baltimore, Maryland 21237
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Fax: 410-574-7970
e-mail: e2cr@erols.com

November 6, 2000

Mr. Larry Walsh
Maryland Environmental Services
2011 Commerce Park Drive
Annapolis, Maryland 21401-5995

Re: Subsurface Investigation
Stancill Sand and Gravel Quarry
Cecil County, Maryland
E2CR Project No.: 00546-04

Dear Mr. Walsh:

In general accordance with our proposal dated August 18, 2000, your purchase order dated September 20, 2000 and your verbal authorization, we have completed the subsurface investigation at the above referenced site. This report presents the results of our findings.

The site (Stancill Sand and Gravel Quarry) is located in Cecil County, Maryland. It is bounded by Mountain Hill Road to the east, Principio Creek to the west and Furnace Bay to the southwest, as shown on figure 1 – Site Vicinity Map. The Stancill sand and gravel quarry is an active quarry and is still being mined for sand, gravel and clay. The ground elevation at the site varies considerably from about El.100 (at the east end of the site) to below El. 0 in some areas in the center of the quarry.

It is proposed to fill the quarry with material dredged from Baltimore Harbor and related channels. The final use of the filled quarry is not known. The material to be placed in the quarry could possibly be somewhat contaminated, but not hazardous. There is concern about the pollutants in the dredged material leaving the site and polluting/contaminating the adjacent streams and/or the water table.

Several options for filling the quarry are being considered. These include:

i) Filling the quarry without further mining.

ii) Excavating the sand and gravel to the underlying Clay, and then filing the quarry.

iii) Excavating the Sand and Gravel and the underlying Clay, and then filling the quarry.

The fill could extend to El. 45± or to El. 90+. The latter option would require building a containment dike, about 45-ft. high, on the western side. The dike could be higher, depending on the final alignment of the dike.

We have been informed that there was a "blow out" of a dike on the west side several years ago. This was apparently caused by rodents digging holes in the dike.

The purpose of this preliminary investigation was to evaluate the subsurface conditions at the site and to evaluate on a preliminary basis, whether or not the pollutants in the dredged material could leave the site. The scope of our services included reviewing the available borings; drilling 6 additional borings ranging in depth from 37-ft. to 85-ft.: installing temporary 2-inch monitoring wells to determine the water table; performing laboratory tests; evaluating the data and preparing a geotechnical report of our findings.

The field investigation was conducted in September – October 2000. A total of six borings (E-1 through E-6) were drilled at the locations shown on Fig.-2 – Test Boring Location Plan. The borings were drilled using a truck mounted drill rig. The holes were advanced using hollow stem augers. Standard penetration tests were conducted and split spoon samples were obtained in every boring at depth intervals of 2.5-ft to 5-ft. Representative portion of each sample was placed in a glass jar and was appropriately marked. Undisturbed 3-inch diameter Shelby tube samples were obtained in the cohesive soils in borings E-1A, E-2A and E-4A. To obtain the shelby tube samples, the borings were offset about 5-ft., and were re-drilled with hollow stem augers to the desired depth. The shelby tubes were carefully sealed and marked. All of the samples were sent to our laboratory for further testing and analysis. The depths of the borings were as follows.

Boring (Feet)	Depth
E-1	37
E-1A	19
E-2	50
E-2A	15.5
E-3	50
E-4	50
E-4A	37.5
E-5	85
E-6	40

Boring E-1 encountered auger refusal at a depth of 37 feet indicating the presence of rock. Rock was not cored in any of the borings. The edited logs of the borings are included in the Appendix.

All samples were visually classified in the laboratory by a geologist to corroborate and/or modify the field classifications. Selected samples were tested for their natural water content, percent fines, grain size distribution, Atterberg Limits and permeabilities. The results of the laboratory tests are included in the Appendix.

Regional geological maps indicate that the site is located in the Atlantic Coastal Plain Physiographic Province. The mined surficial soils at the site are composed of varicolored silts and clays, and cross bedded sands and gravels of the Raritan and Patapsco Formations of Cretaceous age, as well as those of the more recently formed Lowland Deposits of Quaternary age. Directly underlying these Coastal Plain deposits is a saprolite residual material derived from weathering of the rocks of the Port Deposit Gneiss, of Paleozoic age. At this location these rocks have completely weathered into sandy silt and clay, typical of a residual saprolite.

The borings and the geologic data indicate that the subsurface conditions at the site are highly variable. In general, the site is capped by the Coastal Plain Deposits that lie over the residual soils and the parent rock. The depth to the top of the rock varies from about 40-ft. to about 100-ft. The subsurface conditions at the site are highly variable and generally consist of the following major strata:

Stratum I: Brown Silty Sand and Gravel: This stratum extends from the surface to about El.–10. Standard penetration varies from about 3 blows/ft. to 45 blows/ft. The soils generally consist of light brown and red Silty Sand and Gravel with pockets of Silty Clay. The fines content varies from about 10% to about 40%.

Stratum 1A: Fill: Boring E-5 indicated the presence of fill, which is composed of brown Silty Sand, with pockets of Silty Clay and pieces of wood. The fill extends to about El.-10 (depth of 40-ft.). Standard penetration varies from about 15 to 45 blows/ft. The fill was not encountered in any other boring.

Stratum II: White-tan Clayey Silt and Silty Sand: This stratum underlies Stratum I, except in borings E-5 and E-6. Its thickness varies from about 7-ft. (in boring E-2) to about 20 feet (in boring E-1). Standard penetration resistance varies from about 6 blows/ft. to over 100 blows/ft. and is generally in excess of 40 blow/ft. Laboratory data indicates that the liquid limit is about 37, the Plasticity Index in about 7 and the permeability is 5.6 x 10^{-6} cm/sec.

Stratum III: White-brown-orange Clayey Silt: The stratum underlies Stratum II, except in borings E-1, E-5 and E-6. It generally consists of white, brown, orange Clayey Silt to Sandy Silt. Its thickness varies from 0-ft. to about 30-ft. Standard penetration varies from about 11 blows/ft. to over 100 blows/ft., and is generally in excess of 30 blows/ft. Laboratory data indicates that the liquid limit is about 37, Plasticity Index is about 14, and the permeability is about 1 x 10^{-6} cm/sec. The soils in this stratum are of residual origin.

Stratum IV: Red-green-brown Clayey Silt/Silty Clay: This stratum underlies Stratum III, and consists of red, brown, olive-green, blue-green Clayey Silt to Silty/Sandy Clay. The soils are residual in origin, and the relict structure was visible in the samples. Standard penetration resistance varies from about 26 blows/ft. to over 100 blows/ft. The liquid limit is about 70, and the plasticity index is about 47. Its thickness varies from about 5-ft. to more than 20-ft.. It is underlain by rock.

Stratum V: Dark brown organic Silt: This stratum was encountered only in borings E-5 and E-6. Its thickness varies from about 5-ft. in E-5 to more than 20-ft. in E-6. Standard penetration resistance is about 4 to 5 blows/ft. The stratum appears to be thicker towards the west and south.

Groundwater level at the site appears to slope down towards Furnace Bay and Principio Creek on the south and west sides. The groundwater was encountered at depths ranging from about 2-ft. to about 29-ft. The groundwater elevation varied from El. –1.6 to El. 16. In the bottom area of the quarry, the water table is at about El. 0 to El. +5. The groundwater data is summarized below.

Boring	Water Table	
(Depth-Ft.)	(Feet)	(Elevation)
E-1	2.2	El. + 4.5
E-2	1.7	El. + 16.2
E-3	2.6	El. + 10.4
E-4	8.5	El. + 3.7
E-5	28.9	El. + 3.2
E-6	8.3	El. - 1.6

Generalized subsurface profiles are shown in Fig.-3, 4 and 5.

Currently, the soils at the bottom of the quarry pits are Silty Sands and Gravels. Their permeability is anticipated to vary from about 10^{-2} cm/sec. in Gravel to 10^{-5} cm/sec. in Silty Sands. The groundwater is only about 2-ft. below the surface in the quarry pits. If the dredged material is placed in the pits, the pollutants could leach out and travel through the Silty Sand and Gravel to the water table, which is only 2-ft. below the surface. Additionally, water could also seep out through the walls of the pits, at least initially.

If the pit is filled after the Sand and Gravel layer has been mined out, then the soils at the bottom of the pit will be a Clayey Silt / Sandy Silt. This could serve as a hydraulic barrier and minimize the seepage out of the quarry. However, some seepage could still occur through the Sand and Gravel in the walls of the pit.

It should be noted that there is some organic Silt/peat in the southwest/west portion of the site. If a dike is to be built in this area, the peat could have an influence on the design of the dike.

The method of filling the quarry will have a major impact on the final use, short term and long term settlements, and volume and quality of leachate generated. If the quarry is filled by hydraulic methods (i.e. unloading the barges using hydraulic dredging and transporting the soil as a slurry), the resultant fill will be extremely soft and wet. Settlements of several feet, over a very long period of time (especially if a liner or cut-off walls are used) should be anticipated. A large volume of mixing water will need to be handled, and a large area will be required to decant the mixing water.

If the barges are unloaded mechanically, then the material will not be as soft, and relatively little quantity of water will have to be handled. However, the soil will still be too wet for conventional construction and earth moving equipment to traverse the area. Long term settlements will also be quite large.

If the filled quarry will be capped, the cap should be expected to settle many inches. If structures are planned to be constructed on the fill, the structures should be expected to settle many inches, or they will need to be founded on deep foundations.

Final Site development will probably require some underground utilities. These utilities should also be expected to settle several inches.

Based on the limited data, we conclude the following:

1. There appears to be no "fatal flaws" for using the quarry for disposal of dredged material.
2. Water table at the site (bottom of the quarry) is at a very shallow depth (about 2-ft.) in some areas.
3. The existing floor of the quarry is a Silty Sand and Gravel with fairly high permeability.
4. The residual red-green Clayey Silt/Silty Clay appears to underlie the entire site and could serve as hydraulic barrier to mitigate the vertical migration of contaminants. It should be noted that Stratum II and III are not continuous under the entire site, and are missing in some areas (borings E-5, E-6 and E-1).
5. Pollutants could travel through the surficial Sand and Gravel, enter the water table, under the site and manifest in Principio Creek and Furnace Bay.
6. Large volume production wells are apparently located upstream of the site. Therefore, contamination of these wells is not likely to occur.
7. The Western/Southwestern portion of the site could be underlain by organics Silt/Peat.

If a decision is made to proceed to the next phase, the following aspects should be investigated.

1. Drill additional borings to corroborate the continuity of the Clayey Silt / Silty Clay layer(s) under the site.
2. Conduct in-situ and laboratory tests on the Sand, Silt and Clay to evaluate their

permeability.

3. Obtain and map groundwater contours and gradient.
4. Obtain groundwater samples under and around the site to establish the existing water quality level.
5. Conduct a study to evaluate the potential of pollution/contamination of the wells adjacent to the site.
6. Evaluate the stability of the proposed dike to El. 90±, and of the dike that had "blown out."
7. Evaluate methods/problems relating to the handling and placing of the fill at the site.
8. Evaluate the long-term settlement of the fill, and its impact on the final use of the site.
9. Evaluate the seepage of water associated with hydraulic filling through the Sand and Gravel layer in the walls of the quarry.

We appreciate the opportunity to be have worked with you on this project. If you have any questions or need additional information, please call us.

Truly Yours,
E2CR, Inc.

Neeraj Singh

Neeraj Singh, E.I.T.
Project Engineer

Jennifer Spinnato
for Sachinder N. Gupta, P.E.
President

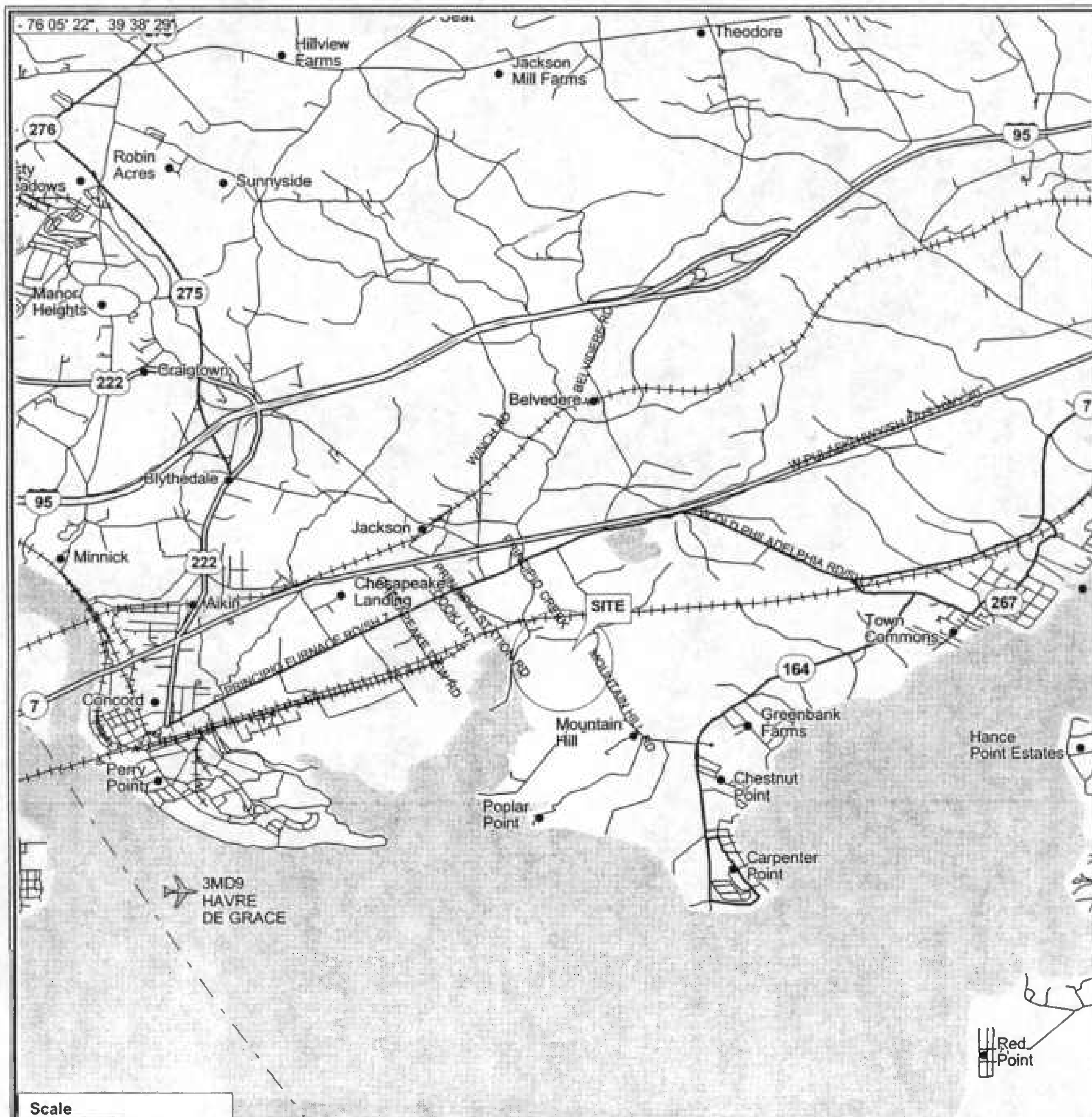
APPENDIX

ENGINEERING · CONSULTATION ·
E2CR inc.
CONSTRUCTION · REMEDIATION ·

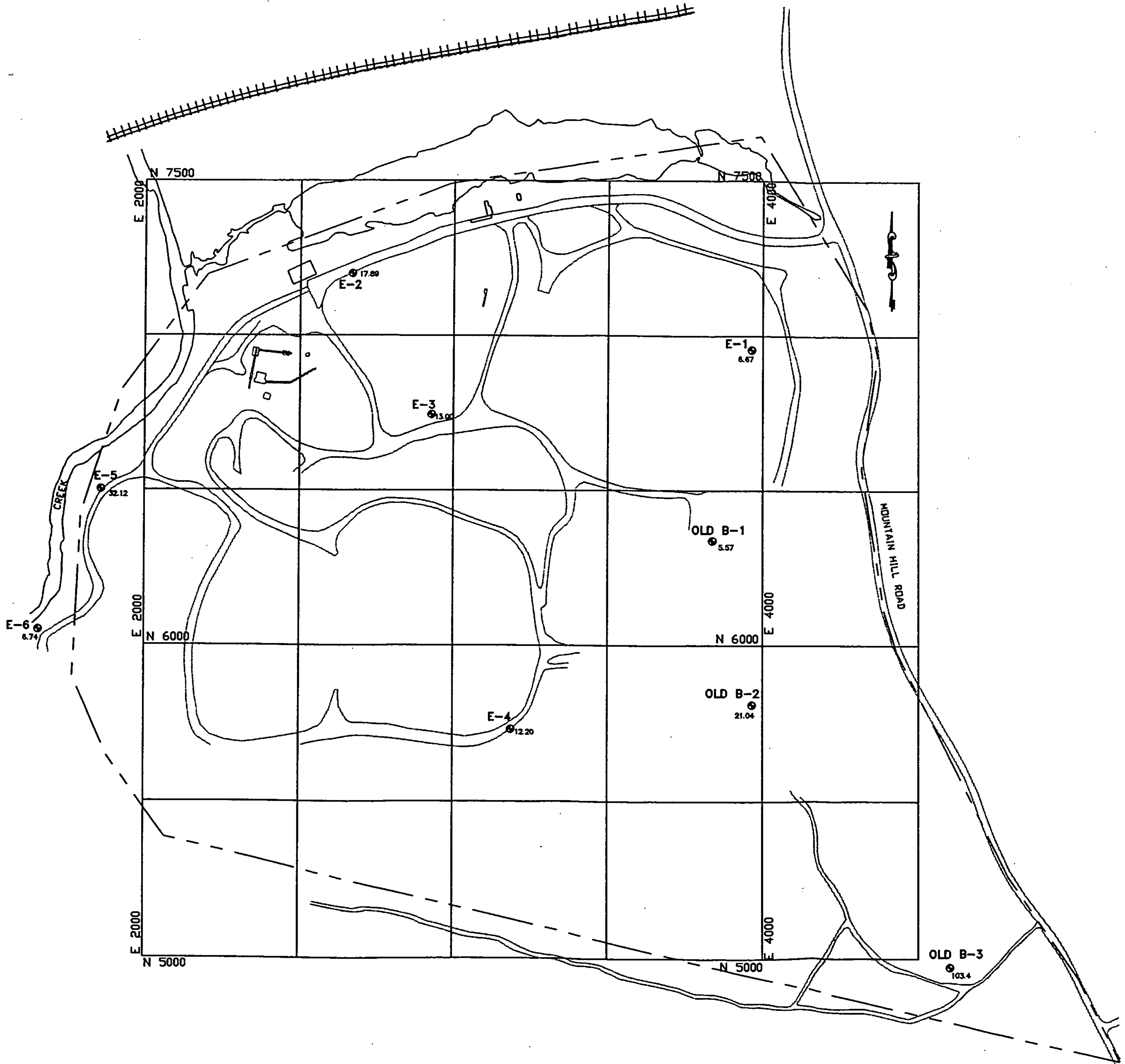
SITE VICINITY MAP
STANCILL SAND & GRAVEL QUARRY
CECIL COUNTY, MARYLAND

FIGURE: 1	DRAWN BY:	CHECKED BY:
DATE: NOV, 00	JOB NO: 00546-04	SCALE: NTS

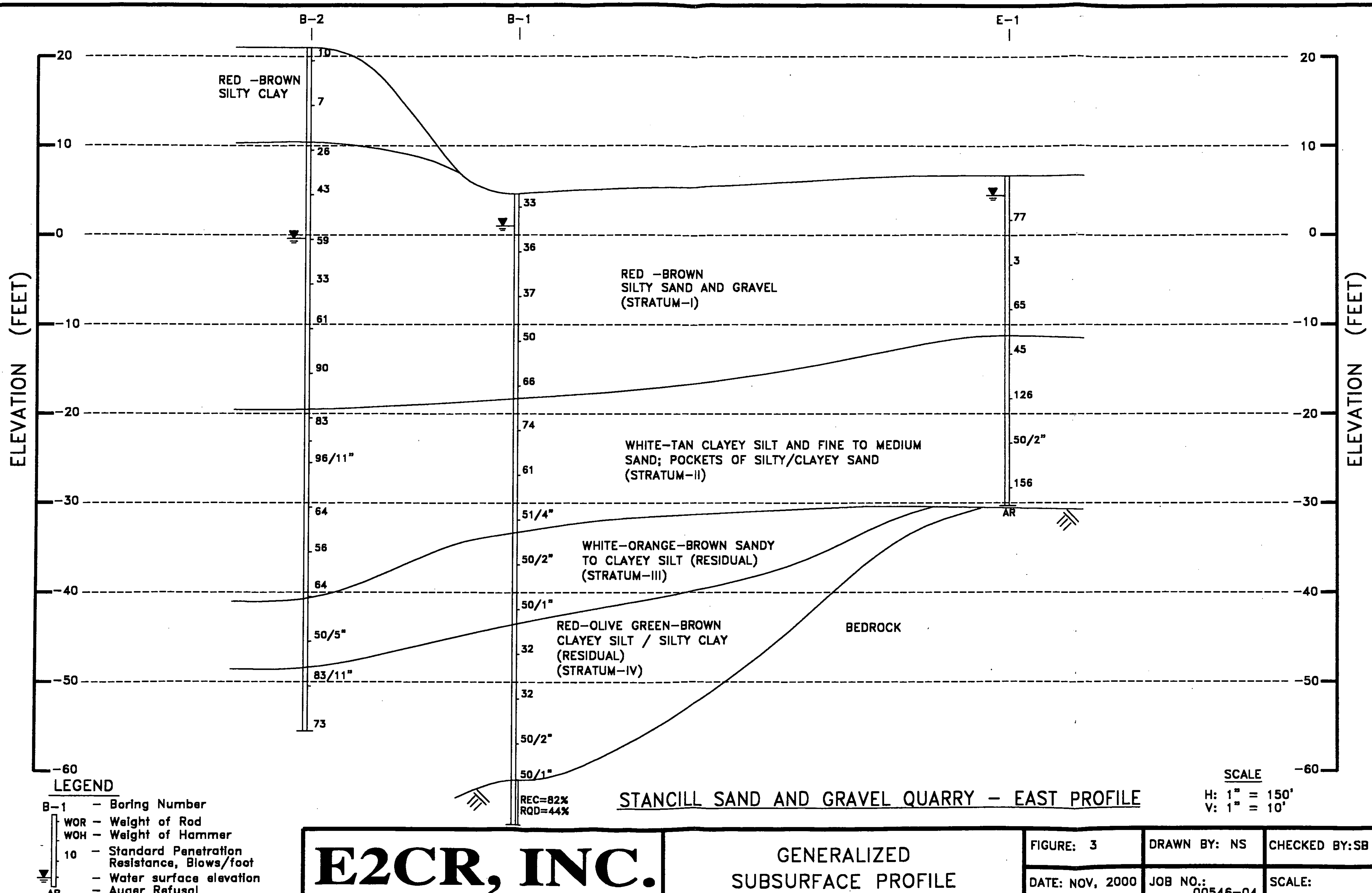
SITE VICINITY MAP



Map created using Precision Mapping 3.0



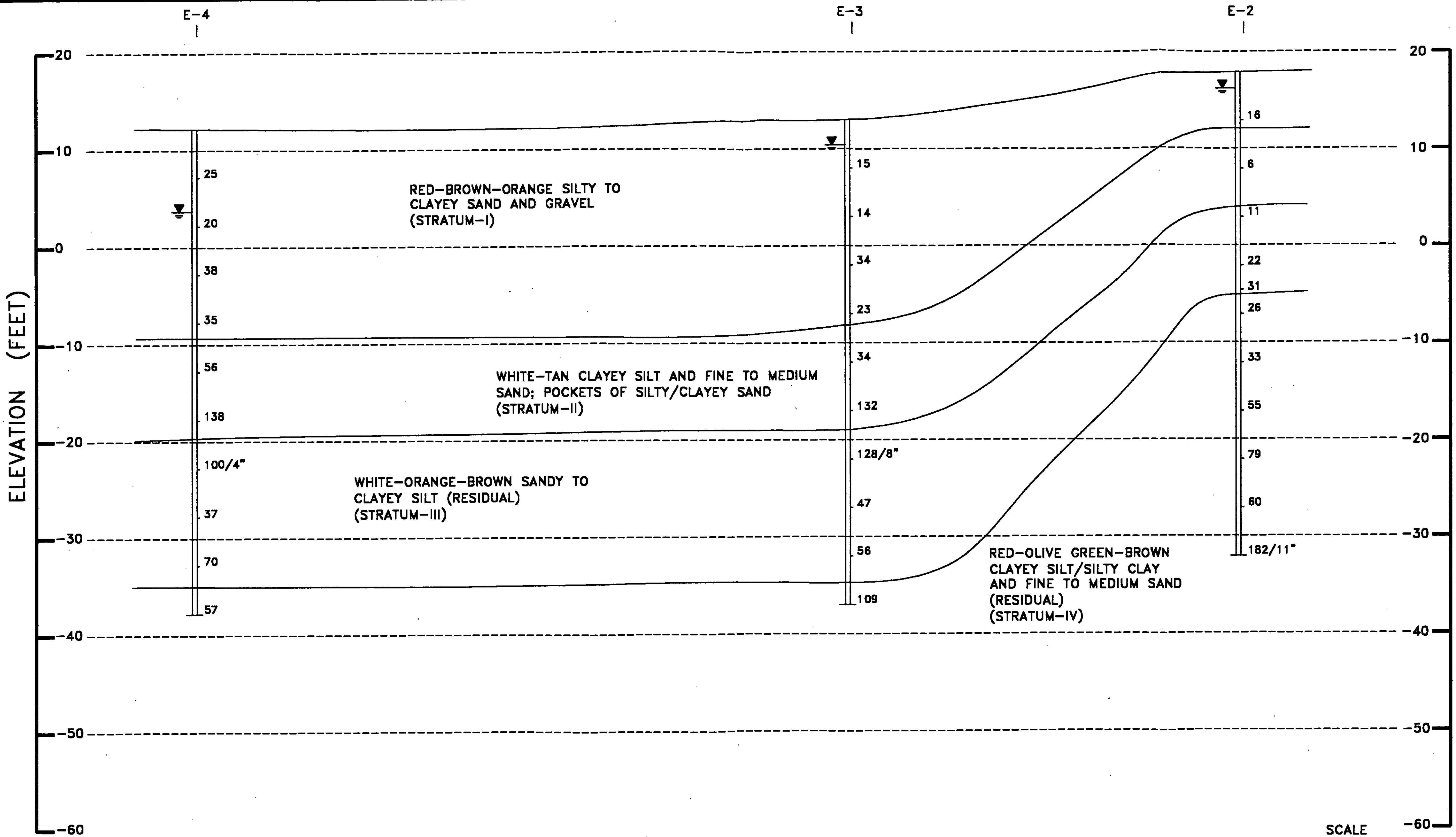
E2CR, INC.	BORING LOCATION PLAN STANCILL SAND & GRAVEL QUARRY	FIGURE: 2	DRAWN BY: NS	CHECKED BY: SB
		DATE: NOV.,2000	JOB NO.: 00546	SCALE: 1"=400'



STANCILL SAND AND GRAVEL QUARRY - EAST PROFILE

SCALE
H: 1" = 150'
V: 1" = 10'

E2CR, INC.	GENERALIZED SUBSURFACE PROFILE	FIGURE: 3	DRAWN BY: NS	CHECKED BY: SB
		DATE: NOV, 2000	JOB NO.: 00546-04	SCALE:



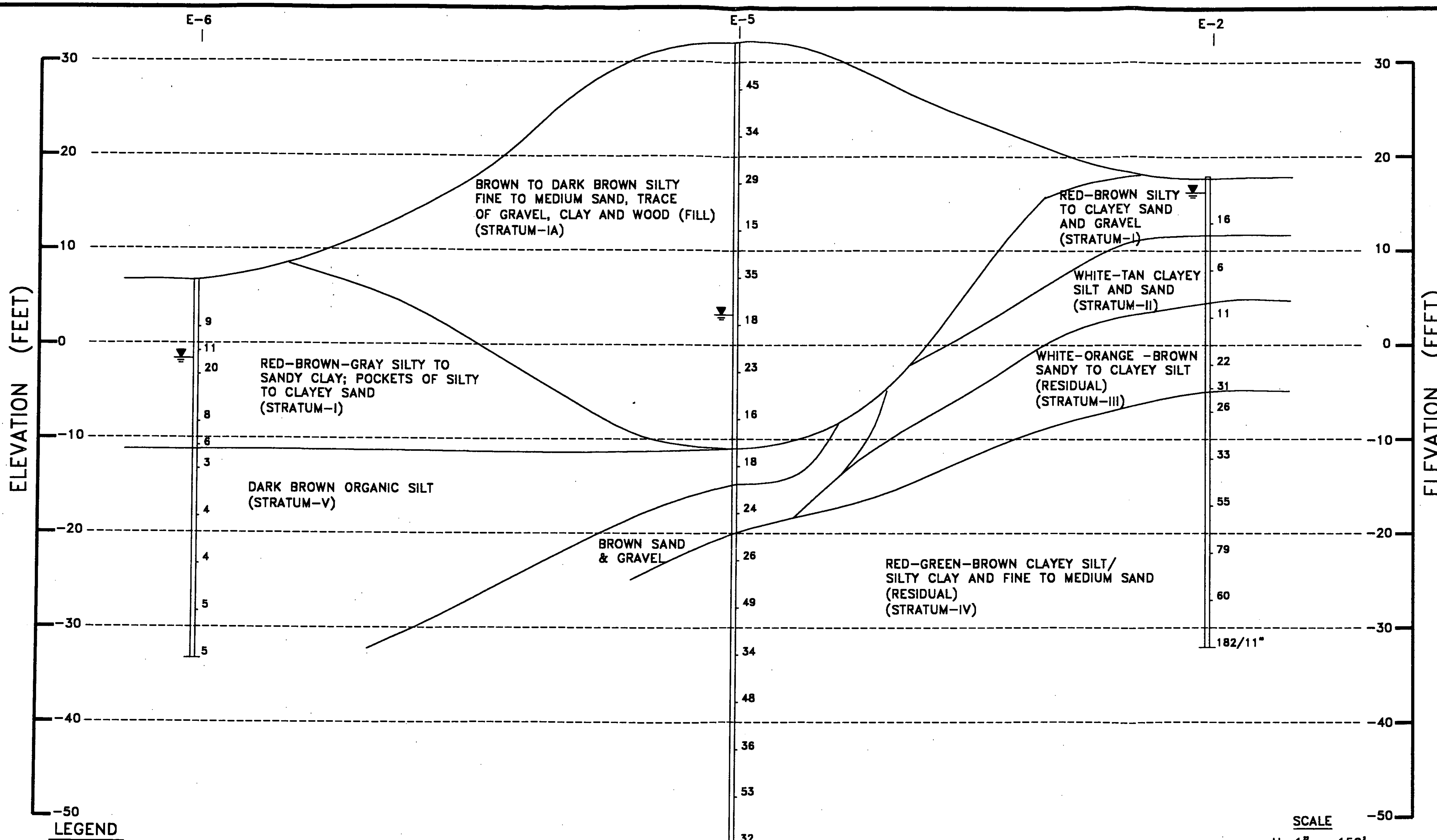
LEGEND

- B-1 – Boring Number
- WOR – Weight of Rod
- WOH – Weight of Hammer
- 10 – Standard Penetration Resistance, Blows/foot
- – Water surface elevation
- AR – Auger Refusal

STANCILL SAND AND GRAVEL QUARRY – CENTER PROFILE

SCALE
H: 1" = 150'
V: 1" = 10'

E2CR, INC.	GENERALIZED SUBSURFACE PROFILE	FIGURE: 4	DRAWN BY: NS	CHECKED BY:SB
		DATE: NOV, 2000	JOB NO.: 00546-04	SCALE:



STANCILL SAND AND GRAVEL QUARRY - WEST PROFILE

SCALE
H: 1" = 150'
V: 1" = 10'

LEGEND

- B-1 – Boring Number
- WOR – Weight of Rod
- WOH – Weight of Hammer
- 10 – Standard Penetration Resistance, Blows/foot
- Water surface elevation
- AR – Auger Refusal

E2CR, INC.	GENERALIZED SUBSURFACE PROFILE	FIGURE: 5	DRAWN BY: NS	CHECKED BY:SB
		DATE: NOV, 2000	JOB NO.: 00546-04	SCALE:

TABLE-1: SUMMARY OF LABORATORY TEST RESULTS
STANCILL SAND AND GRAVEL QUARRY
E2CR Project No. 00546-04

BORING NO	SAMPLE NO	DEPTH (FEET)	NATURAL MOISTURE CONTENT,%	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE DISTRIBUTION GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	HYDRAULIC CONDUCTIVITY (CM/SEC)	USCS CLASSI-FICATION
E-1	S-3	13.5-15.0	15.0								
	S-4	18.5-20.0	22.3			0	43	57			
	S-5	23.5-25.0	22.4								
	S-6	28.5-30.0	21.2								
	S-7	33.5-35.0	31.0	44	14	1	37	28	34		ML
E-1A	ST-1	18.0-18.75		37	7					5.6E-06	ML
E-2	S-1	3.5-5.0	20.7								
	S-2	8.5-10.0	19.2								
	S-3	13.5-15.0	22.3			5	54	41			
	S-4	18.5-20.0	23.7								
	S-5	21.0-22.5	18.0								
	S-6	23.5-25.0	24.4								
	S-7	28.5-30.0	18.0			0	44	56			
	S-8	33.5-35.0	19.5								
E-2A	ST-1	13.5-15.5		37	14					1.1E-06	SC
E-3	S-2	8.5-10.0	17.0			9	80	11			SM
	S-4	18.5-20.0	9.1			65	29	6			GM
	S-6	28.5-30.0	15.3	29	5			45			SM
	S-10	48.5-50.0	16.2	70	47	0	29	27	44		CH
E-4	S-2	8.5-10.0	8.0			28	66	6			SM-SP
	S-4	18.5-20.0	9.6			12	79	9			SM-SP
E-5	S-2	8.5-10.0	8.4			12	58	30			SM
	S-5	23.5-25.0	7.0			31	42	27			SM
	S-7	33.5-35.0	16.6			3	50	47			SM
	S-11	53.5-55.0	26.1								
	S-12	58.5-60.0	26.0								
	S-13	63.5-65.0	29.1	50	13	0	29	46	25		ML

TABLE-1: SUMMARY OF LABORATORY TEST RESULTS
STANCILL SAND AND GRAVEL QUARRY
E2CR Project No. 00546-04

BORING NO	SAMPLE NO	DEPTH (FEET)	NATURAL MOISTURE CONTENT,%	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE DISTRIBUTION				HYDRAULIC CONDUCTIVITY (CM/SEC)	USCS CLASSI-FICATION
						GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)		
E-5	S-14	68.5-70.0	24.4								
	S-15	73.5-75.0	20.3								
	S-16	78.5-80.0	30.0								
E-6	S-3	8.5-10.0	9.8			8	52	40			SC
	S-7	23.5-25.0	88.9	85	22						MH
	S-8	28.5-30.0	84.0								
	S-9	33.5-35.0	103.2								

Particle Size Distribution Report

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	43.1	56.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.896	0.110						

MATERIAL DESCRIPTION	USCS	AASHTO
○ White Clayey SILT and fine to medium SAND		

Project No. 00546-04 **Client:** MDE
Project: Stancills Sand & Gravel Quary

○ **Source:** E-1 **Sample No.:** S-4 **Elev./Depth:** 18.5'-20.0'

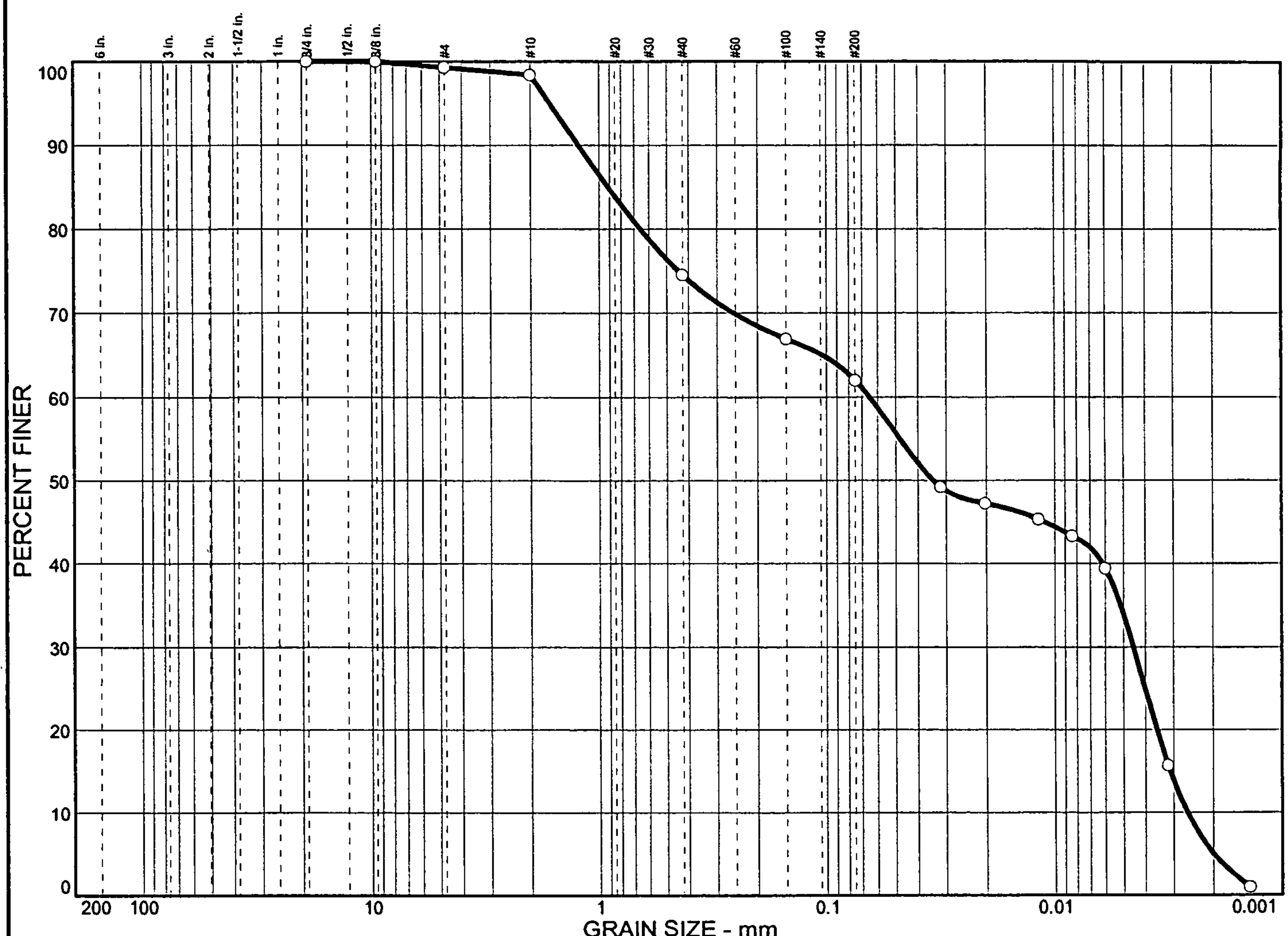
Remarks:
○ Natural Moisture= 22.3%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.7	37.3	28.1	33.9

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	44	30	0.915	0.0650	0.0343	0.0045	0.0031	0.0026	0.12	24.96

MATERIAL DESCRIPTION	USCS	AASHTO
○ White, Clayey SILT, and Fine to Medium SAND	ML	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-1 **Sample No.:** S-7 **Elev./Depth:** 33.5'-35.0'

Remarks:

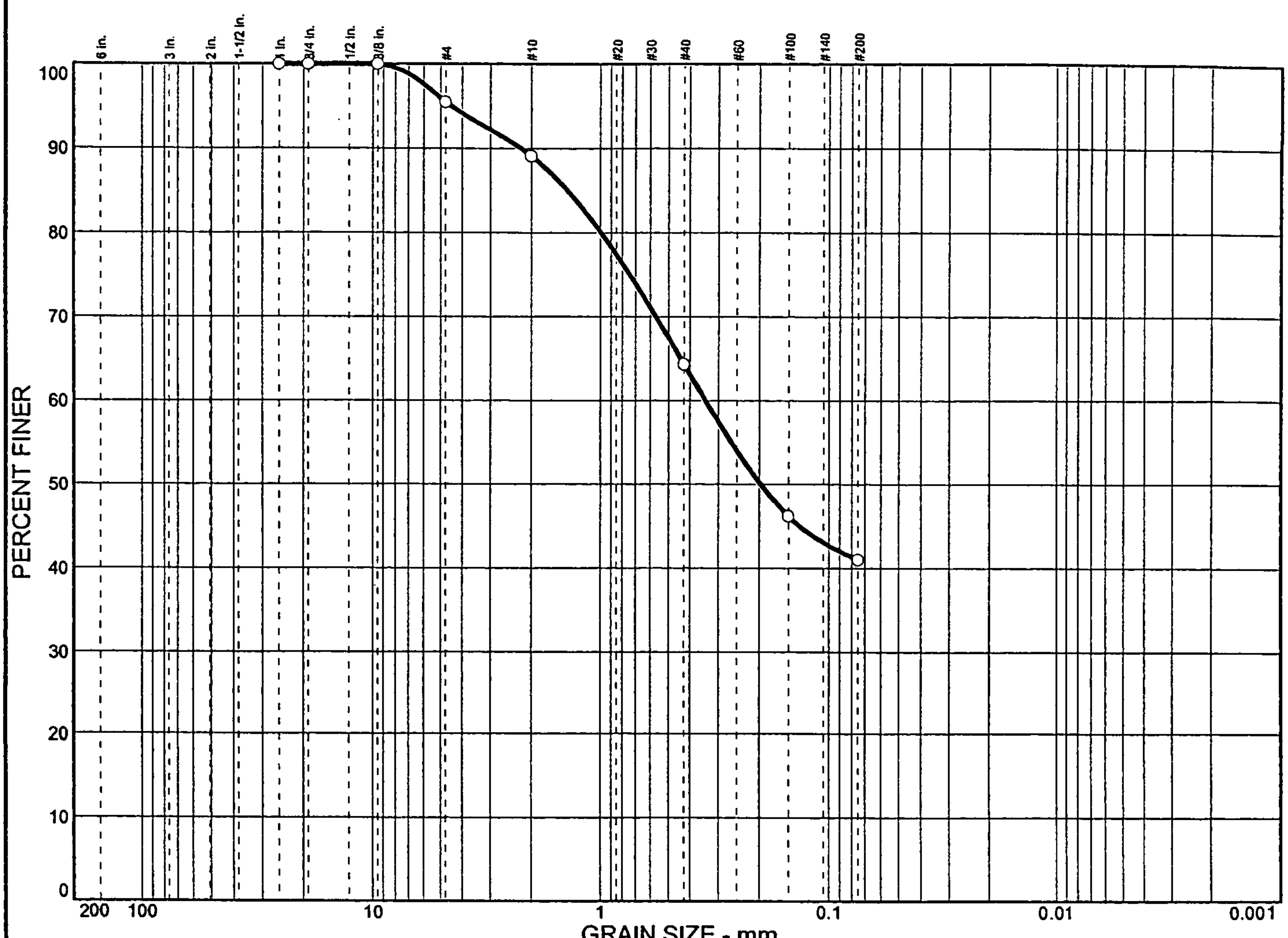
○ Natural Moisture= 31.0%,
PI= 14

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	4.5	54.5	41.0	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.40	0.342	0.198					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Orange and white Clayey fine to coarse SAND		

Project No. 00546-04 **Client:** MDE
Project: Stancills Sand & Gravel Quary

○ **Source:** E-2 **Sample No.:** S-3 **Elev./Depth:** 13.5'-15.0'

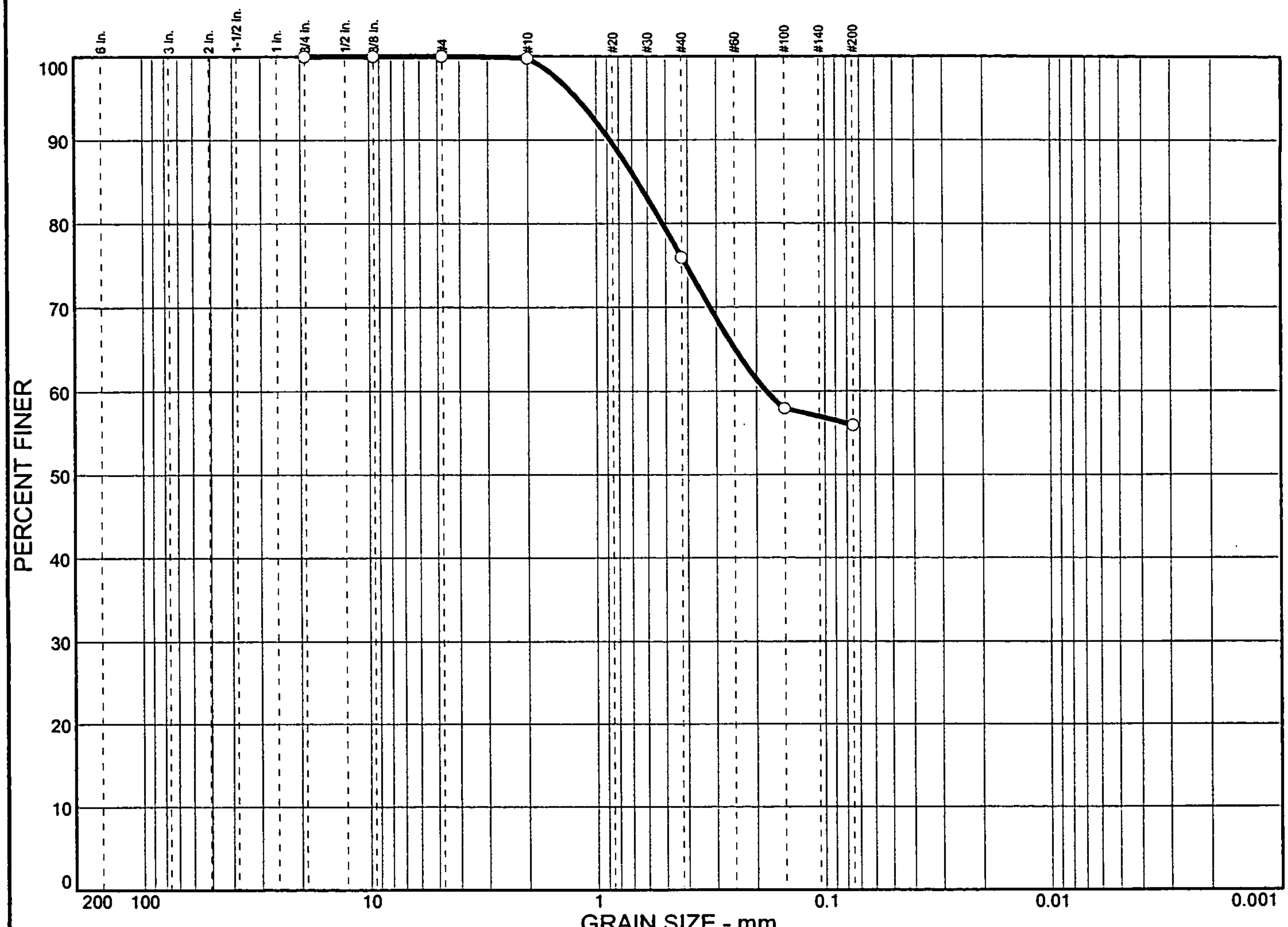
Remarks:
○ Natural Moisture= 22.3%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	44.1	55.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.664	0.181						

MATERIAL DESCRIPTION	USCS	AASHTO
○ Gray-Green Clayey SILT and fine to medium SAND		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-2 **Sample No.:** S-7 **Elev./Depth:** 28.5'-30.0'

Remarks:

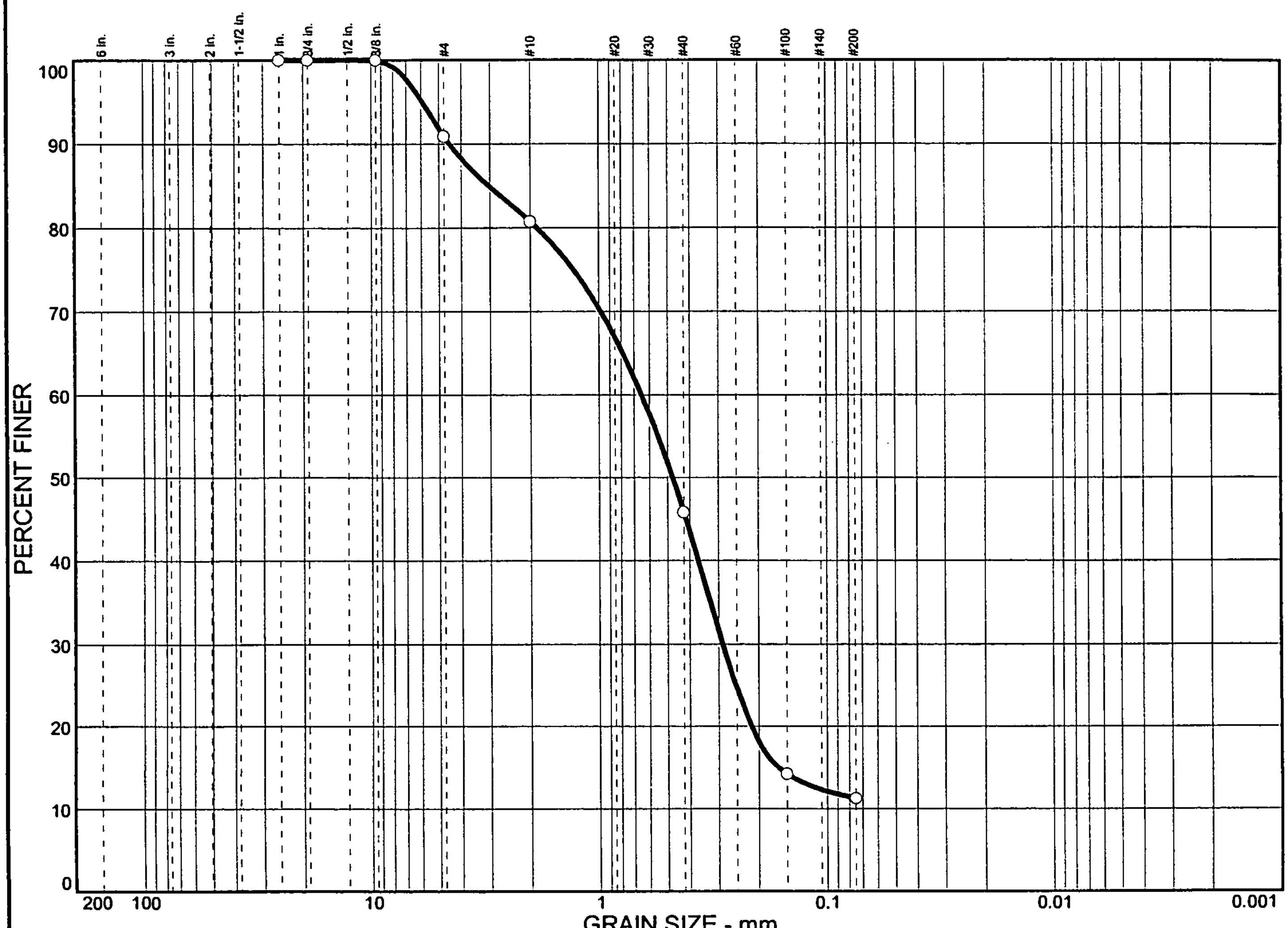
○ Natural MOisture= 18.0%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	9.1	79.6	11.3	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.05	0.651	0.476	0.288	0.165			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Light Gray Silty fine to coarse SAND, trace of Gravel		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-3 **Sample No.:** S-2 **Elev./Depth:** 8.5'-10.0'

Remarks:

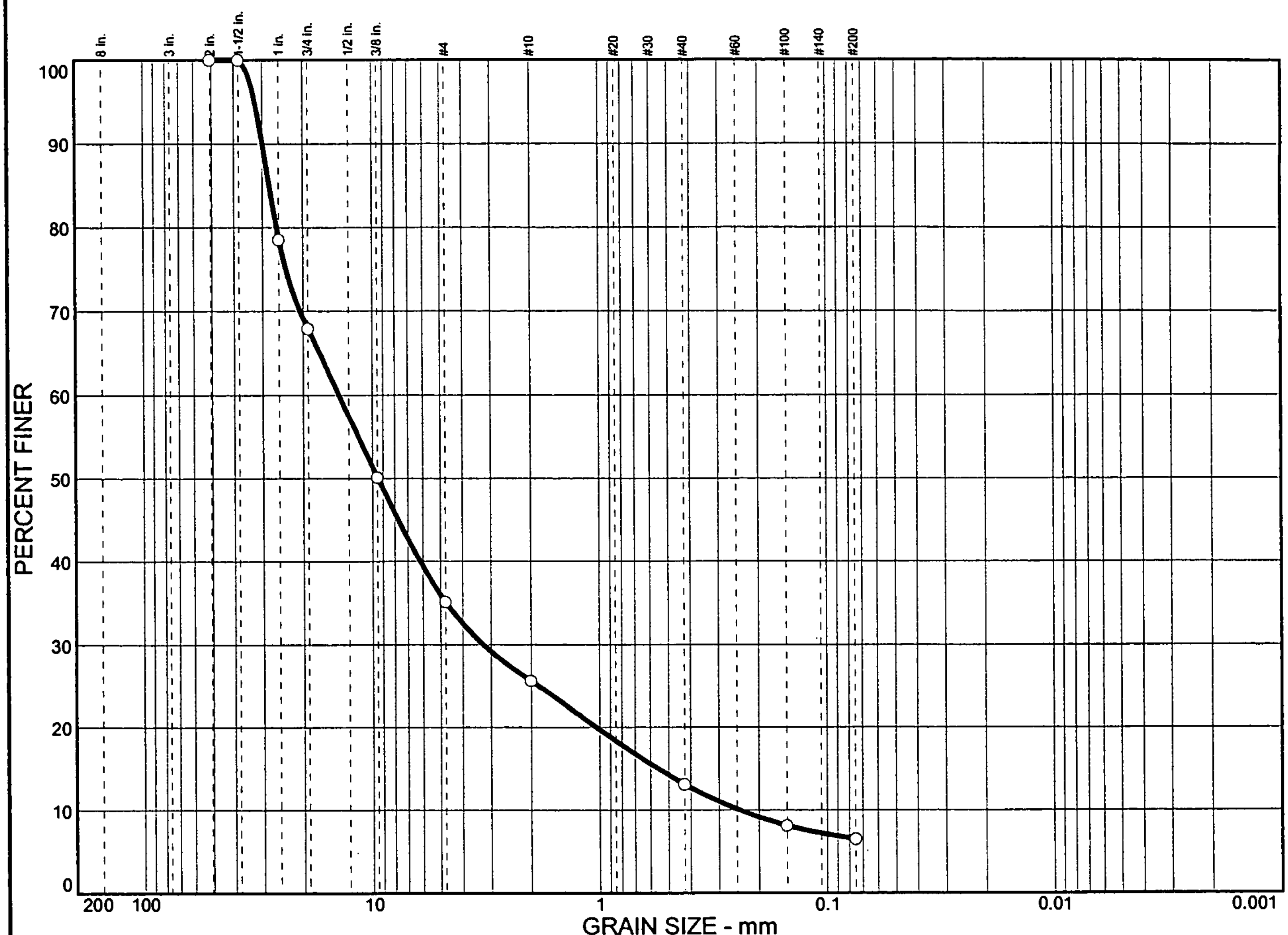
○ Natural Moisture= 17.0%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	64.9	28.6	6.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			28.0	14.0	9.49	3.24	0.558	0.245	3.05	57.32

MATERIAL DESCRIPTION	USCS	AASHTO
○ Light Brown Sandy GRAVEL, trace of Silt and mica		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-3 **Sample No.:** S-4 **Elev./Depth:** 18.5'-20.0'

Remarks:

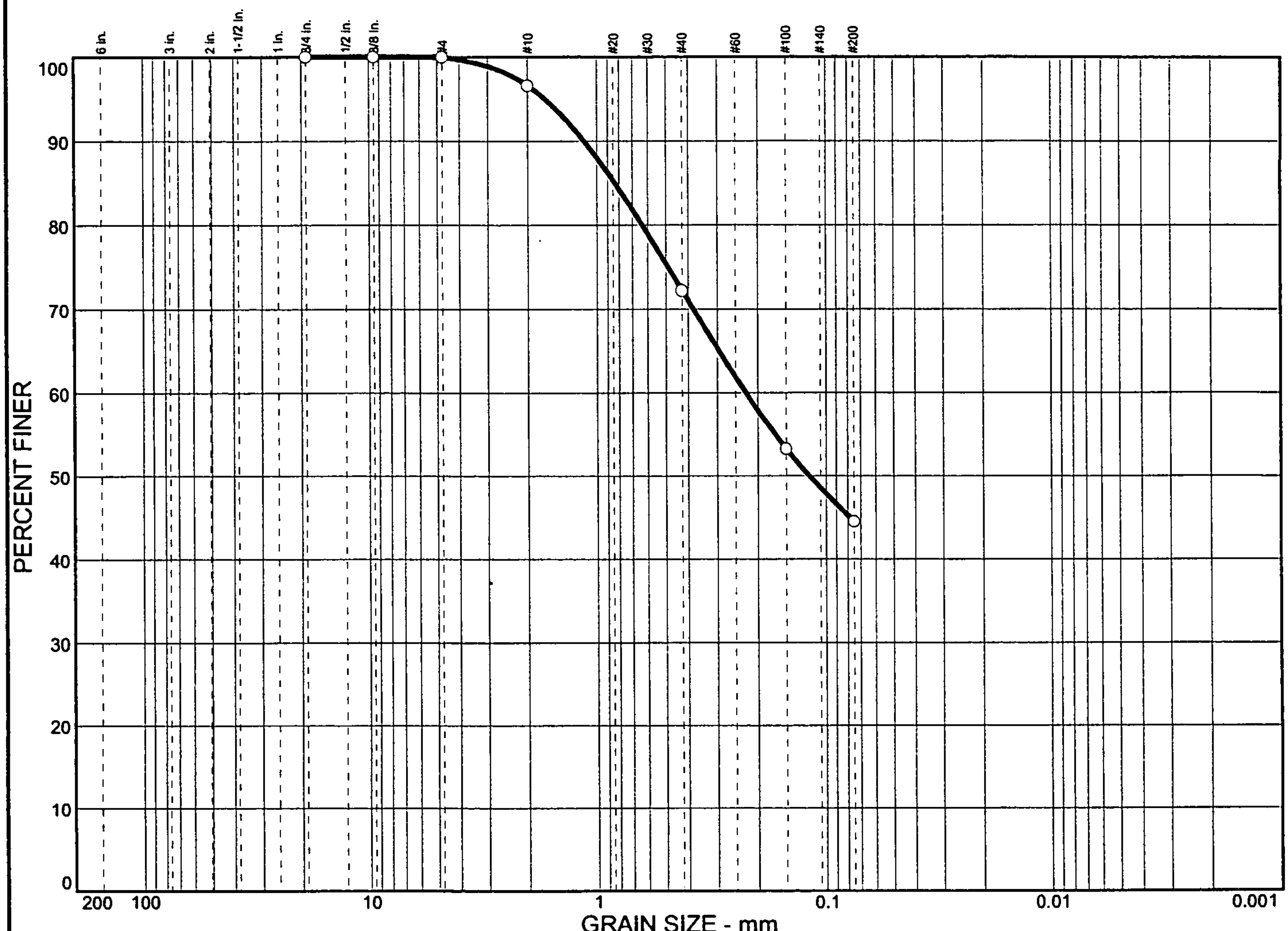
○ Natural Moisture= 9.1%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	55.5	44.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	29	24	0.836	0.226	0.119					

MATERIAL DESCRIPTION	USCS	AASHTO
○ White to Orange Brown Silty fine to medium SAND, trace of Clay	SM	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-3 **Sample No.:** S-6 **Elev./Depth:** 28.5'-30.0'

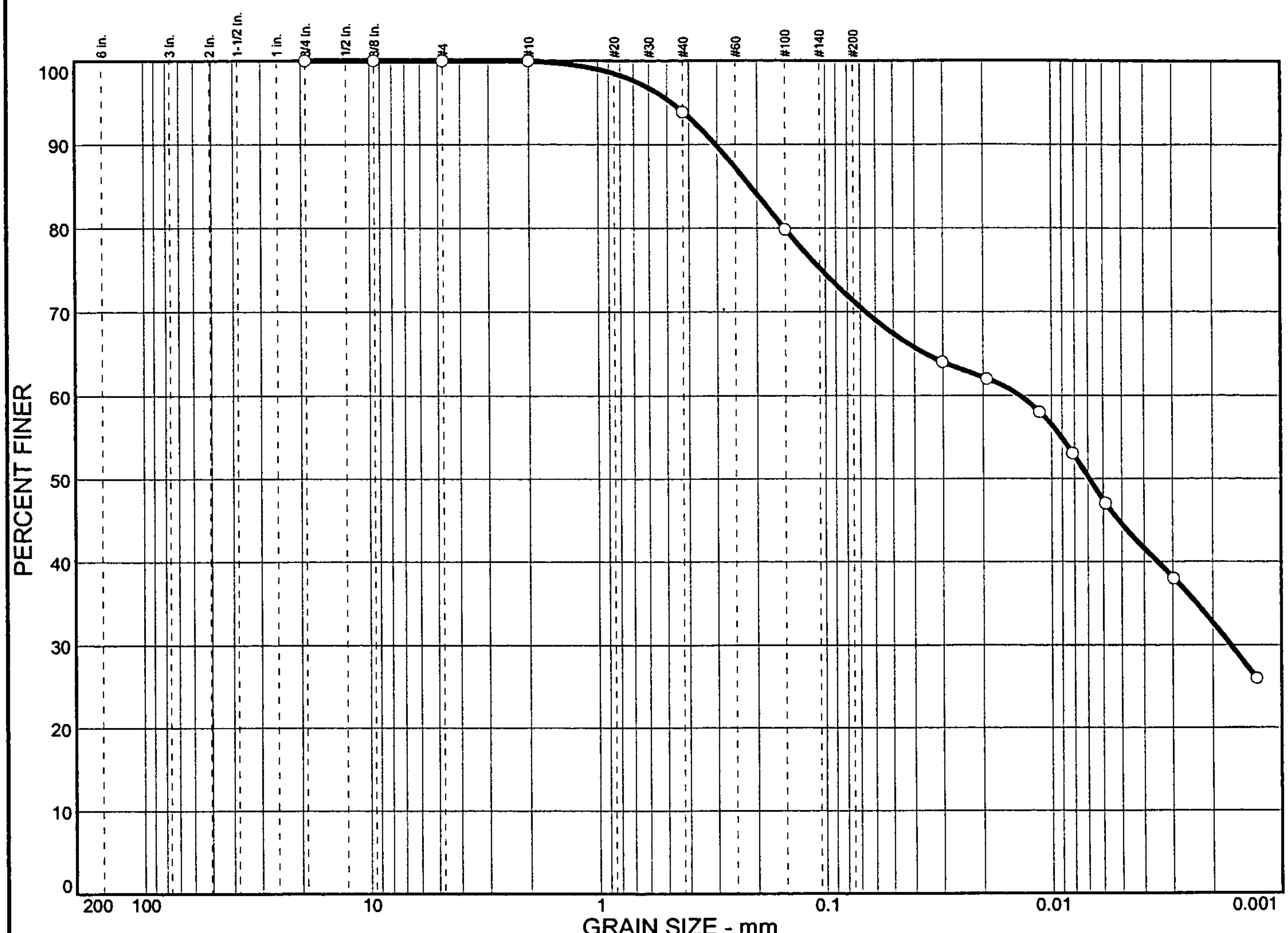
Remarks:
○ Natural Moisture= 15.3%,
PI= 5

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	28.8	26.7	44.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	70	23	0.215	0.0138	0.0069	0.0017				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Olive Green, Sandy CLAY (decomposed rock)	CH	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-3 **Sample No.:** S-10 **Elev./Depth:** 48.5'-50.0'

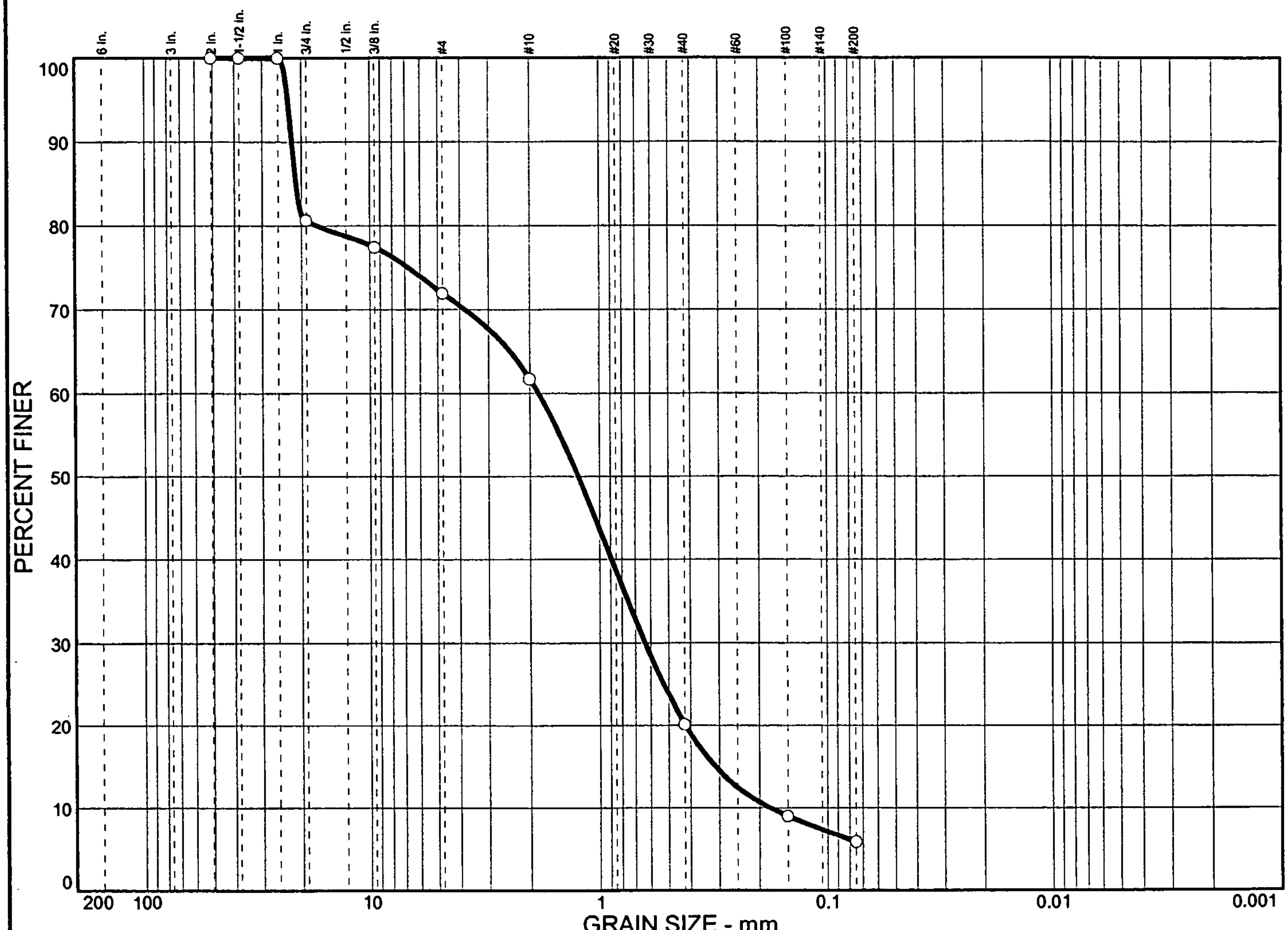
Remarks:
○ Natural Moisture= 16.2%, PI= 47

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	28.1	66.0	5.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			21.2	1.84	1.24	0.634	0.313	0.180	1.21	10.23

MATERIAL DESCRIPTION	USCS	AASHTO
○ Light Reddish Brown fine to coarse SAND, some Gravel, trace of Silt and mica	SM-SP	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-4 **Sample No.:** S-2 **Elev./Depth:** 8.5'-10.0'

Remarks:

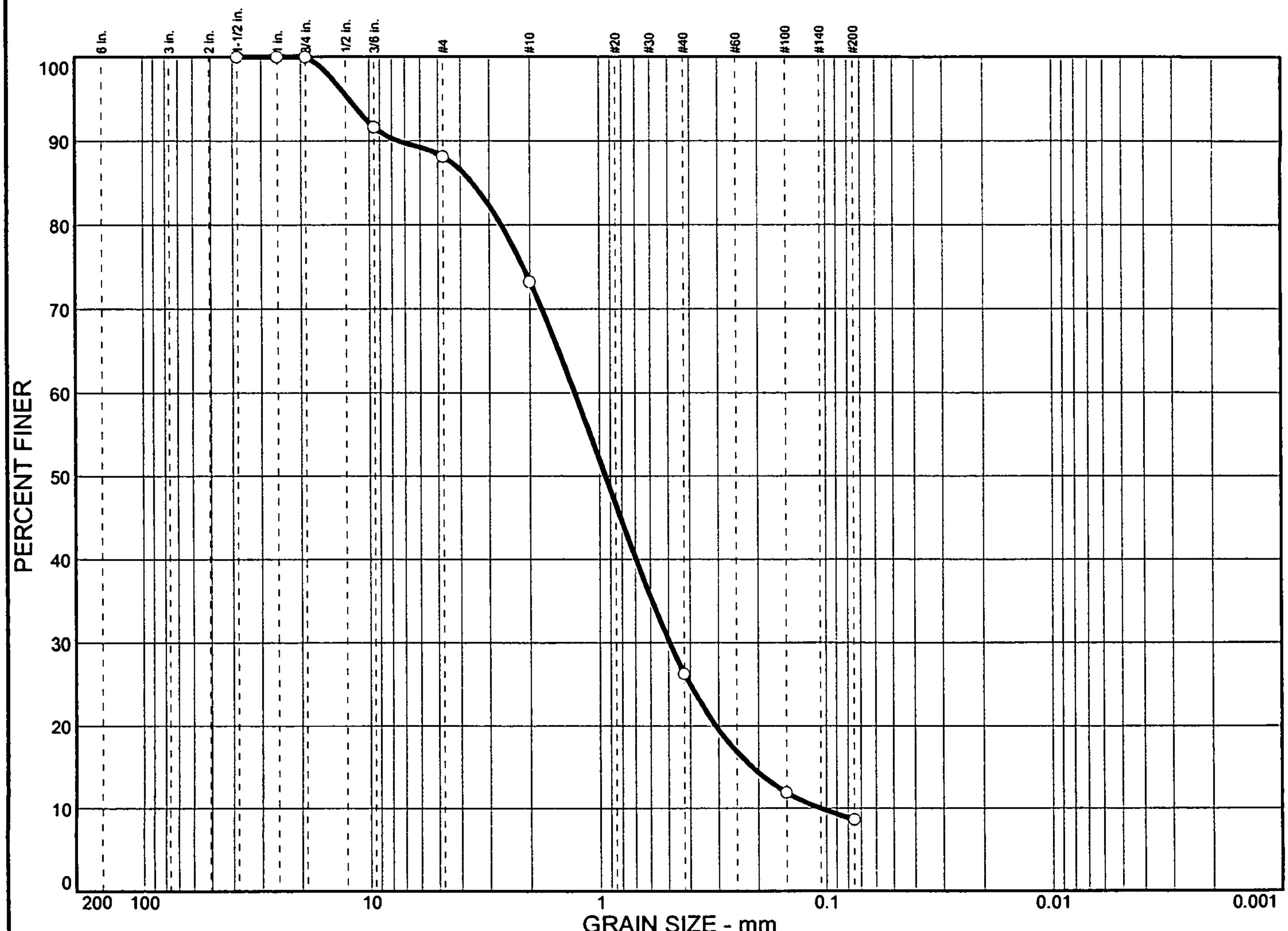
○Natural Moisture= 8.0%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	11.9	79.5	8.6	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.55	1.28	0.946	0.493	0.215	0.106	1.78	12.06

MATERIAL DESCRIPTION	USCS	AASHTO
○ Light Reddish Brown fine to coarse SAND, little Gravel, trace of Silt and mica	SM-SP	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-4 **Sample No.:** S-4 **Elev./Depth:** 18.5'-20.0'

Remarks:

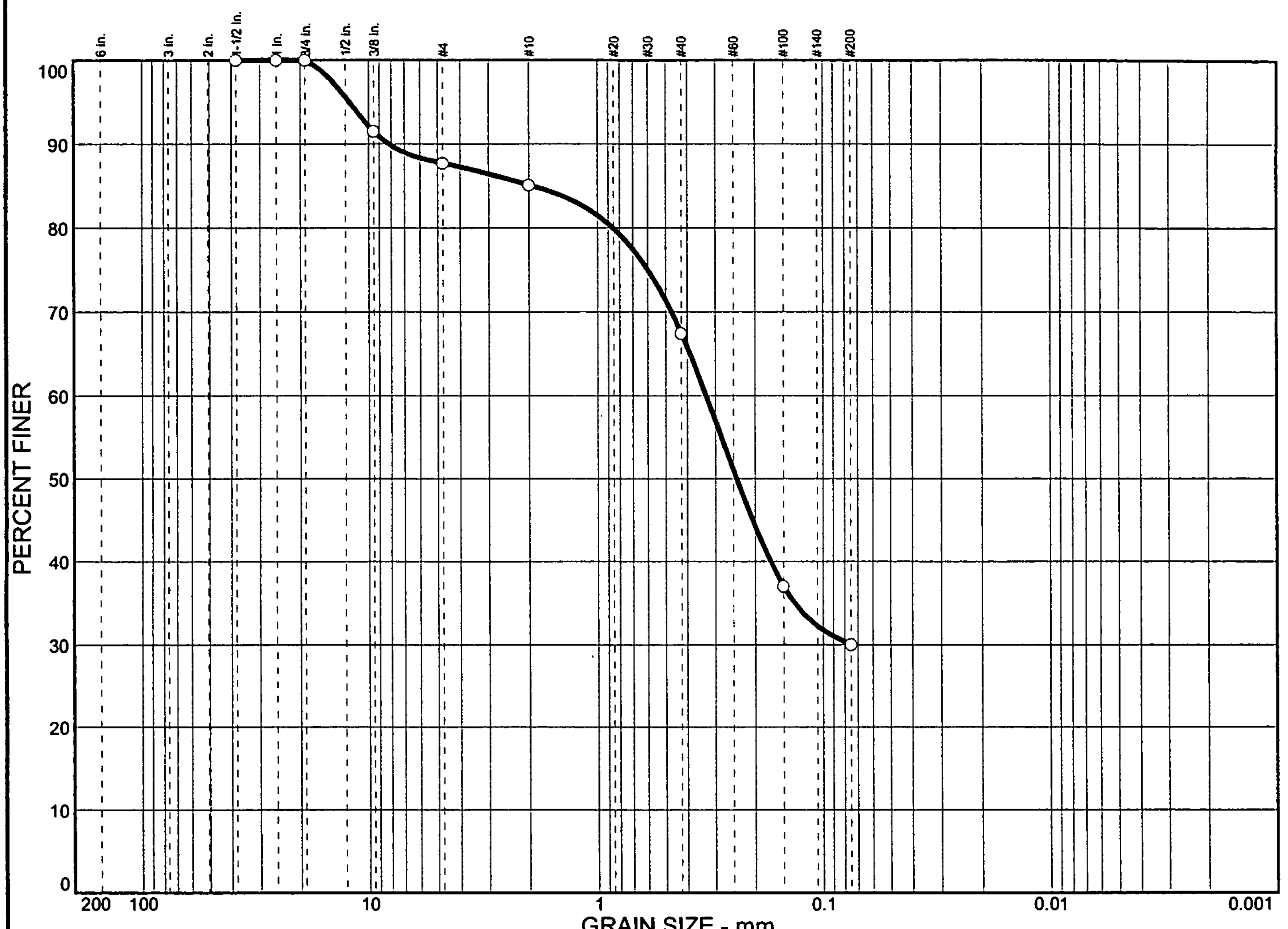
○ Natural Moisture= 9.6%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	12.3	57.7	30.0	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.94	0.330	0.242	0.0750				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Reddish Brown Silty fine to coarse SAND, little Gravel, trace of Clay and mica (Fill)		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-5 **Sample No.:** S-2 **Elev./Depth:** 8.5'-10.0'

Remarks:

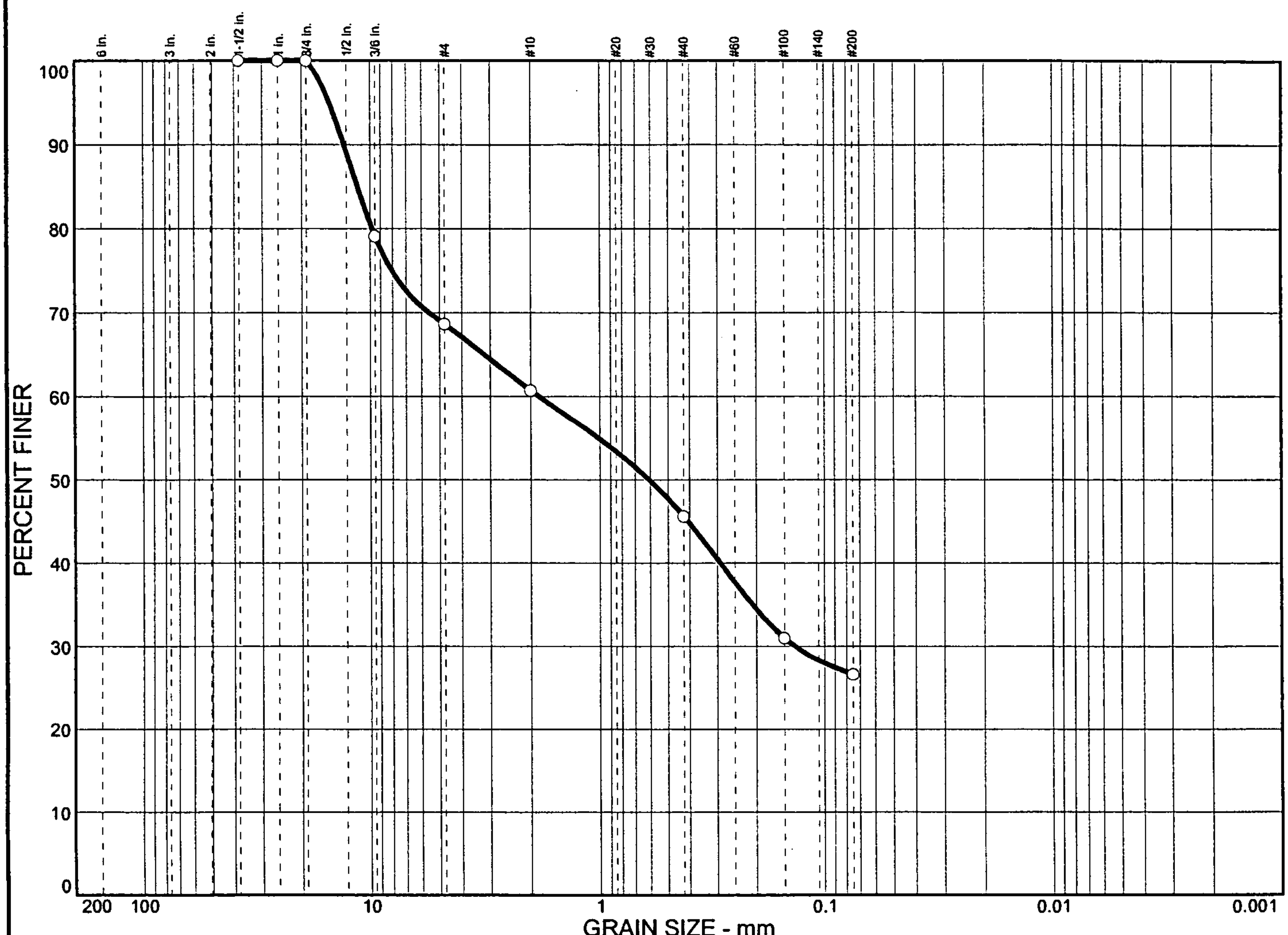
○ Natural Moisture= 8.4%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	31.4	41.9	26.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			11.4	1.85	0.609	0.134				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Brown to Reddish Brown Silty fine to coarse SAND, some Gravel (Fill)		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-5 **Sample No.:** S-5 **Elev./Depth:** 23.5'-25.0'

Remarks:

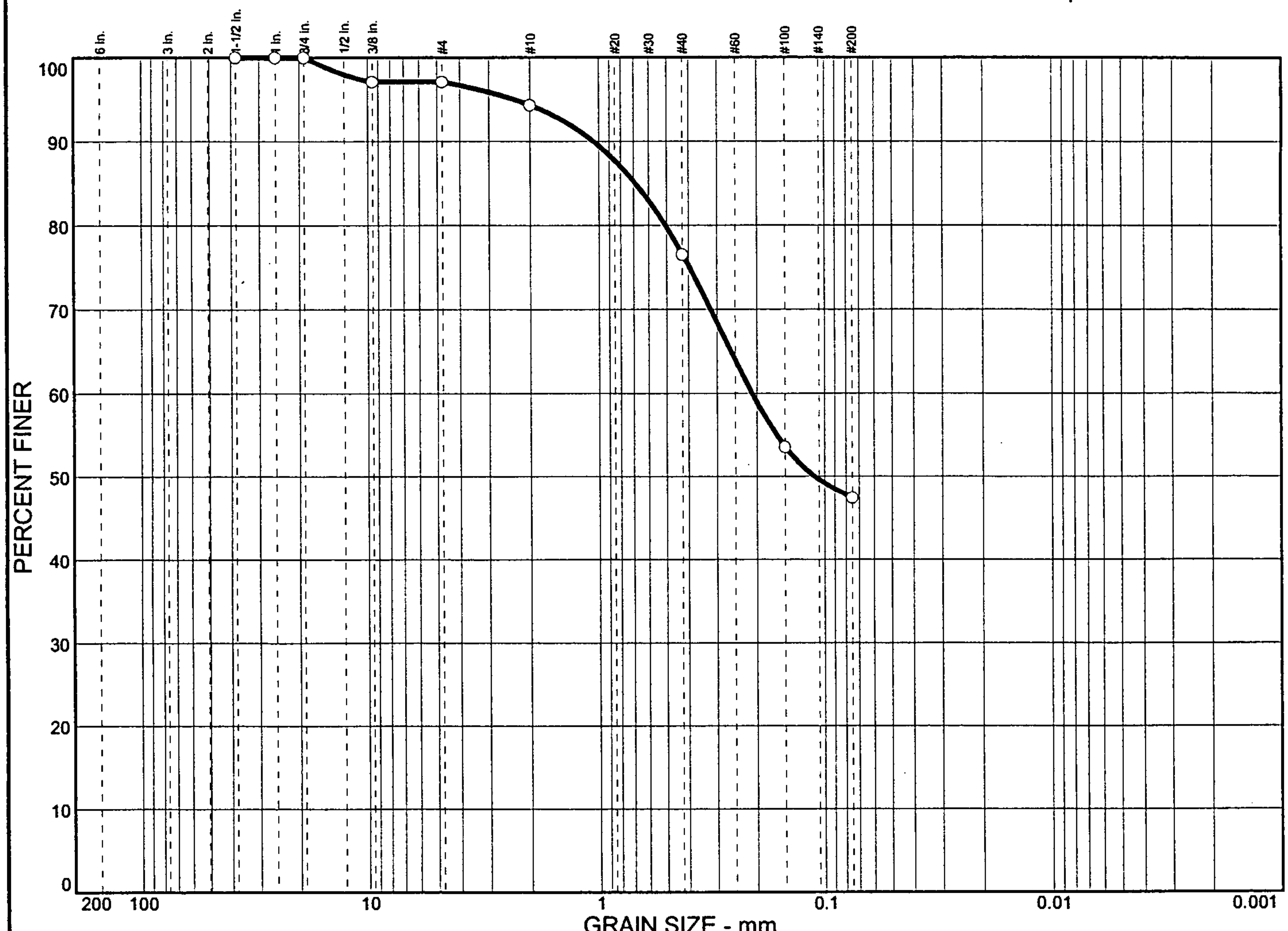
○ Natural Moisture= 7.0%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	2.9	49.7	47.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.690	0.211	0.111					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Brown to Reddish Brown Silty fine to medium SAND, trace of Clay, organics and wood fragments (Fill)		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-5 **Sample No.:** S-7 **Elev./Depth:** 33.5'-35.0'

Remarks:

○ Natural Moisture= 16.6%

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	28.8	46.3	24.9

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	50	37	0.473	0.0242	0.0159	0.0062	0.0032	0.0023	0.69	10.33

MATERIAL DESCRIPTION	USCS	AASHTO
○ Red, Clayey SILT, some fine to medium Sand	ML	

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-5 **Sample No.:** S-13 **Elev./Depth:** 63.5'-65.0'

Remarks:

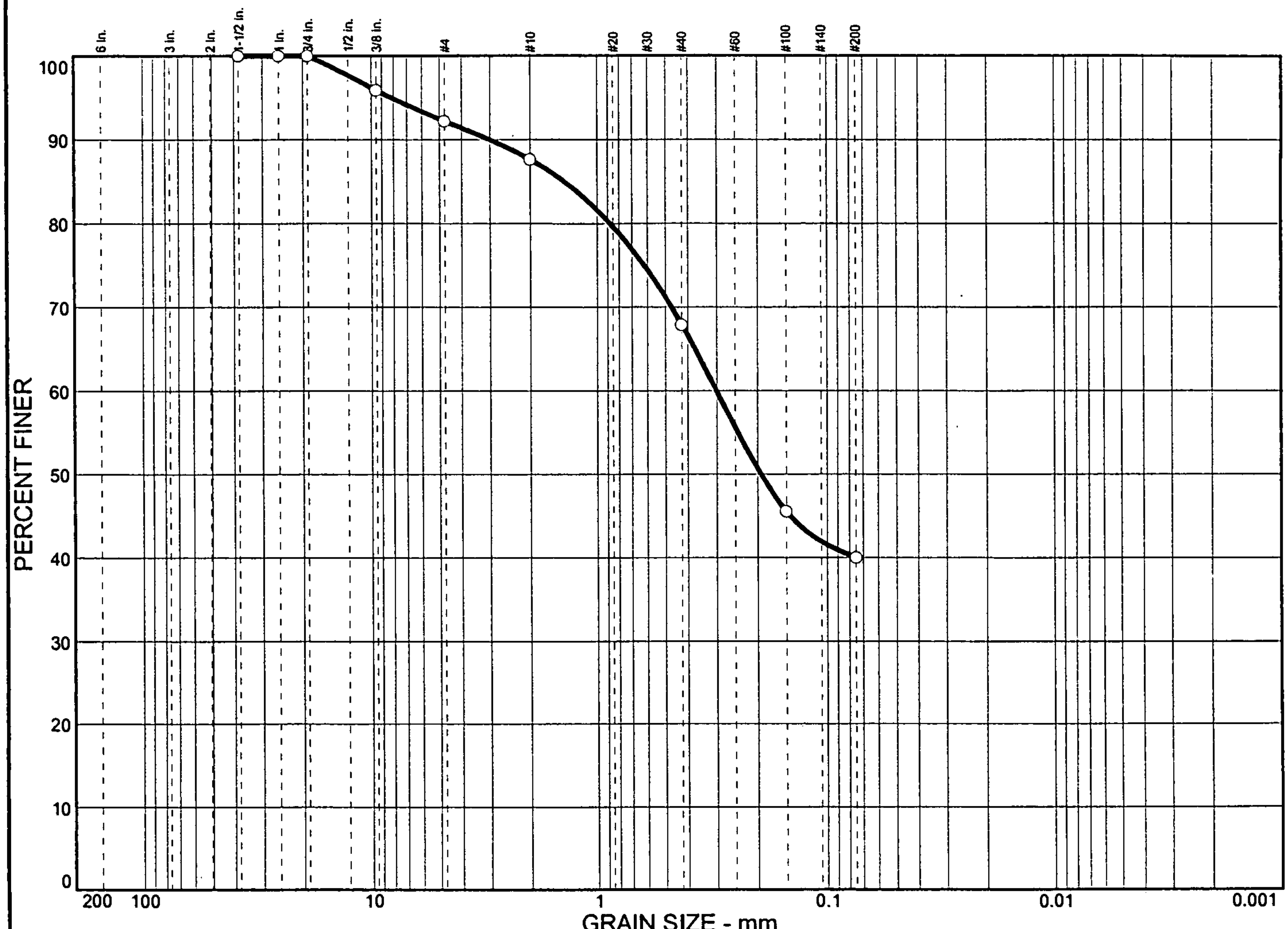
○ Natural Moisture= 29.1%, PI= 13

Particle Size Distribution Report

E2CR, Inc.

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	7.8	52.2	40.0	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.42	0.302	0.194					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Brown Clayey fine to medium SAND, trace Gravel		

Project No. 00546-04 **Client:** MDE

Project: Stancills Sand & Gravel Quary

○ **Source:** E-6 **Sample No.:** S-3 **Elev./Depth:** 8.5'-10.0'

Remarks:

○Natural Moisture= 9.8%

Particle Size Distribution Report

E2CR, Inc.

Plate

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CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No.: E – 1

PROJECT No.: 00546–04

ELEV: 6.67
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START: 10/2/00
HAMMER DROP : 30 In.
ROCK CORE DIA. :

FINISH: 10/3/00
SPOON O.D. : 2 In. FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
6.67	Reddish brown, moist, Silty fine to medium SAND, trace to little Gravel (SM)		0					
			5	S–1	5 – 4 – 73	DS	12"	
								Offset 6.5' South and re–drilled boring E–1A to obtain Shelby sample from 18' to 18.75'
			10	S–2	2 – 2 – 1	DS	12"	
			15	S–3	10 – 26 – 39	DS	14"	
–11.33	White, moist, Clayey SILT and fine to medium SAND (ML)	18.0						
			20	S–4	11 – 16 – 29	DS	18"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS : 4.5 feet
AT COMPLETION : - CAVED
AT 24 Hours
WATER : 2.20 feet CAVED

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CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No.: E – 1

PROJECT No. : 00546–04

ELEV: 6.67
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START: 10/2/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH: 10/3/00
SPOON O.D. : 2 In.
FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
–13.33	White, moist, Clayey SILT and fine to medium SAND (ML)		20					
			25	S–5	9 – 28 – 98	DS	18"	
			30	S–6	39 – 50/2"	DS	8"	
			35	S–7	75 – 68 – 88	DS	18"	
–30.33	Bottom of Boring at 37.0 feet	37.0						Auger refusal at 37' feet
			40					

LEGEND
DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER
WATER ON RODS : 4.5 feet
AT COMPLETION : CAVED
AT- 24 Hours
WATER : 2.20 feet CAVED

ENGINEERING • CONSULTATION •

E2CR inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stacill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E-2

Location : See Test Boring Location Plan

PROJECT No. : 00546-04

ELEV 17.9 | DATE START : 9/27/00 | FINISH : 9/27/00
HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA | ROCK CORE DIA. :

ELEV	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
17.9	Light brown, moist, Silty fine SAND (SM)		0					
13.4		4.5		S-1	3 - 7 - 9	DS	18"	
	White and orange, moist to wet Silty to Clayey fine to medium SAND (SM-SC)		5					Offset 5.0 feet and re-drilled boring E-2A to obtains Shelby sample @ 13.5' to 15.5'
			10	S-2	3 - 3 - 3	DS	18"	
5.9		12.0						
	White to tan and orange, moist, Clayey fine to coarse SAND, (SC) (Decomposed Rock)			S-3	4 - 4 - 7	DS	18"	Residual material from S-3
			15					
0.4		17.5						
	Reddish gray, mottled, slightly moist, Clayey Silt, little fine Sand(ML) (Decomposed Rock)			S-4	6 - 9 - 13	DS	18"	
			20					

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS : 8.0 feet
AT COMPLETION : 4.0 feet CAVED 4.0 feet
AT 24 Hours
WATER : 1.7 feet CAVED

ENGINEERING • CONSULTATION •
E2CR inc.
CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E-2
PROJECT No. : 00546-04

ELEV : 17.9
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/27/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH : 9/27/00
SPOON O.D. : 2 In.
FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
-2.1			20					
-2.6	Orange and gray, moist, Clayey SILT, little fine Sand (ML) (Decomposed Rock)	20.5		S-5	10 - 13 - 18	DS	18"	
-5.1	Red, gray and olive green, mottled, moist, Clayey SILT, little fine Sand (ML) (Decomposed Rock)	23.0	25	S-6	6 - 10 - 16	DS	18"	
-10.1	Yellowish gray to olive green, slightly moist, Clayey SILT and fine to medium Sand (ML) (Decomposed Rock)	28.0	30	S-7	12 - 19 - 14	DS	18"	
-14.1	Gray, slightly moist, fine Sandy SILT (ML) (Decomposed Rock)	32.0	35	S-8	24 - 21 - 34	DS	18"	
			40	S-9	18 - 41 - 38	DS	18"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER
WATER ON RODS : 8.0 feet
AT COMPLETION : 4.0 feet — CAVED 4.0 feet
AT 24 Hours
WATER : 1.7 feet — CAVED

ENGINEERING • CONSULTATION •

E2 C R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E-2

Location : See Test Boring Location Plan

PROJECT No. : 00546-04

ELEV: 17.89 | DATE START : 9/27/00 | FINISH : 9/27/00
HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA | ROCK CORE DIA.

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
-22.11	Gray, slightly moist, fine Sandy SILT (ML) (Decomposed Rock)		40					
			45	S-10	17 - 22 - 38	DS	18"	
-32.11		50.0	50	S-11	30 - 132 - 50/5"	DS	12.5"	
	Bottom of Boring at 50.0 feet							
			55					
			60					

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS : 8.0 feet
AT COMPLETION : 4.0 feet CAVED 4.0 feet
AT 24 Hours
WATER : 1.7 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E-3

Location : See Test Boring Location Plan

PROJECT No. : 00546-04

ELEV 13.0 | DATE START : 10/3/00 | FINISH: 10/4/00
HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA | ROCK CORE DIA. :

ELEV	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
13.0	Reddish brown, Silty fine to coarse SAND and GRAVEL (SM-GM)		0					
			5	S-1	10 - 9 - 6	DS	18"	
7.0	Light gray, moist, Silty fine to coarse SAND, trace Mica (SM)	6.0						
			10	S-2	9 - 8 - 6	DS	18"	
2.0	Light brown, wet, fine to coarse SAND and GRAVEL, trace Clay (SM)	11.0						
			15	S-3	11 - 16 - 18	DS	14"	
-4.5	Light brown, Light brown, wet, Sandy GRAVEL, trace Silt and mica (GM)	17.5						
			20	S-4	13 - 15 - 8	DS	12"	

LEGEND
DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER
WATER ON RODS : 2.60 feet
AT COMPLETION : CAVED
AT 24 Hours
WATER : 2.60 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E-3

PROJECT No. : 00546-04

ELEV : 13.0
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 10/3/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH: 10/4/00
SPOON O.D. : 2 In. FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
-7.0			20					
-8.0	White, moist, fine Sandy SILT (ML)	21.0						
				S-5	7 - 11 - 23	DS	18"	
			25					
-14.0	White to orange brown, moist, Silty fine to medium SAND, trace Clay (SM) (Decomposed Rock)	27.0						
				S-6	18 - 38 - 94	DS	18"	
			30					
-19.0	White to orange brown, moist, fine to medium Sandy SILT (ML) (Decomposed Rock)	32.0						
				S-7	48 - 78 - 50/2"	DS	14"	
			35					
				S-8	17 - 23 - 24	DS	18"	
			40					

LEGEND
DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER
WATER ON RODS : 2.60 feet
AT COMPLETION : CAVED
AT 24 Hours
WATER : 2.60 feet CAVED

ENGINEERING • CONSULTATION •

E2CR inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E-3

Location : See Test Boring Location Plan

PROJECT No.: 00546-04

ELEV: 13.0 | DATE START : 10/3/00 | FINISH : 10/4/00
HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA | ROCK CORE DIA. :

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
-27.0	White to orange brown, moist, fine to medium Sandy SILT (ML) (Decomposed Rock)		40					
			45	S-9	15 - 23 - 33	DS	18"	
-34.0	Olive green, slightly moist, Sandy CLAY (CL) (Decomposed Rock)	47.0						
-37.0	Bottom of Boring at 50.0 feet	50.0	50	S-10	26 - 40 - 69	DS	18"	
			55					
			60					

LEGEND
- DS DRIVEN SPOON
- ST SHELBY TUBE
- PS PISTON SAMPLE
- RC ROCK CORE
- HSA HOLLOW STEM AUGER
- DC DRIVEN CASING
- MD MUD DRILLING

GROUND WATER
WATER ON RODS : 2.60 feet
AT COMPLETION : CAVED
AT 24 Hours
WATER : 2.60 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E – 4

Location : See Test Boring Location Plan

PROJECT No. : 00546–04

ELEV 12.2
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/29/00
HAMMER DROP : 30 In.
ROCK CORE DIA. :

FINISH : 10/2/00
SPOON O.D. : 2 In. FOREMAN : B. Taylor

ELEV	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
12.20	Light reddish brown, moist to saturated, fine to coarse SAND, little to some fine to coarse Gravel, trace Silt and mica (SM)		0					
			5	S–1	8 – 12 – 13	DS		Offset 11.5' East and re–drilled boring E–4A to obtain Shelby tube sample from 37' to 37.5'
			10	S–2	6 – 9 – 11	DS		
			15	S–3	9 – 16 – 22	DS		
			20	S–4	12 – 18 – 17	DS		

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS : 8.0 feet
AT COMPLETION : CAVED
AT 72 Hours
WATER : 8.50 feet CAVED

ENGINEERING • CONSULTATION •
E/2 C/R inc.
CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E – 4
PROJECT No. : 00546–04

ELEV : 12.2
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/29/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH : 10/2/00
SPOON O.D. : 2 In.
FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
−7.8	Light reddish brown, moist to saturated, fine to coarse SAND, little to some fine to coarse Gravel, trace Silt and mica (SM)		20					
−9.8	Light Gray, moist, Silty fine SAND, little mica (SM)	22.0						
			25	S–5	24 – 28 – 28	DS		
−13.8	Orange and white, slightly moist, Clayey fine to medium SAND, trace Gravel (SC)	26.0						
			30	S–6	14 – 41 – 97	DS		
−19.8	Orange brown and white, moist, Sandy SILT and CLAY (ML–CL) (Decomposed Rock)	32.0						
			35	S–7	17 - 100/4"	DS		
			40	S–8	16 – 16 – 21	DS	18"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER
WATER ON RODS : 8.5 feet
AT COMPLETION : CAVED
AT - 72 Hours
WATER : 8.50 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No. : E – 4

Location : See Test Boring Location Plan

PROJECT No. : 00546–04

ELEV: 12.2
DATE START : 10/2/00
FINISH : 10/2/00
HAMMER : 140 Lbs
HAMMER DROP : 30 In.
SPOON O.D. : 2 In
FOREMAN : B. Taylor
BORING METHOD : HSA
ROCK CORE DIA. :

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
−27.80	Orange brown and white, moist, Sandy SILT and CLAY (ML–CL) (Decomposed Rock)		40					
			45	S–9	45 – 38 – 32	DS		
−34.80	Olive green, slightly moist, fine Sandy SILT and CLAY (ML–CL) (Decoposed Rock)	47.0						
			50	S–10	16 – 26 – 31	DS		
−37.80	Bottom of Boring at 50.0 feet	50.0						
			55					
			60					

LEGEND
- DS DRIVEN SPOON
- ST SHELBY TUBE
- PS PISTON SAMPLE
- RC ROCK CORE
- HSA HOLLOW STEM AUGER
- DC DRIVEN CASING
- MD MUD DRILLING

GROUND WATER
WATER ON RODS : 8.0 feet
AT COMPLETION : CAVED
AT 72 Hours
WATER : 8.50 feet CAVED

ENGINEERING • CONSULTATION •
E2CR inc.
CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E – 5
PROJECT No. : 00546–04

ELEV 32.1
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/28/00
HAMMER DROP : 30 In.
ROCK CORE DIA. :

FINISH : 9/29/00
SPOON O.D. : 2 In. FOREMAN : B. Taylor

ELEV	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
32.12	Reddish brown, moist, Silty fine to coarse SAND, trace to some fine to medium Gravel, trace Clay, with wood fragments near base (SM) (Fill)		0					
			5	S–1	10 – 19 – 26	DS	3"	
			10	S–2	10 – 12 – 22	DS	18"	
			15	S–3	11 – 12 – 17	DS	18"	
			20	S–4	17 – 9 – 6	DS	4"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS :
AT COMPLETION : CAVED
AT 120 Hours
WATER : 28.9 feet CAVED

ENGINEERING • CONSULTATION •

E2CR inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E – 5

PROJECT No. : 00546–04

ELEV : 32.1
DATE START : 9/28/00
FINISH : 9/29/00
HAMMER : 140 Lbs
HAMMER DROP : 30 In.
SPOON O.D. : 2 In.
FOREMAN : B. Taylor
BORING METHOD : HSA
ROCK CORE DIA.

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
12.1	Reddish brown, moist, Silty fine to coarse SAND, trace to some fine to medium Gravel, trace Clay, with wood fragments near base (SM) (Fill)		20					
9.1	Dark brown, moist, Silty fine to medium SAND, trace fine to coarse Gravel with wood fragments (Fill)	23.0						
			25	S–5	8 – 7 – 28	DS	18"	
			30	S–6	9 – 9 – 9	DS	18"	
			35	S–7	20 – 11 – 12	DS	14"	
			40	S–8	11 – 8 – 8	DS	1"	

LEGEND
DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER
WATER ON RODS :
AT COMPLETION : CAVED
AT 120 Hours
WATER : 28.9 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No.: E – 5

Location : See Test Boring Location Plan

PROJECT No.: 00546–04

ELEV: 32.12 | DATE START : 9/28/00 | FINISH : 9/29/00
HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA | ROCK CORE DIA. :

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
−7.88	Dark brown, moist, Silty fine to medium SAND, trace fine to coarse Gravel with wood fragments (Fill)		40					
−10.88	Dark brown, moist, organic SILT (MH)	43.0						
			45	S−9	7 – 7 – 11	DS	18"	
−14.88	Medium Brown, saturated, Silty fine to coarse SAND and GRAVEL (SM−GM)	47.0						
			50	S−10	11 – 16 – 8	DS	12"	
−19.88	Red, moist, Clayey SILT, some Sand (ML) (Decomposed Rock)	52.0						
			55	S−11	8 – 11 – 15	DS	18"	
			60	S−12	14 – 19 – 30	DS	18"	

LEGEND

DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER

WATER ON RODS :
AT COMPLETION : CAVED :
AT 120 Hours
WATER : 28.9 feet CAVED :

ENGINEERING • CONSULTATION •

E2 C R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No. : E – 5

PROJECT No. : 00546–04

ELEV: 32.12
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/28/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH : 9/29/00
SPOON O.D. : 2 In. FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
−27.88	Red, moist, Clayey SILT, some Sand (ML) (Decomposed Rock)		60					
			65	S–13	10 – 11 – 23	DS	18"	
			70	S–14	13 – 21 – 27	DS	18"	
			75	S–15	11 – 19 – 17	DS	18"	
			80	S–16	6 – 17 – 36	DS	18"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS :
AT COMPLETION : CAVED
AT 120 Hours -
WATER : 28.9 feet CAVED

ENGINEERING • CONSULTATION •

E/2 C/R inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No.: E – 5

Location : See Test Boring Location Plan

PROJECT No.: 00546–04

ELEV: 32.12
DATE START : 9/28/00
FINISH : 9/29/00
HAMMER : 140 Lbs
HAMMER DROP : 30 In.
SPOON O.D. : 2 In. FOREMAN : B. Taylor
BORING METHOD : HSA
ROCK CORE DIA. :

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
	Red, moist, Clayey SILT, some Sand (ML) (Decomposed Rock)		80					
				S–17	19 – 17 – 15	DS	18"	
–51.88	Bottom of Boring at 85.0 feet	85.0	85					
			90					
			95					
			100					

LEGEND
DS DRIVEN SPOON
ST SHELBY TUBE
PS PISTON SAMPLE
RC ROCK CORE
HSA HOLLOW STEM AUGER
DC DRIVEN CASING
MD MUD DRILLING

GROUND WATER
WATER ON RODS :
AT COMPLETION : CAVED :
AT 120 Hours
WATER : 28.9 feet CAVED :

ENGINEERING • CONSULTATION •

E2CR inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland

BORING No.: E – 6

Location : See Test Boring Location Plan

PROJECT No.: 00546–04

ELEV: 6.7 | DATE START : 9/29/00 | FINISH: 9/29/00

HAMMER : 140 Lbs | HAMMER DROP : 30 In. | SPOON O.D. : 2 In. FOREMAN : B. Taylor

BORING METHOD : HSA | ROCK CORE DIA. :

ELEV.	DESCRIPTION	DEPTH	SCALE	No.	Blows / 6 in	TYPE	REC	NOTES
6.7	Red and gray to brown, moist, Silty CLAY and Sandy SILT (CL)		0					
			5	S–1	3 – 4 – 5	DS	18"	
				S–2	3 – 4 – 7	DS	18"	
–1.3	Medium brown, moist, Clayey fine to medium SAND, trace fine to medium Gravel (SC)	8.0						
			10	S–3	15 – 11 – 9	DS	18"	
–6.3	Reddish brown and gray, moist, Sandy CLAY (CL)	13.0						
			15	S–4	3 – 4 – 4	DS	18"	
				S–5	2 – 3 – 3	DS	18"	
–11.3	Medium brown to dark brown, moist, organic SILT, trace fine Sand and charcoal fragments (MH)	18.0						
			20	S–6	2 – 1 – 2	DS	18"	

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER

WATER ON RODS : 8.51 feet

AT COMPLETION : CAVED

AT 96 Hours

WATER : 8.31 feet CAVED

ENGINEERING • CONSULTATION •

E2CR inc.

CONSTRUCTION • REMEDIATION •

Boring Log

PROJECT: Stancill Sand & Gravel Quarry
Cecil County, Maryland
Location : See Test Boring Location Plan

BORING No.: E – 6

PROJECT No. : 00546–04

ELEV: 6.7
HAMMER : 140 Lbs
BORING METHOD : HSA

DATE START : 9/29/00
HAMMER DROP : 30 In.
ROCK CORE DIA.

FINISH: 9/29/00
SPOON O.D. : 2 In.
FOREMAN : B. Taylor

ELEV.	DESCRIPTION	DEPT	SCALE	NO.	Blows / 6 in	TYPE	REC	NOTES
	Medium brown to dark brown, moist, organic SILT, trace fine Sand and charcoal fragments (MH)		20					
			25	S–7	1 – 1 – 3	DS	18"	
			30	S–8	1 – 2 – 2	DS	18"	
			35	S–9	1 – 2 – 3	DS	18"	
–33.26		40.0	40	S–10	2 – 2 – 3	DS	18"	
	Bottom of Boring 40.00 feet							

LEGEND

DS	DRIVEN SPOON
ST	SHELBY TUBE
PS	PISTON SAMPLE
RC	ROCK CORE
HSA	HOLLOW STEM AUGER
DC	DRIVEN CASING
MD	MUD DRILLING

GROUND WATER
WATER ON RODS : 8.51 feet
AT COMPLETION : CAVED
AT 96 Hours
WATER : 8.31 feet CAVED

Appendix C

Inventory of Wells In The Vicinity Of The Site

```
SQL> start grid_search1
Input truncated to 1 characters
Enter value for min_n_grid: 630000
Enter value for max_n_grid: 636000
old   5: WHERE N_GRID27 BETWEEN &MIN_N_GRID AND &MAX_N_GRID
new   5: WHERE N_GRID27 BETWEEN 630000 AND 636000
Enter value for min_e_grid: 1072000
Enter value for max_e_grid: 1078000
old   6:    AND E_GRID27 BETWEEN &MIN_E_GRID AND &MAX_E_GRID
new   6:    AND E_GRID27 BETWEEN 1072000 AND 1078000
```

NORTH	EAST	PERMIT	DEPTH	gpm RATE	Water Level BEFORE	DURING	Use U	OWNER	ROAD
630000	1075000	CE730536 (Cancelled)					D	INGRAM, JAS J	BURNT BARN
630000	1075000	CE732386	177	30	110	160	D	ROGERSON, HARRY	MOUNTAIN HILL
630000	1075000	CE733091	70	30	18	45	D	RITTENHOUSE, NORMAN	BURNT BARN RD
630000	1075000	CE732902	165	30	90	118	D	BOSTIC, STEPHEN	BURNT BARN RD
630000	1076000	CE811340	157	32	90	157	D	ALEXANDER JOSEPH	MOUNTAIN HILL RD
630000	1077000	CE810773	175	10	98	150	D	BARBERO JAMES	MOUNTAIN HILL RD
630000	1077000	CE812079	124	12	100	105	D	MONTGOMERY BROS INC	MOUNTAIN HILL RD
632000	1076000	CE880487	140	20	90	130	D	ALBANESE JOHN	MOUNTAIN HILL RD
632000	1077000	CE812582	165	20	137	160	D	MONTGOMERY BROS INC	MOUNTAIN HILL
633000	1074000	CE733987	210	11	20	80	I	STANCILLS INC	MOUNTAIN HILL RD
634000	1075000	CE881819	300	2	50	210	D	GRAY EDWARD	MOUNTAIN HILL RD
634000	1075000	CE882359	600	1	95	470	D	JACKSON JAMES	MT HILL
635000	1074000	CE810473	225	3	70	225	D	GRAY E G	MOUNTAIN HILL RD
635000	1075000	CE730741	260	2	30	180	D	PORTER, GEORGE	JACKSON STA RD
635000	1075000	CE731295 (Cancelled)					D	CURRIN, LINDA	MOUNTAIN HILL RD
635000	1075000	CE731339	185	30	99	128	D	BETTER HOMES INC	MT VIEW RD
635000	1075000	CE731401	181	25	99	124	D	MCELYEA, WILLIAM	MT VIEW RD

```
17 rows selected.

SQL> spool off
```

pdw_no	Owner	Use Tu	Name_road	North ~~Dlatitu~~	East ~~Tlongitu~~	Depth Treal	GPM Rate_	Water Level Befor	Durin
E-81-2235	DELMARVA	I	MD RD 272	6120000	10870000	174	135	98	136
E-73-3229	MORNING CHEER	I	MD 272	6200000	10900000	88	50	34	42
E-81-3759	MORNING CHEER	I	MD 272	6240000	10910000	95	45	35	62
E-73-2957	CHESTNUT PT	I	CARPENTERS Pt	6250000	10750000	93	45	68	84
E-81-0339	CARPENTERS PT	P	CARPENTERS "	6250000	10790000	90	50	23	84
E-81-1565	CARPENTERPT	P	CARPENTERS "	6250000	10790000	0	0	0	0
E-73-2605	IREY, DON	I	CARPENTERS "	6250000	10800000	70	30	19	30
E-81-2350	CARPENTERS PT	P	CARPENTERS "	6260000	10790000	91	40	31	63
E-88-2600	CRAFT HAVEN	I	CARPENTER "	6270000	10800000	77	10	45	70
E-81-1480	FRONHEISER	I	CARPENTERS "	6280000	10780000	85	15	40	60
E-88-0702	CHESTNUT PT M	P	CARPENTERS "	6280000	10780000	105	12	60	85
E-71-0020	FIRESTONE	I	MD 7	6300000	10650000	35	15	8	0
E-71-0069	FRONHEISER,	I	CARPENTER PT	6300000	10800000	67	30	13	42
E-73-3203	NE WASTE	I	CARPENTER Point	6300000	10800000	100	18	18	88
E-73-2771	HANCES POINT	P	MD 272	6300000	10900000	92	50	5	63
E-73-2969	N E YACHT Sales	I	HANCE POINT	6300000	10900000	53	15	7	10
E-72-0018	MAGDEBURGER,	I	MD 272	6300000	10950000	53	25	16	40
E-88-1860	HANCES PT	I	WEAVER RD	6310000	10930000	97	15	45	80
E-73-3987	STANCILLS INC	I	MOUNTAIN	6330000	10740000	210	11	20	80
E-81-3090	CHARLESTOWN	I	BLADEN ST	6340000	10880000	150	35	20	60
E-88-2612	TOWN OF	P	CECIL Parkway	6340000	10880000	143	100	14	50
E-92-0245	ELKTON	I	HANCES PT RD	6340000	10960000	70	40	12	40
E-73-3441	MCGRADY,	P	US 40	6350000	10640000	200	3	15	155
E-73-3442	MCGRADY,	P	US 40	6350000	10640000	125	23	15	42
E-71-0262	WILLIAMS,	I	JACKSON	6350000	10650000	80	10	5	0
E-88-0725	FIRST BAPTIST	I	PULASKI HWY	6350000	10650000	224	12	40	138
E-81-3044	SPANGLER JOHN	I	MARKET ST	6350000	10880000	138	30	15	80
CE-71-0185	NORTHEAST	I	MD 272	6350000	10900000	68	50	17	45
CE-81-0593	LEES MARINA	I	WATER ST	6350000	10900000	70	16	4	30
CE-70-0078	CALOTEX OF	I	MD 272	6350000	10950000	127	50	31	100
CE-70-0207	MCDANIEL	I	OLD MD 272	6350000	10950000	75	30	11	65
CE-81-2017	N E LITTLE	I	MD 272	6360000	10970000	100	30	22	73
CE-73-3453	BEACHCOMER	I	MD 7	6370000	10890000	0	0	0	0
CE-73-3931	BEACHCOMBER	I	BLADEN ST	6370000	10890000	50	5	20	30
CE-73-3502	MD DEPT OF	I	US RT 40	6390000	10760000	0	0	0	0
CE-73-3646	STATE HIGHWAY	I	US 40	6390000	10770000	0	0	0	0
CE-72-0019	PHILLIPS	I	RT 222	6400000	10600000	120	18	42	0
CE-73-0372	GRACE BAPTIST	I	CRAIGTOWN RD	6400000	10600000	40	15	15	23
CE-73-0635	WILLIAMS TRLR	I	US 222	6400000	10600000	0	0	0	0
CE-73-1762	JACKSON, ROSS	I	OLD 222	6400000	10600000	75	8	25	75
CE-73-2286	TRI STATE	I	US RT 40	6400000	10800000	204	30	60	100
CE-73-2691	COUNTY COMM	I	MD RT 7	6400000	11000000	80	1	33	70
CE-88-2555	SNNOD OF	I	HAPPY VALLEY	6430000	10580000	238	18	48	140
CE-88-2590	SYNOD OF	I	HAPPY VALLEY	6430000	10580000	250	15	40	200
CE-88-2654	FIRST BAPTIST	I	BAINBRIDGE	6440000	10590000	150	10	10	75
CE-73-2814	HOPKINS JR.	I	US RT 222	6450000	10550000	125	7	30	80
CE-73-0002	ASBURY	I	MD 222 OLD	6450000	10600000	117	6	60	117
CE-73-0366	VERDEL	I	NORTHEASTERN	6450000	10750000	110	10	78	90
CE-73-1877	SHIVERY	I	US 40	6450000	10950000	155	10	30	100
CE-73-2618	CHUCK HOUSE	I	US 40	6450000	10950000	102	4	20	80
CE-73-2674	TRAINER,	I	MD 272	6450000	10950000	370	4	25	350
CE-72-0081	UNITED	I	U S 40	6450000	11000000	140	1	25	140
CE-72-0233	UNITED	I	U S 40	6450000	11000000	0	0	0	0
CE-73-0997	SLAYSMANS	I	US RT 40	6450000	11000000	0	0	0	0
CE-73-2358	C & D GRAIN	I	RT 40 &	6450000	11000000	214	3	50	150
CE-73-2494	FIRST UNITED	I	US 40	6450000	11000000	190	9	25	170
CE-73-3103	LITZENBERG.	I	US RT 40	6450000	11000000	280	3	15	250
CE-81-0308	CECIL CO BD	I	PRESTON DR	6460000	10600000	310	42	50	115

pdw_no	Owner	Tu	Name_road	Tlattitu	Tlongitu	Treal	Rate_	Befor	Durin
CE-73-3988	MLJ GRAVEL &	I	275	6460000	10630000	32	9	21	32
CE-73-3503	L AND D	I	#276	6470000	10630000	65	5	28	65
CE-81-0430	INTERSTATE	I	RT 275	6480000	10630000	150	10	50	100
CE-81-0040	HOWARD LOWELL	I	US 40	6490000	10970000	300	15	30	200
CE-92-0140	CLEMENTS	I	RT 40	6490000	10980000	200	20	18	190
CE-81-1944	HARRISON JOHN	I	PULASKI HWY	6490000	11000000	163	12	30	163
CE-88-1115	HARRISON JOHN	I	RT 40	6490000	11000000	320	4	19	226
CE-81-0234	MD MANOR	I	RT 40	6490000	11010000	150	25	25	150
CE-81-3337	BAY COUNTRY	I	W PULASKI	6490000	11020000	295	8	35	250
CE-88-1791	BURKHEIMER	I	PULASKI HWY	6490000	11020000	275	15	26	75
CE-70-0157	BENJAMIN, John	I	276	6500000	10500000	96	14	20	80
CE-73-0225	BENJAMIN, John	I	MD 276	6500000	10550000	90	20	15	90
CE-73-1763	PERKINS,	I	COKESBURY	6500000	10550000	200	20	25	200
CE-73-2374	Presbyterian CH PLEASANTVIEW	I	*	6500000	10550000	125	6	40	125
CE-73-0731	SHERRARD, A C	I	JACKSON PARK	6500000	10600000	165	12	35	0
CE-73-3237	WALKER,	I	RED TOAD RD	6500000	10850000	375	10	30	350
CE-70-0253	CIRCLE [illegible]	I	MECHANICS Valley	6500000	10900000	168	8	18	78
CE-73-1176	LITHRO CARTON	I	OLD LESLIE	6500000	10950000	128	12	60	128
CE-73-1717	HAMILTON, G	I	MD 272	6500000	10950000	84	6	15	84
CE-81-4074	MARYLAND	I	QUARRY RD	6500000	11010000	312	25	25	100
CE-88-0874	SIMMONS HENRY	P	RT 275	6520000	10570000	200	10	24	160
CE-88-0822	SIMMONS HENRY	P	RT 275	6520000	10580000	400	8	18	250
CE-88-2268	KINGS AUTO	I	255 LINTON	6520000	10680000	0	0	0	0
CE-81-4068	MINKER	I	CRAIGTOWN &	6530000	10580000	300	3	1	150
CE-88-0393	BOUCHELLE	I	BOUCHELLE RD	6530000	11020000	160	5	15	30
CE-92-0045	SHERRARD	P	ORCHARD	6540000	10620000	300	15	55	110
CE-72-0222	EARLEYWINE,	I	RT 276	6550000	10550000	56	50	30	56
CE-73-0975	SHERRARD, A C	I	WAIBEL	6550000	10550000	60	30	6	60
CE-73-2988	WOODLAWN MOB	I	FIRE TOWER	6550000	10600000	137	15	35	137
CE-81-2296	WOODLAWN	I	CAMP MEETING	6550000	10610000	0	0	0	0
CE-71-0070	BOY SCOUTS	I	272	6550000	11000000	50	8	17	25
CE-73-2845	MITCHELL,	I	BOUCHELLS	6550000	11000000	200	20	10	200
CE-81-0306	WOODLAWN	I	CAMPGROUND	6560000	10610000	0	0	0	0
CE-81-0307	WOODLAWN	I	CAMPGROUND	6560000	10610000	0	0	0	0
CE-73-3840	WOODLAWN	I	CAMP GROUND	6560000	10620000	300	10	50	300
CE-81-1467	JONES ALICE M	I	DR CARR RD	6560000	10990000	310	9	5	85
CE-73-3737	CAINBRIDGE	I	TIME HIWAY	6570000	10590000	300	3	40	300
CE-88-2525	MARYLAND Material	I	QUARRY RD	6580000	11000000	325	10	97	205
CE-81-1162	CECIL CO BD	I	MD 272	6590000	10940000	560	15	25	275
CE-81-1230	CECIL COBD	I	MD 272	6590000	10940000	300	6	18	230
CE-81-0015	BAY COUNTRY	I	EBENEZER	6600000	10780000	200	9	20	150
CE-81-0212	BAY-COUNTRY-E	I	EBENEZER-CH	6600000	10790000	200	12	40	130
CE-73-1132	BIBLE Fellowship	I	WA Schoolhouse	6600000	10800000	138	10	25	120
CE-70-0147	BD OF Northeast	I	272	6600000	10900000	222	14	8	68
CE-73-0560	BAYVIEW ELEM	I	272	6600000	10900000	145	18	25	105
CE-73-1219	BAY VIEW Methodist	I	BAILEY RD	6600000	10900000	63	30	25	63
CE-73-2682	BOARD OF Trustees	I	MD 272	6600000	10900000	210	10	18	61
CE-73-3565	CECIL Comm Coll	I	MD 272	6600000	10940000	255	50	50	70
CE-71-0229	MCKINLEY,	I	BOUCHELLE	6600000	10950000	150	9	14	60
CE-73-0188	STONY CHASE	I	BOUCHELLE RD	6600000	10950000	300	15	52	100
CE-73-1009	STONY CHASE	I	BOUCHELLE	6600000	10950000	430	7	22	400
CE-73-3059	STONEY CHASE	I	BOUCHELLE	6600000	10950000	390	30	40	200
CE-88-2529	WEAVER	I	BOUCHELLE	6600000	10970000	287	7	35	240
CE-81-0498	BITUMINOUS	I	QUARRY RD	6600000	11020000	0	0	0	0