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A Survey for Oysters and Shell in the Vicinity of the Proposed Bridge Construction at the Site of the Hampton Boulevard Bridge (Rte. 337) Over the Lafayette River in Norfolk, VA.

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A Survey for Oysters and Shell in the Vicinity of the Proposed Bridge Construction at the Site of the Hampton Boulevard Bridge (Rte. 337) Over the Lafayette River in Norfolk, VA.

Conducted for the

Virginia Department of Transportation

VDOT Project No. 0337-122-113, RW201, Parcel #001

by

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INTRODUCTION

At the request of the Virginia Department of Transportation (VDOT), the Virginia Institute of Marine Science (VIMS) conducted a survey of certain parcels of oyster grounds in the Lafayette River in the immediate vicinity of a proposed construction site for a new bridge across the river on Hampton Blvd., east of the present bridge, in Norfolk, Va.

VDOT's number for this project is 0337-122-113, RW201, Parcel #001.

The section of river bottom to be surveyed was delineated by the Department of Transportation on their preliminary engineering construction plans. It consisted of a strip immediately adjacent to and parallel to the present bridge, across two oyster grounds leased by Holland Fisheries, Inc. (Virginia Marine Resources Commission Plat File No. 1403, along the whole length of the bridge SSW of the bulkhead under the bridge, and Plat File No. 4587, adjoining No. 1403 at the SSW bulkhead and extending past the NNE bulkhead for approximately 140 ft.) and a public oyster ground (Public Ground No. 7), which adjoins ground No. 4587 at its NNE edge and extends in the same direction for approximately 150 ft (Figure 1).

The strip is demarcated in the plans within a "Proposed Present and Future Limits of Construction & Restricted Area" and is approximately 1698 ft. long on the edge immediately adjacent to the bridge, but its width varies from one end to the other.

The survey was conducted between May 7 and 10, 1991. Collection of field data was done by Reinaldo Morales-Alamo and Kenneth S. Walker. The final report was prepared by Mr. Morales-Alamo and Dr. Roger Mann.

DESCRIPTION OF SURVEY AREA

Three oyster ground parcels were surveyed within the strip; an additional parcel outside the strip boundaries was also surveyed to obtain supplementary information. Location of the four parcels is given below:

PARCEL I : This parcel was identified in the engineering plans as "Parcel 001". It was approximately 1043 long alongside the bridge and 150 ft. wide and parallel to the bridge across most of ground No. 1403 but bent at a 150-degree angle towards the SSW end of the bridge, approximately 250 ft. from that end (Figure 1). The total area of this parcel was estimated to be 3.3 acres.

PARCEL II : PARCEL II was the additional parcel sampled for supplementary information. It consisted of a rectangular area parallel to the bridge ESE of PARCEL I, approximately 25 ft from that parcel (Figure 1). It was approximately 475 ft long and 80 ft wide. Its area was estimated to be 1.3 acres.

PARCEL III : This parcel was located between Ground No. 1403 and Public Ground No. 7 and crossed the navigation channel located between the north boundary of Ground No. 1403 and the Norfolk Yacht and Country Club piers on the NNE side of the parallel bulkheads under the bridge (Figure 1). Its length was approximately 225 ft. alongside the bridge; its maximum width was approximately 75 ft at its boundary with Ground No. 1403 and it was aproximately 38 ft wide at its boundary with Public Ground No. 7. The area of this parcel was estimated at 0.3 acre.

PARCEL IV : This parcel adjoined Parcel II at its NNE margin and included part of Public Ground No. 7 (Figure 1). It was approximately 150 ft long alongside the bridge; its width was approximately 160 ft on the SSW edge adjoining Ground No. 4587 and approximately 85 ft wide on its NNE margin. The estimated area of this parcel was 0.3 acre.

Preliminary soundings of the bottom with a 3/4-inch-diameter copper pipe indicated that the bottom in most of the survey area was muddy with a thin layer of shells over it. This was deduced from the fact that the pipe penetrated the bottom with ease and could be pushed far into the bottom but at the same time the presence of shells was detected frequently by the scratchy sound produced when the pipe struck the shells. Subsequent examination of the material brought up in the oyster tongs showed that the muddy sediments included noticeable sand and clay fractions. The presence of mud (mixed with sand and clay) and buried shells in most of the samples, as well as the collection of softshell clams and angel-wing clam shells in several of them (these two organisms live in bottom burrows) substantiates our conclusion that the ground surveyed supported only a thin layer of oyster shells on its surface. The mud bottom, however, appeared compacted enough to sustain oysters and shells above the bed surface. The bottom on the extreme SSW margin of the survey area, near the shore, was found to include a substantial quantity of hard sandy sediments.

Water salinity in the Lafayette River ranges between 18 and 24 $^{o}/oo$ and is similar to that found in Hampton Roads. That salinity range is within the optimum range for oyster culture. It is also, however, within the optimum range for growth and development of the oyster pathogens "MSX" (*Haplosporidium nelsoni*) and "Dermo" (*Perkinsus marinus*), which have decimated oyster populations in Hampton Roads and vicinity. The Lafayette River and its tributaries have also been included since 1983 in a special restricted area by the Virginia State Department of Health, within which all shellfish harvesting and relaying is prohibited. The special restricted area is defined in the State Department of Health's "Notice and Description of Shellfish and Condemnation Number 7, Hampton Roads, effective 15 June 1983".

METHODS OF SAMPLE COLLECTION

The boundaries of the survey area as well as the boundaries of the oyster grounds included within it were located and marked with stakes by surveyors from the Virginia Marine Resources Commission. We used those markers to locate the area and mark the points to be sampled within that area.

A series of 21 transects perpendicular to the bridge formed the core of the sampling scheme used. The transects were located as extensions of the lines formed by each of 26 parallel rows of support concrete piles under the bridge. The outside pile of each row on the ESE side of the bridge had previously been numbered successively 1 through 26, beginning at the NNE end of the bridge. The rows of piles were separated by distances that alternated between 60 and 70 ft. The distance between an odd-numbered pile and the immediately following even-numbered pile in a SSW direction was approximately 70 ft but the distance between an even-numbered pile and the immediately following odd-numbered pile in a SSW direction was only approximately 60 ft.

The numbering sequence of the piles and the alternating distances between them was broken up by the pile arrangement immediately adjacent to the navigation channel bulkheads, where the concrete piles adjoining the bulkheads were only approximately 30 ft from pile row 10 on the NNE side and from pile

11 on the SSW side; the distance across the navigation channel between the bulkheads was approximately 75 ft. The two rows of piles adjoining the bulkheads were not included in the numbering sequence (see Figure 1).

Sampling points on each transect were located by attaching a rope to the outside pile and extending it along the transect, aligned with the row of piles. Samples were collected at 50-ft intervals marked on the rope.

In PARCEL I, the first sampling point off the pile was located at a distance of 50 ft on all even-numbered transects and on Transect 11; on all odd-numbered transects in the same parcel, except for Transects 1 and 11, the first sampling point off the pile was located at a distance of 25 ft with all subsequent ones 50 ft apart (see Figure 1). Points sampled in PARCEL II were located along even-numbered transects 12 through 22 and on transect 11; they were 50 ft from the last sampling point on the same transect in PARCEL I. Points selected for sampling in PARCEL III were located at points 20-25 ft from the bridge piles and along the ESE boundary of the parcel which resulted in uneven distances between points along the transects. Sampling points in PARCEL IV were located at distances of 25 and 75 ft from the piles along the two short transects included.

Samples were collected with an 18-ft-long pair of oyster tongs. The tongs' shafts were adjusted so that the distance between the open heads would be 20 inches, which combined with the head-width of 2 ft provided a sample area of 3.33 ft^2. Maximum penetration of the tongs' heads into the bottom was estimated at 2.5 inches. A single oyster tongs grab was collected at each sampling point.

A Ponar bottom grab (similar in construction and operation to a clamshell dredge but considerably smaller in size) was used in an attempt to collect samples in Parcel II because there the water was too deep for sampling with the oyster tongs. The grab was dropped to the bottom fully opened and upon hitting the bottom, a latch was automatically tripped allowing the grab to close; through a series of jerks on the rope, the grab was shut tight and caused to dig into the bottom . The area sampled by the grab was 0.6 ft^2.

Information recorded from each sample included:

1) The number of live oysters, broken down into market (3 in. or larger), small (smaller than 3 in., excluding spat) and spat (young-of-the year).

2) The number of oyster boxes. A box is a pair of shell halves still hinged together but open and without any oyster meat inside. Oyster boxes were classified as "recent" if the inside of the shells was clean, indicating that the oyster had died very recently, most likely within the previous week, or as "old" if the inside of the shells was distinctly covered by fouling organisms, indicating that the oyster had most likely been dead for a period exceeding one week.

3) Numbers of other organisms found in the sample. These were limited to large organisms easily seen without magnification: primarily slipper shells (*Crepidula convexa*), hooked mussels (*Ischadium recurvum*), angel-wing clams (*Cyrtopleura costata*), mud crabs (family Xanthidae), softshell clams (*Mya arenaria*) and barnacles (species not identified).

4) The volume of loose shells above the bottom (surface shells) and of shells buried in the mud (identifiable by their color, either gray or white, and the absence of any fouling growth on them).

The number of oysters per bushel was obtained by dividing the number of oysters and spat by the total volume of bottom material collected, which included the volume of surface and buried shells and boxes (counted as two shells each) as well as that of the oysters themselves, even though the volume of boxes and oysters was almost negligible when compared with the volume of shells. The quantity of oysters and shells within the survey area was calculated by converting the combined number and volume in all the samples collected from each parcel into bushels per unit area in acres (based on the number of grabs taken at the parcel and the area sampled by each grab, 3.3 ft^2) and multiplying that value by the total number of acres in the parcel. The monetary value of those quantities was then estimated from the most current market information available.

RESULTS

The numerical information obtained from each of the individual samples appears in Table 1 and a summary of the estimates of total volume of oysters and oyster shells in the parcels appears in Table 2. They are described separately for each parcel below.

SUMMARY OF NUMERICAL INFORMATION (TABLE 1).

PARCEL I.

Market oysters were found in only 11 (28%) of the 40 samples collected, but they were very few, making up only 8% of the total number of oysters and spat collected. Most of the oysters found (71%) were small and 22% were spat. The number of oysters per grab was 0.5 for markets, 4.2 for small and 1.3 for spat. Many boxes were found in the samples (89) but most of them (78%) were old boxes which may represent an accumulation over many months.

There were twice as many surface shells as there were buried ones but it should be pointed here that most of the surface shells were found to be free of fouling; this suggests that they were intermittently covered by a layer of muddy sediments which prevented fouling organisms from establishing permanent settlements on those shells.

The number (and, in parentheses, the number per qt of surface shells) of slipper shells (1.8), hooked mussels (0.7) and barnacles (1.8) (representing the fouling community on the shells) found in the samples was fairly low in terms of what is usually found on bottoms with a substantial layer of unburied shells.

The frequency with which softshell clams and angel-wing clam shells were found was an indication that the tongs were easily penetrating through the shell cover and sampling the muddy bottom beneath, suggesting that shell cover was fairly thin.

PARCEL II.

The data obtained from the samples collected in Parcel II were of the same magnitude as those collected in Parcel I. This lends support to the accuracy of our estimates for abundance of oysters and shells in Parcel I.

Market oysters were found in 6 (43%) of the 14 samples collected, but, as in Parcel I, they were very few, making up only 13% of the total number of oysters and spat collected. Most of the oysters found (71%) were small and 16% were spat. The number of oysters per grab was 0.9 for markets, 4.9 for small and 1.1 for spat. Most of the boxes found in Parcel II samples (78%) were old boxes.

There were twice as many surface shells as there were buried ones but, as in Parcel I, most of the surface shells were found to be free of fouling.

The number of slipper shells, hooked mussels and barnacles found in the samples was also fairly low in terms of what is usually found on bottoms with a substantial layer of unburied shells. Number per qt of surface shells for those three organisms were respectively, 0.9, 0.4 and 1.4, somewhat lower than in Parcel I.

No angel-wing shells were found in this parcel and the frequency of softshell clams was about half of what was seen in Parcel I, but the indication that the shell cover on the bottom was thin was still evident from our information.

PARCEL III.

This parcel could not be sampled adequately because the water depth exceeded 16 ft over most of it. We were able to sample only one point (sample no. 59 in Figure 1) at the NNE boundary of the parcel next to the bridge and that information cannot be used to derive accurate estimates for the whole parcel.

Attempts at sampling with the Ponar bottom grab were not successful because shells on or in the bottom prevented the grab from shutting tightly. A few oyster shells were brought up in each of the sampling attempts and some were always found caught between the grabs cutting edges, which is what prevented the grab from shutting tightly.

Although we were not able to sample the bottom in Parcel III adequately, the presence of shells in each grab led us to assume that the bottom in the navigation channel was not just mud and that oysters and shells were probably present there in numbers comparable to those found in Plot I.

PARCEL IV.

The percent frequency distribution of oysters of different sizes in Parcel IV was similar to that in Parcels I and II. Market oysters were found in 2 of the 4 samples collected, but there were only 4, making up only 6% of the total number of oysters and spat collected. Most of the oysters found (80%) were small and 14% were spat. The number of oysters per grab was higher in this parcel than in Parcels I and II. Although the average for markets (1.0) was similar to that in Parcel II, it was twice that in Parcel I, and the average for small (14.0) was five times greater in Parcel IV than in the other two; the average number of spat per grab in Parcel IV (2.5) was also twice as high as that in Parcels I and II. Most of the boxes found in the Parcel IV samples (78%) were old boxes.

As in Parcels I and II, there were twice as many surface shells as there were buried ones, and most of the surface shells were found to be free of fouling.

The number of slipper shells, hooked mussels and barnacles found Parcel IV was also higher than in Parcels I and II but was still lower than what would be found on bottoms with a substantial layer of unburied shells. Number per qt of surface shells for those three organisms were.respectively, 0.9, 0.4 and 1.4.

No angel-wing shells were found in this parcel but some softshell clams were present.

SUMMARY OF ESTIMATED ABUNDANCE OF OYSTERS AND SHELLS (TABLE 2).

Part A of Table 2 summarizes the total number and volume in bushels of oysters and shells in all the samples collected from each of the parcels. Those values were used in Part B to estimate the total number and volume in each of the parcels.

The final estimates obtained for the two privately-owned parcels of oyster grounds (PARCEL I: Oyster Ground No. 1403, parcel 001, and PARCEL II: Oyster Ground No. 4587) as given in Table 2 are:

VOLUME OF OYSTERS:

MARKETS :

PARCEL I	66 bushels
PARCEL III	6 bushels
TOTAL PARCELS I & III	72 bushels

SMALL AND SPAT (Seed Oysters):

PARCEL I	44 bushels
PARCEL III	4 bushels
TOTAL PARCELS I & III	48 bushels

VOLUME OF SHELLS:

PARCEL I	2508 bushels
PARCEL III	228 bushels
TOTAL PARCELS I & III	2736 bushels

VALUE OF OYSTER SEED AND SHELLS

Seed Oysters:

The current price for a bushel of oyster seed, which would consist of one bushel of bottom material (shells + seed-size oysters), is about $3.85. That price, however, might only be paid for a bushel that contained at least 600 seed oysters. Our estimate for the number of seed oysters per bushel of bottom substrate in the oyster ground surveyed is only 99/bu (Table 2, Part B). It is unlikely that a bushel of bottom material with so few seed oysters would command any commercial value.

Shells:

The current price for a bushel of shells from a shucking house ("house shells") fluctuates around 50 cents. These, however, would be clean, solid shells. The quality of the shells we found on the bottom of the surveyed oyster ground segment were considered to be of a lower quality than that of "house shells". It is difficult, therefore, to place a price per bu on those shells, but any value would be below that for "house shells". Assuming a value of 30 cents/bu, their total value would be 2736 X 0.30 = $820.80 (delivered).

CONCLUSIONS

The oyster ground surveyed by us must have been a healthy and productive ground in years past. It is obvious, however, that the effects of the oyster diseases "MSX" and "Dermo" have for all practical purposes terminated its productivity. This is evident from the fact that the few oysters found, as well as the recently-dead oysters, were small and young (probably less than two-years-old), indicating that oysters were dying before thay could attain a larger size or grow older. The oysters found on the ground would, therefore, be only suitable for sale as seed. Their quantity, however, is so small (99/bu) that it would not be worthwhile harvesting the ground for that purpose.

The relativelly small number of spat found suggests that recruitment of new oysters into these grounds has been very low. The small number of recent boxes found, although an indicator of low recent mortalities, also indicates that the total number of oysters present in the grounds prior to mortalities was still very low.

The sparse productivity of these grounds, associated with the absence of active cultivation, has reduced the shell cover over the bottom to a thin layer of relatively poor quality material. Any value that those shells might have as cultch material for use on other productive grounds would be small and not profitable for the lease-holders to sell it.

The presence on this ground of surface shells, small oysters and spat, as well as other organisms such as slipper shells, hooked mussels and mud crabs, indicates that it would be productive if cultivated in the absence of the oyster diseases and restrictions due to contamination of the river waters. The only value that could be assigned to this resource would have to be based on its potential for production sometime in the future. It is impossible at present to predict when, if ever, that would occur, and what the future value of the resource might be.

The above value assessment is rendered moot by the inclusion of the Lafayette River in a special restricted area from which no shellfish may be removed. This, in effect, means that at this time no real value can be assigned to the oysters on the ground. It is assumed that the same is true for the shells.

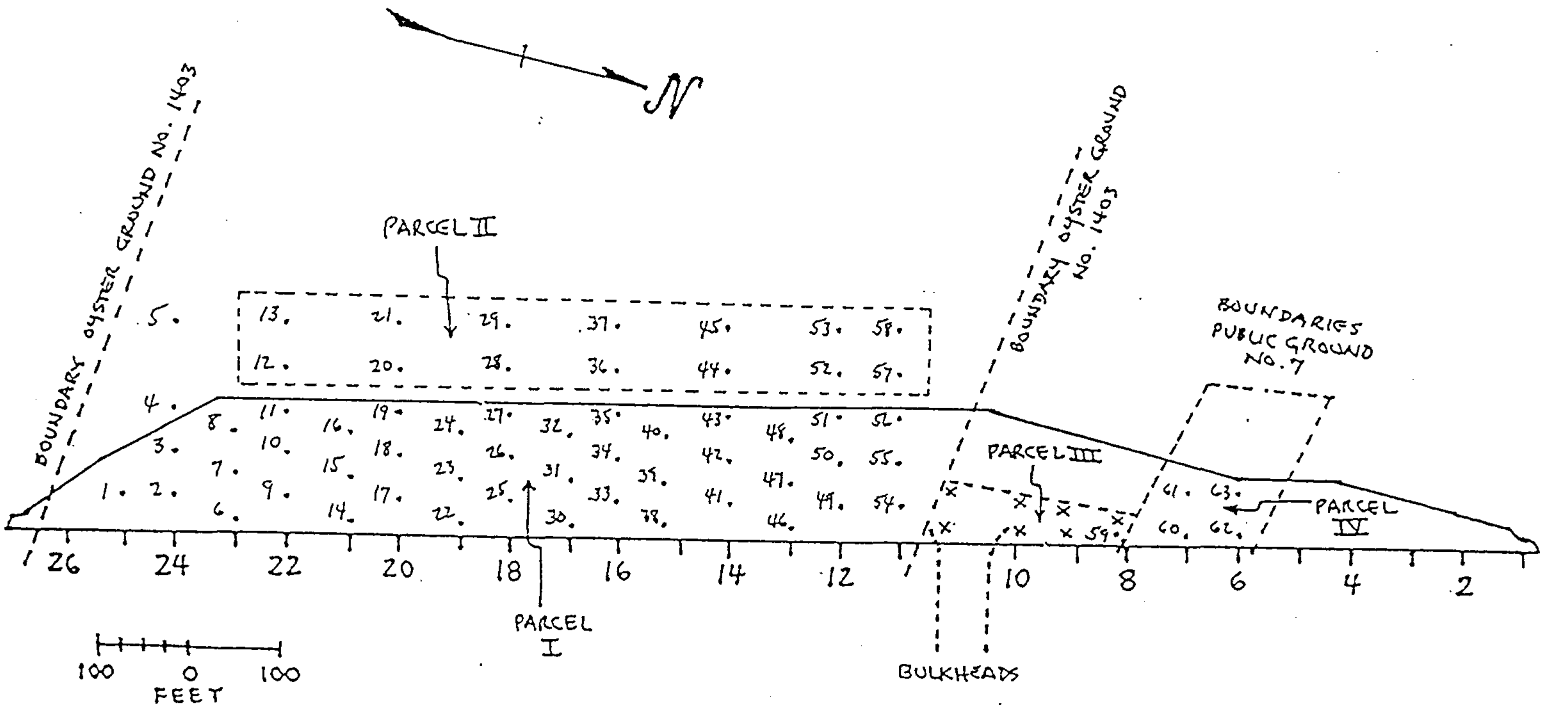

FIGURE 1. Chart illustrating the bottom parcels surveyed for oysters and shells in the Lafayette River by the Hampton Blvd. bridge (State Rte. 337). The solid lines outline the "Proposed Present and Future Limits of Construction & Restricted Area" demarcated in the preliminary engineering plans for Project 0337-122-113, RW201, Parcel #001 of the Virginia Department of Transportation . Numbered points mark the stations sampled. Numbered tick marks on the base line, which represents the ESE margin of the bridge, identify the location of the numbered rows of concrete piles under the bridge as well as the sampling transects. PARCEL I: "Parcel 001" in leased Oyster Ground No. 1403; PARCEL II: Additional parcel in leased Oyster Ground No. 1403; PARCEL III: Parcel in leased Oyster Ground No. 4587; PARCEL IV: Parcel in Public Ground No. 7. X-marks in Parcel III indicate stations where sampling attempts were not successful.

TABLE 1

Number of oysters, boxes, and other organisms and volume of shells found in tonged samples from three oyster ground parcels included within and adjoining the "Proposed Present & Future Limits of Construction & Restricted Area" outlined in the preliminary plans for the Virginia Department of Transportation construction project at the Hampton Boulevard bridge (Rte.337) over the Lafayette River in Norfolk, VA. (PROJECT NO. 0337-122-113,RW201, Parcel #001.)

PARCEL I : VMRC Plat File No. 1403 ,Parcel 001 (3.3 acres within limits of construction and restricted area.)

SAMPLE NO.	WATER DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
1	1[1]	0	0	0										
2	4	0	0	0			1sh[2]	3sh						
3	3	0	0	0										
6	3	0	0	0			2sh							
7	7	0	4	0	0	2	1.5	1	1	1				11
8	6.5	0	5	0	1	2	1	0.75						1
9	6.5	1	2	0	0	0	2	7sh	4	1			1	6
10	6.5	1	9	0	0	1	2.5	7sh	4	1			1	4
11	6	0	2	0	0	1	0.5	3sh	2	2		1		
14	7	1	0	1	1	1	1.5	1	3			1		15
15	7	0	6	0	0	2	2.5	1	5			1		
16	7	0	0	0				3sh						
17	7	0	0	0	2	3	2	0.5					2	
18	7	1	5	1	0	2	2	2.5	1	1	4			3
19	7	0	0	0				3sh						
22	7	1	3	0	0	0	2	1.5	3			1	24	3
23	7	0	3	1	1	0	2.5	2	2		1	4	1	4
24	7	0	1	0	0	0	7sh	11sh	1		1			
25	7	0	0	3	0	1	2	4	21					8
26	7	0	2	1	0	0	3	1	2		3	1		2
27	6	0	0	0				4sh						
30	10	2	11	1	0	1	3	1	1	2		1	8	9
31	7	0	0	1	0	0	2sh	0	3					
32	7	3	18	8	2	11	10.5	3	15	8	1			5
33	8	0	16	2	0	5	5	3	6			2	11	2
34	8	0	0	0	0	1	2sh	0.25	2		1			1
35	8	0	3	3	0	1	2	2.5	2				1	

TABLE 1 (Continuation)

PARCEL I continued

SAMPLE NO.	WATER DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
38	11[1]	0	5	2	3	1	1	0.75	4	2	0	0	2	3
39	10	0	0	0	0	0	6sh	1			2		2	
40	11	0	0	0	0	0	1sh	0.5			1			
41	10	0	2	0	0	2	0.75	1	4				10	
42	9	4	6	1	2	4	3.5	0.75	17	1		1		1
43	8	1	9	3	2	1	4	1		6		5	3	4
46	12	0	15	9	1	7	4	0.75	2	5				4
47	10	0	8	4	0	2	1.75	0.5	6	5		1	4	4
48	10	0	13	1	1	5	4	0.5	4	8		2		5
49	12	0	1	0	0	0	1sh	1sh				10	20	
50	13	1	12	5	2	9	4.5	4sh	4	1		2	2	2
51	11	2	6	4	2	4	2.25	1sh	11	6			1	33
54	18	Not Sampled ; too deep.												
55	18	Not Sampled ; too deep.												
56	16	0	0	0										
TOTALS		18	167	51	20	69	72.6[3]	34.6[3]	130	50	14	33	93	130
Ave./grab		0.5	4.2	1.3	0.5	1.7	1.8	0.9						
Ave./ft^2 of Surface Shell									1.8	0.7				1.8

PARCEL II : VMRC Plat File No. 1403. Additional parcel (1.3 acres outside limits of construction and restricted area.)

SAMPLE NO.	WATE DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
12	6[1]	0	1	0	0	0	1sh	6sh		1				
13	6	0	0	0				7sh						
20	6	6	1	2	2	1	1.5	1.5	6	1			1	
21	6	0	0	0										
28	6	0	1	0	1	0	0.5	2						2
29	6	0	0	0				2sh						
36	8	1	1	0	0	0	4sh	1						
37	8	1	13	0	1	9	4.5	4	2	2			2	5
44	8	1	13	2	0	6	5	1		2				2
45	8	0	12	4	2	1	4.75	1	3				1	3
52	10	0	2	1	1	2	1.5	1	2	1				21
53	10	0	1	2	2	2	1	1	3	2				2
57	13	2	9	2	2	10	4	0.75	8	2		1		3
58	11	1	14	3	0	7	5	0.75	2	1				
TOTALS		12	68	16	11	38	28.1[3]	14.9[3]	26	12	0	1	4	38
Ave./grab		0.9	4.9	1.1	0.8	2.7	2.0	0.4						
Ave./ft^2 of Surface Shell									0.9	0.4				1.4

TABLE 1 (Continuation)

PARCEL III : VMRC Plat File No. 4587. (0.3 acre)

SAMPLE NO.	WATER DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
59	16[1]	0	0	0	0	0	2sh	3sh						

Water depth at all other points in this parcel was greater than 17 feet at maximum low tide.

Too deep for sampling with our 18-ft tongs.

Attempts at sampling with a Ponar bottom grab were unsuccessful because there were enought shells over the bottom to prevent the grab from penetrating the bottom fully and from closing its two halves and shut tightly.

PARCEL IV: Public Ground No. 7 (0.3 acre parcel within limits of construction and restricted area.)

SAMPLE NO.	WATER DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
60	12[1]	2	25	4	2	4	3	6sh	6	6		1	4	6
61	13	0	0	0				3sh					1	
62	10	2	23	2	2	3	1.5	0.75	1					14
63	13	0	8	4	0	2	2	0	24	4			3	
TOTALS		4	56	10	4	9	6.5[3]	1.3[3]	31	10		1	8	20
Ave./grab		1.0	14.0	2.5	1.0	2.2	1.6	0.3						
Ave./ft^2 of Surface Shell									4.8	1.5				3.1

ADDITIONAL SAMPLES: Outside survey area, on southeast margin of Parcels I and II.

SAMPLE NO.	WATER DEPTH (FT)	NO. LIVE OYSTERS MK	SM	SP	NO. BOXES REC	OLD	OYSTER SHELLS Vol. in Qts. SURFC	BURIED	NO. OTHER ORGANISMS CR	HM	AW	MC	SC	BR
4	2.5[1]	Only sandy mud in sample.												
5	2	Hard sand ; tongs would not penetrate bottom.												

TABLE 1 (Continuation)

FOOTNOTES:

1. Water depth at time of sampling.
2. sh = single shells
3. Includes volume of single shells (Ave. no. shells/bu. = 850)

KEY TO ABBREVIATIONS:

OYSTERS:

MK= Market-size oysters; 3 inches or larger.
SM= Small oysters past spat stage but less than 3 inches.
SP= Spat: small, with all edges flat against substrate.

BOXES:

REC= Recent; inside of shells clean (no fouling).
OLD= Old; fouling evident on inside of shells.

SHELL:

SURFC= Surface shells; not buried in bottom sediments.
BURIED= Shells buried in bottom sediments.

OTHER ORGANISMS:

CR= Live "convex slipper shells" (*Crepidula convexa*).
HM= Live "hooked or bent mussels" (*Ischadium recurvum*.
AW= Shells and fragments of "angel-wing clams" (*Cyrtopleura costata*).
MC= Live "mud crabs" (Family Xanthidae)
SC= Live softshell clams (*Mya arenaria*).
BR= Live barnacles (species not identified)

TABLE 2

Summary of estimates of the total number and volume of oysters and oyster shells in the parcels of oyster grounds surveyed in the Lafayette River, adjoining the eastern side of the Hampton Blvd. bridge (Rte.337), in Norfolk, VA. Parcels as outlined in the preliminary plans for the Virginia Department of Transportation construction Project No. 0337-122-113, RW201, Parcel #001, or as otherwise identified in the text of the survey report.

PART A: NUMERICAL INFORMATION FOR SAMPLES

Parcel No.	Total Area (acres)	No. Tongs Grabs	Total Area Sampled (acres)		Number and Volume in All Samples: OYSTERS			BOXES		SHELLS	
					MK	SM	SP	REC	OLD	SURFC	BURIED
I	3.3	40	0.003[1]								
				No.	18	167	51	20	69		
				Qts.						72.6	34.6
				Bu.	.06[2]	.04[3]		.05[4]	.03[4]	1.5[5]	.7[5]
II	1.3	14	0.001								
				No.	12	68	16	11	38		
				Qts.						28.1	14.9
				Bu.	.04	.02		.03	.02	.6	.3
III	0.3	1									
IV	0.3	4	0.0003								
				No.	4	56	10	4	9		
				Qts.						6.5	1.3
				Bu.	.01	.01		.01	.02	.1	.03

TABLE 2 (Continuation)

PART B: ESTIMATED ABUNDANCE OF OYSTERS AND SHELLS

Parcel No.	Area (acres)	Total Vol. Cultch In Samples (bu)[6]	Number of Oysters Per Bushel Of Bottom Cultch[7] MK	SM+SP[8]	ALL	Vol. Shells Per Acre (bu)	Vol. Oysters In Parcel (bu)[9] MK	SM+SP	Vol. Shells In Parcel (bu)[10]
I	3.3	2.38	8	92	99	760	66	44	2508
III[11]	0.3						(6)	(4)	(228)
			TOTAL PARCELS I AND III =				(72)	(48)	(2736)
II	1.3	1.01	12	83	95	950	52	26	1235
IV	0.3	0.18	22	367	389	533	10	10	100

FOOTNOTES:

1. Total Area Sampled (in acres) :

$$= \frac{\text{(No. tongs grabs) X (Area of one grab in ft}^2\text{)}}{43560^*}$$

*No. ft² in one acre

2. Volume of Market (MK) Oysters is based on an average of 300 market oysters per bushel for this survey.

3. Volume of Small (SM) Oysters is based on an average of 4150 small oysters per bushel for this survey.

4. Volume of Boxes is based on an average of 850 oyster shells per bushel for this survey; multiplied by 2 for boxes.

TABLE 2 (Continuation)

FOOTNOTES: (continued)

5. Volume of Shells is based on an average of 850 shells per bushel for this survey.

6. Total Volume of Cultch in samples = Sum of volumes for oysters, boxes and shells.

7. Oysters per Bushel of Bottom Cultch :

$$= \frac{\text{Number of Oysters}}{\text{Total Volume of Bottom Material in All Samples}}$$

8. Small oysters and spat together constitute "seed oysters", usually purchased to be transplanted elsewhere for growth into market-size oysters.

9. Volume of Oysters in Parcel (in bu.) :

$$= \frac{\text{Volume of Oysters in Samples}}{\text{(Total Area Sampled) X (Total Area in Parcel)}}$$

10. Volume of Shells in Parcel (in bu.) :

$$= \frac{\text{Volume of shells and boxes in samples}}{\text{(Total Area Sampled) X (Total area in parcel)}}$$

11. Figures given in parentheses for Parcel III (which was not sampled) are derived from data collected at Parcel I and considered as acceptable based on incomplete samples taken from Plot III with a Ponar bottom sampler.