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BIOLOGICAL CONDITION OF MONEY PONT BENTHIC COMMUNITIES, SOUTHERN BRANCH OF THE ELIZABETH RIVER (2010)

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EXECUTIVE SUMMARY

The subtidal macrobenthic communities off Money Point in the Southern Branch of the Elizabeth River were quantitatively sampled in summer 2011. The designated Money Point study area will be a part of a sediment contaminant remediation effort. The primary objectives of this study were to: (1) characterize the biological health of the benthos of Money Point and (2) produce an historical data base that will allow an assessment of the effectiveness of the proposed sediment contamination remediation efforts with respect to Money Point benthos.

The most quantitative characterization of the benthos of the Elizabeth River watershed was the random sampling program conducted by the Benthic Ecology Lab of Old Dominion University from 1999 to 2007. This program combined the application of the Benthic Index of Biotic Integrity (B-IBI) developed for the Chesapeake Bay and probability-based sampling to calculate confidence intervals around estimates of condition of the benthic communities and allowed estimates of the areal extent of degradation of the benthic communities.

This study estimated the level of degraded benthic bottom of Money Point as 96% ± 4.0% - the highest level of degradation recorded by any previous studies in the Elizabeth River watershed. Previous quantitative areal estimates of benthic degradation in the watershed have varied from 52 ± 19.6% in 2001 to 84 ± 12.7% in 2005.

In general the benthic community condition off Money Point was consistent with previous characterizations of the Elizabeth River watershed: (1) benthic community species diversity and biomass below reference condition levels; (2) abundance often above reference condition levels and considered excessive; and (3) community composition unbalanced with levels of pollution indicative species above, and levels of pollution sensitive species below, reference conditions.

Compared to previous characterizations of the benthos of the Elizabeth River, the Money Point benthos had (1) the lowest average B-IBI value, 2.0, a level characterized as severely degraded (Figure 5); (2) the lowest Shannon Diversity Index value (Figure 8); and (3) the lowest biomass level (Figure 7). The low level of biomass is probably indicative of poor ecological value of the benthos as a food source for higher trophic levels, i.e fish, crabs, birds, etc.

Previous unpublished field experiments conducted by the ODU Benthic Ecology Lab in the Southern branch of the Elizabeth River, indicate that when total PAH levels are remediated to 45 ppm or less that significant benthic recruitment from indigenous populations will occur. Such recruitment levels are also likely to be sufficient to improve the condition of the benthos as measured by the B-IBI, to levels significantly above those in this study.

INTRODUCTION

The subtidal macrobenthic communities of a designated portion off Money Point in the Southern Branch of the Elizabeth River was quantitatively sampled in summer 2011 (Figs. 1-4). The designated Money Point study area will be a part of a sediment contaminant remediation effort (See Appendix C). The primary objectives of this study were: (1) characterize the biological health of the benthos of Money Point and (2) produce an historical data base that will allow an assessment of the effects of the proposed sediment contamination remediation efforts upon the Money Point benthos. This characterization is based upon application of benthic restoration goals and the Benthic Index of Biotic Integrity (B-IBI) developed for the Chesapeake Bay to the Money Point Stratum (Ranasinghe et al. 1994; Weisberg et al. 1997; Alden et al. 2002) and probability-based sampling to calculate confidence intervals around estimates of condition of the benthic communities and allowed estimates of the areal extent of degradation of the benthic communities.

The macrobenthic communities of the Elizabeth River have been studied since the 1969 sampling of Boesch (1973) with three stations in the Mainstem of the river. Other important studies were limited to the Southern Branch of the river including seasonal sampling at 10 sites in 1977-1978 (Hawthorne and Dauer 1983), seasonal sampling at the same 10 sites a decade later in 1987-1988 by Hunley (1993), the establishment of two long-term monitoring stations in 1989 as part of the Virginia Chesapeake Bay Benthic Monitoring Program (Dauer et al. 1999) and summarizations of the two Southern Branch long-term monitoring stations (Dauer 1993; Dauer et al. 1993). The condition of the benthic community of the Elizabeth River watershed was characterized by spatially extensive sampling of the river in 1999 with 175 locations sampled among seven strata (Dauer 2000; Dauer and Llansó 2003). Beginning in 2000 the Elizabeth River watershed was sampled as a single stratum with the benthic community condition characterized at 25 random locations (Dauer 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009).

RATIONALE

Characterizing Benthic Community Condition

Coastal seas, bays, lagoons and estuaries have become increasingly degraded due to anthropogenic stresses (Nixon 1995). Relationships between land use, levels of nutrients and contaminants, and the condition of the biotic communities of receiving waters are well studied in freshwater ecosystems (Allan et al. 1997) with fewer studies addressing these relationships in estuarine ecosystems (Comeleo et al. 1996; Valiela et al. 1997; Dauer et. al. 2000).
Land use patterns in a watershed influence the delivery of nutrients, sediments and contaminants into receiving waters through surface flow, groundwater flow, and atmospheric deposition (Correll 1983; Correll et al. 1987; Hinga et al. 1991; Correll et al. 1992; Lajtha et al. 1995; Jordan et al. 1997c). Increased nutrient loads are associated with high levels of agricultural and urban land use in both freshwater and coastal watersheds compared to forested watersheds (Klein 1979; Ostry 1982; Duda 1982; Novotny et al. 1985; Ustach et al. 1986; Valiela and Costa 1988; Benzie et al. 1991; Fisher and Oppenheimer 1991; Turner and Rabalais 1991; Correll et al. 1992; Hall et al. 1994; Jaworski et al. 1992; Lowrance 1992; Weiskel and Howes 1992; Balls 1994; Hopkinson and Vallino 1995; Nelson et al. 1995; Hall et al. 1996; Hill 1996; Allan et al. 1997; Correll 1997; Correl et al. 1997; Valiela et al. 1997; Verchot et al. 1997a, 1997b; Gold et al. 1998). At smaller spatial scales, riparian forests and wetlands may ameliorate the effects of agricultural and urban land use (Johnston et al 1990; Correll et al. 1992; Osborne and Kovacic

1993).

Aquatic biotic communities associated with watersheds with high agricultural and urban land use are generally characterized by lower species diversity, less trophic complexity, altered food webs, altered community composition and reduced habitat diversity (Fisher and Likens 1973; Boynton et al. 1982; Conners and Naiman 1984; Malone et al. 1986, 1988, 1996; Mangum 1989; Howarth et al. 1991; Fisher et al. 1992; Grubaugh and Wallace 1995; Lamberti and Berg 1995; Roth et al 1996; Correll 1997). High nutrient loads in coastal ecosystems result in increased algal blooms (Boynton et al. 1982; Malone et al. 1986, 1988; Fisher et al. 1992), increased low dissolved oxygen events (Taft et al. 1980; Officer et al. 1984; Malone et al. 1996), alterations in the food web (Malone 1992) and declines in valued fisheries species (Kemp et al. 1983; USEPA 1983). Sediment and contaminant loads are also increased in watersheds dominated by agricultural and urban development mainly due to storm-water runoff (Wilber and Hunter 1979; Hoffman et al. 1983; Medeiros et al. 1983; Schmidt and Spencer 1986; Beasley and Granillo 1988; Howarth et al. 1991; Vernberg et al. 1992; Lenat and Crawford 1994; Corbett et al. 1997).

Benthic invertebrates are used extensively as indicators of estuarine environmental status and trends because numerous studies have demonstrated that benthos respond predictably to many kinds of natural and anthropogenic stress (Pearson and Rosenberg 1978; Tapp et al. 1993; Wilson and Jeffrey 1994; Dauer et al. 2000). Many characteristics of benthic assemblages make them useful indicators (Bilyard 1987; Dauer 1993), the most important of which are related to their exposure to stress and the diversity of their responses to stress. Exposure to hypoxia is typically greatest in near-bottom waters and anthropogenic contaminants often accumulate in sediments where benthos live. Benthic organisms generally have limited mobility and cannot avoid these adverse conditions. This immobility is advantageous in environmental assessments because, unlike most pelagic fauna, benthic assemblages reflect local environmental conditions (Gray 1979). The structure of benthic assemblages responds to many kinds of stress because these assemblages typically include organisms with a wide range of physiological tolerances, life history strategies, feeding modes, and trophic interactions (Pearson and Rosenberg 1978; Rhoads et al. 1978; Boesch and Rosenberg 1981; Dauer 1993). Benthic community condition in the Chesapeake Bay watershed has been related in a quantitative manner to water quality, sediment quality, nutrient loads, and land use patterns (Dauer et al. 2000).

Estuarine Contaminant Perspective

Historically our nations' estuarine and coastal waters have been repositories of potentially toxic contaminants through municipal sewage, agricultural runoff, industrial effluents, and various other routes. The accumulation of these contaminants varies between different components of coastal ecosystems and their ecological effects are depended upon the different chemical/biological states of each contaminant.

<u>The ultimate fate of all organisms, particles and compounds is to reside at some time in the benthos.</u>

Most contaminant entities become attached to very small suspended particles in the water (e.g. clay sized particles). As these particles sink to the bottom they carry the toxicants with them. The natural interaction of currents, waves and tides results in the accumulation in fine-grained sedimentary deposits. Typically, the concentrations of toxicants are much higher in sediments than in the overlying water. High winds, shallow water depth, strong currents, or changes in ambient chemistry, result in the release, resuspension or dispersion of accumulated contaminants are released. Sediments are both sinks and sources of contaminants and; therefore, can pose serious threats to the health of resident marine life.

The Chesapeake Bay Index of Biotic Integrity

The Benthic Index of Biotic Integrity (B-IBI) was developed for macrobenthic communities of the Chesapeake Bay (Weisberg et al. 1997). The index defines expected conditions based upon the distribution of metrics from reference samples. Reference samples were collected from locations relatively free of anthropogenic stress. In calculating the index, categorical values are assigned for various descriptive metrics by comparison with thresholds of the distribution of metrics from reference samples. The result is a multi-metric index of biotic condition, frequently referred to as an index of biotic integrity (IBI). The analytical approach is similar to the one Karr et al. (1986) used to develop comparable indices for freshwater fish communities. Selection of benthic community metrics and metric scoring thresholds were habitat-dependent but by using categorical scoring comparisons between habitat types are possible.

A six-step procedure was used to develop the index: acquire and standardize data sets from a number of monitoring programs; temporally and spatially stratify data sets to identify seasons and habitat types; identify reference sites; select benthic community metrics; select metric thresholds for scoring; and validate the index with an independent data set (Weisberg et al. 1997). The B-IBI developed for Chesapeake Bay is based upon subtidal, unvegetated, infaunal macrobenthic communities. Hard-bottom communities, e.g., oyster beds, were not sampled as part of the monitoring program because the sampling gears could not obtain adequate samples to characterize the associated infaunal communities. Infaunal communities associated with submerged aquatic vegetation (SAV) were not avoided, but were rarely sampled due to the limited spatial extent of SAV in Chesapeake Bay. Only macrobenthic data sets based on processing with a sieve of 0.5-mm mesh aperture and identified to the lowest possible taxonomic level were used. A data set of over 2,000 samples collected from 1984 through 1994 was used to develop, calibrate and validate the index (see Table 1 in Weisberg et al. 1997). Because of inherent sampling limitations in some of the data sets, only data from the period of July 15 through September 30 were used to develop the index.

A multivariate cluster analysis of the biological data was performed to define habitat types. Salinity and sediment type were the two important factors defining habitat types and seven habitats were identified - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline and, and polyhaline mud habitats (see Table 5 in Weisberg et al. 1997).

Metrics to include in the index were selected from a candidate list proposed by benthic experts of the Chesapeake Bay. Selected metrics had to (1) differ significantly between reference and all other sites in the data set and (2) differ in an ecologically meaningful manner. Reference sites were selected as those sites which met all three of the following criteria: no sediment contaminant exceeded Long et al.'s (1995) effects range-median (ER-M) concentration, total organic content of the sediment was less than 2%, and bottom dissolved oxygen concentration was consistently high. A total of 11 metrics representing measures of species diversity, community abundance and biomass, species composition, depth distribution within the sediment, and trophic composition were used to create the index (see Table 2 in Weisberg et al. 1997).

The habitat-specific metrics are scored and combined into a single value of the B-IBI. Thresholds for the selected metrics were based on the distribution of values for the metric at the reference sites. The IBI approach involves scoring each metric as 5, 3, or 1, depending on whether its value at a site approximates, deviates slightly, or deviates greatly from conditions at reference sites (Karr et al. 1986). Threshold values are established as approximately the 5th and 50th (median) percentile values for reference sites in each habitat. For each metric, values below the 5th percentile are scored as 1; values between the 5th and 50th percentiles are scored as 3, and values above the 50th percentile are scored as 5. Metric scores are combined into an index by computing the mean score across all metrics for which thresholds were developed. Assemblages with an average score less than three are considered stressed, as they have metric values that on average are less than values at the poorest reference sites. Two of the metrics, abundance and biomass, respond bimodally; that is, the response can be greater than at reference sites with moderate degrees of stress and less than at reference sites with higher degrees of stress (Pearson and Rosenberg 1978; Dauer and Conner 1980; Ferraro et al. 1991). For these metrics, the scoring is modified so that both exceptionally high (those exceeding the 95^{th} percentile at reference sites) and low (<5th percentile) responses are scored as a 1. Values between the 5th and 25th percentiles or between the 75th and 95th percentiles are scored as 3, and values between the 25th and 75th percentiles of the values at reference sites are scored as 5. The index was validated by examining its response at a new set of reference sites and a new set of sites with known environmental stress. Data used for validation were collected between 1992 and 1994 and were independent of data used to calibrate the index. The B-IBI classified 93% of the validation sites correctly (Weisberg et al. 1997).

Values for the B-IBI range from 1.0 to 5.0. Benthic community condition was classified into four levels based on the B-IBI. Values ≥ 2 were classified as **severely degraded**; values from 2.1 to 2.6 were classified as **degraded**; values greater than 2.6 but less than 3.0 were classified as **marginal**; and values of 3.0 or more were classified as **meeting the goal**. Values in the marginal category do not meet the Restoration Goals, but they differ from the goals within the range of measurement error typically recorded between replicate samples. These categories are used in annual characterizations of the condition of the benthos in the Chesapeake Bay (Dauer et al. 2006a,b,c).

METHODS

A glossary of selected terms used in this report is found in Appendix D.

Probability-based Sampling

A wide variety of sampling designs have been used in marine and estuarine environmental monitoring programs (e.g., see case studies reviewed recently in Kramer, 1994; Kennish, 1998; Livingston, 2001). Allocation of samples in space and time varies depending on the environmental problems and issues addressed (Kingsford and Battershill, 1998) and the type of variables measured (e.g., water chemistry, phytoplankton, zooplankton, benthos, nekton). In the Chesapeake Bay, the benthic monitoring program consists of both fixed-point stations and probability-based samples. The fixed-point stations are used primarily for the determination of long-term trends (e.g., Dauer and Alden, 1995; Dauer, 1997; Dauer et al. 2006a,b,c) and the probability-based samples for the determination of the areal extent of degraded benthic community condition (Llansó et al. 2003; Dauer and Llansó 2003). The probability-based sampling design consists of equal replication of random samples among strata and is, therefore, a stratified simple random design (Kingsford, 1998). Sampling design and methodologies for probability-based sampling are based upon procedures developed by EPA's Environmental Monitoring and Assessment Program (EMAP, Weisberg et al. 1993) and allow unbiased comparisons of conditions between strata (Dauer and Llansó 2003).

Within the Money Point Stratum 25 random locations were sampled using a 0.04 m^2 Young grab. Table 1 lists the sampling coordinates. The minimum acceptable depth of penetration of the grab was 7 cm. At each station one grab sample was taken for macrobenthic community analysis and an additional grab sample for sediment particle size analysis and the determination of total volatile solids. A 50 g subsample of the surface sediment was taken for sediment analyses. Salinity, temperature and dissolved oxygen were measured at the bottom and water depth was recorded.

Probability-Based Estimation of Degradation

Areal estimates of degradation of benthic community condition within a stratum can be made because all locations in each stratum are randomly selected. The estimate of the proportion of a stratum failing the Benthic Restoration Goals developed for Chesapeake Bay (Ranasinghe et al. 1994; updated in Weisberg et al. 1997) is the proportion of the 25 samples with B-IBI values of less than 3.0. The process produces a binomial distribution: the percentage of the stratum attaining goals versus the percentage not attaining the goals. With a binomial distribution the 95% confidence interval for these percentages can be calculated as:

$$\text{95\% Confidence Interval} = p \pm 1.96\,(\text{SQRT}(pq/N))$$

where p = percentage attaining goal, q = percentage not attaining goal and N = number of samples. This interval reflects the precision of measuring the level of degradation and indicates that with a 95% certainty the true level of degradation is within this interval. Differences between levels of degradation using a binomial distribution can be tested using the procedure of Schenker and Gentleman (2001).

50 random points were selected using the GIS system of Versar, Inc. Decimal degree reference coordinates were used with a precision of 0.000001 degrees (approximately 1 meter) which is a smaller distance than the accuracy of positioning; therefore, no area of a stratum is excluded from sampling and every point within a stratum has a chance of being sampled. In the field the first 25 acceptable sites are sampled. Sites may be rejected because of inaccessibility by boat, inadequate water depth or inability of the grab to obtain an adequate sample (e.g., on hard bottoms).

Laboratory Analysis

Each replicate was sieved on a 0.5 mm screen, relaxed in dilute isopropyl alcohol and preserved with a buffered formalin-rose bengal solution. In the laboratory each replicate was sorted and all the individuals identified to the lowest possible taxon and enumerated. Biomass was estimated for each taxon as ash-free dry weight (AFDW) by drying to constant weight at 60 ^{o}C and ashing at 550 ^{o}C for four hours. Biomass was expressed as the difference between the dry and ashed weight.

Particle-size analysis was conducted using the techniques of Folk (1974). Each sediment sample is first separated into a sand fraction (> 63 µm) and a silt-clay fraction (< 63 µm). The sand fraction was dry sieved and the silt-clay fraction quantified by pipette analysis. For random stations, only the percent sand and percent silt-clay fraction were estimated. Total volatile solids of the sediment was estimated by the loss upon ignition method as described above and presented as percentage of the weight of the sediment.

Benthic Index of Biotic Integrity

B-IBI and Benthic Community Status Designations

The B-IBI is a multiple-metric index developed to identify the degree to which a benthic community meets the Chesapeake Bay Program's Benthic Community Restoration Goals (Ranasinghe et al. 1994; Weisberg et al. 1997; Alden et al. 2002). The B-IBI provides a means for comparing relative condition of benthic invertebrate communities across habitat types. It also provides a validated mechanism for integrating several benthic community attributes indicative of community health into a single number that measures overall benthic community condition.

The B-IBI is scaled from 1 to 5, and sites with values of 3 or more are considered to meet the Restoration Goals. The index is calculated by scoring each of several attributes as either 5, 3, or 1 depending on whether the value of the attribute at a site approximates, deviates slightly from, or deviates strongly from the values found at reference sites in similar habitats, and then averaging these scores across attributes. The criteria for assigning these scores are numeric and dependent on habitat type. Application of the index is limited to a summer index period from July 15th through September 30th.

Benthic community condition was classified into four levels based on the B-IBI. Values ≥ 2 were classified as **severely degraded**; values from 2.1 to 2.6 were classified as **degraded**; values greater than 2.6 but less than 3.0 were classified as **marginal**; and values of 3.0 or more were classified as **meeting the goal**. Values in the marginal category do not meet the Restoration Goals, but they differ from the goals within the range of measurement error typically recorded between replicate samples. These categories are used in annual characterizations of the condition of the benthos in the Chesapeake Bay (e.g. Dauer et al. 2002a,b; Llansó et al 2004).

Further Information concerning the B-IBI

The analytical approach used to develop the B-IBI was similar to the one Karr et al. (1986) used to develop comparable indices for freshwater fish communities. Selection of benthic community metrics and metric scoring thresholds were habitat-dependent but by using categorical scoring comparisons between habitat types were possible. A six-step procedure was used to develop the index: (1) acquiring and standardizing data sets from a number of monitoring programs, (2) temporally and spatially stratifying data sets to identify seasons and habitat types, (3) identifying reference conditions, (4) selecting benthic community metrics, (5) selecting metric thresholds for scoring, and (6) validating the index with an independent data set (Weisberg et al. 1997). The B-IBI developed for Chesapeake Bay is based upon subtidal, unvegetated, infaunal macrobenthic communities. Hard-bottom communities, e.g., oyster beds, were not sampled because the sampling gears could not obtain adequate samples to characterize the associated infaunal communities. Infaunal communities associated with submerged aquatic vegetation (SAV) were not avoided, but were rarely sampled due to the limited spatial extent of SAV in Chesapeake Bay.

Only macrobenthic data sets based on processing with a sieve of 0.5 mm mesh aperture and identified to the lowest possible taxonomic level were used. A data set of over 2,000 samples collected from 1984 through 1994 was used to develop, calibrate and validate the index (see Table 1 in Weisberg et al. 1997). Because of inherent temporal sampling limitations in some of the data sets, only data from the period of July 15 through September 30 were used to develop the index. A multivariate cluster analysis of the biological data was performed to define habitat types. Salinity and sediment type were the two important factors defining habitat types and seven habitats were identified - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand and polyhaline mud habitats (see Table 5 in Weisberg et al. 1997).

Reference conditions were determined by selecting samples which met all three of the following criteria: no sediment contaminant exceeded Long et al.'s (1995) effects range-median (ER-M) concentration, total organic content of the sediment was less than 2%, and bottom dissolved oxygen concentration was consistently high.

A total of 11 metrics representing measures of species diversity, community abundance and biomass, species composition, depth distribution within the sediment, and trophic composition were used to create the index. The habitat-specific metrics were scored and combined into a single value of the B-IBI. Thresholds for the selected metrics were based on the distribution of values for the metric at the reference sites. Data used for validation were collected between 1992 and 1994 and were independent of data used to develop the index. The B-IBI classified 93% of the validation sites correctly (Weisberg et al. 1997).

RESULTS AND SUMMARY

Benthic Community Condition using Probability-Based Sampling

Environmental Parameters

Physical-chemical parameters are summarized in Table 2. Mean water depths at the stratum varied from 0.5 to 10.7 m and averaged 3.7 m. Salinity was in the polyhaline range (18-32) for all samples and varied from 21.7 to 22.0 and averaged 21.9 ppt.

Sediments were a mixture of sands and mud with an average sand content of 56.1% and 43.9% of silts and clays (Table 3). The sand content varied from 5.0 - 97.8% indicating a highly heterogeneous mixture and sands and muds with total volatile solids value averaging 7.0% and a range from 1.2 to11.7%.

Benthic Community Condition

Benthic community parameters including the B-IBI value, abundance, biomass, and Shannon diversity index are presented in Table 4. A complete list of all taxa collected is presented in Appendix A and all raw benthic community data is presented in Appendix B. Results of this study are compared to the annual means for the Elizabeth River Benthic Random Monitoring program from 1999-2007 (Figures 5-10). The primary ecological diagnostic approach is the B-IBI developed for the Chesapeake Bay and selected metrics of the index that provide insight into possible impairments from natural ecosystem status and functions (Dauer et al. 2000).

In general the benthic community condition off Money Point was consistent with previous characterizations of the Elizabeth River watershed: (1) benthic community species diversity and biomass below reference condition levels; (2) abundance often above reference condition levels and considered excessive; and (3) community composition unbalanced with levels of pollution indicative species above, and levels of pollution sensitive species below, reference conditions. The levels of pollution sensitive species in Table 4 and Figure 9 are misleadingly high due to the polychaete species *Mediomastus ambiseta*. This species is the top abundance dominant (see Table 5) in the Elizabeth River watershed and at Money Point. In the original development of the B-IBI this species was characterized as a pollution sensitive species (Weisberg et al. 1997). Numerous studies in the Elizabeth River, after the development of the B-IBI, clearly indicate that this species should be considered as pollution indicative. Thus the balance between the levels of pollution sensitive versus pollution indicative species would indicate a more unbalanced ecological condition that reported in this study.

Finally, compared to previous characterizations of the benthos in the Elizabeth River, the Money Point benthos had (1) the lowest average B-IBI value (2.0) a level characterized as severely degraded (Figure 5), (2) the lowest Shannon Diversity Index value (Figure 8), and (3) the lowest biomass level (Figure 7). The low level of biomass is probably indicative of poor ecological value of the benthos as a food source for higher trophic levels, i.e fish, crabs, birds, etc.

Benthic Community Dominant Species

The dominant taxa of the random sites are summarized in Table 4. Consistent with previous studies the Money Point Stratum was dominated by annelid species including the polychaete species *Mediomastus ambiseta*, *Streblospio benedicti*, *Paraprionospio pinnata*, *Leitoscoloplos* spp., *Glycinde solitaire,* and the oligochaete taxon *Tubificoides* spp. Minor differences in the dominant species included the polychaete *Parandalia tricuspis* found in this study that was only recently recorded in Chesapeake Bay and most likely is an introduced species from the Gulf of Mexico.

Benthic Community Level of Degraded Area

This study estimated the level of degraded benthic bottom of Money Point as 96% ± 4.0% - the highest level of degradation recorded by any previous studies in the Elizabeth River watershed. Previous quantitative areal estimates of benthic degradation in the watershed have varied from 52 ± 19.6% in 2001 to 84 ± 12.7% in 2005.

Benthic Community Colonization Potential

Previous unpublished field experiments conducted by the ODU Benthic Ecology Lab in the Southern branch of the Elizabeth River, indicate that when total PAH levels are remediated to 45 ppm or less that significant benthic recruitment from indigenous populations will occur. Such recruitment levels are also likely to be sufficient to improve the condition of the benthos as measured by the B-IBI, to levels significantly above those in this study.

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Figures 1-10

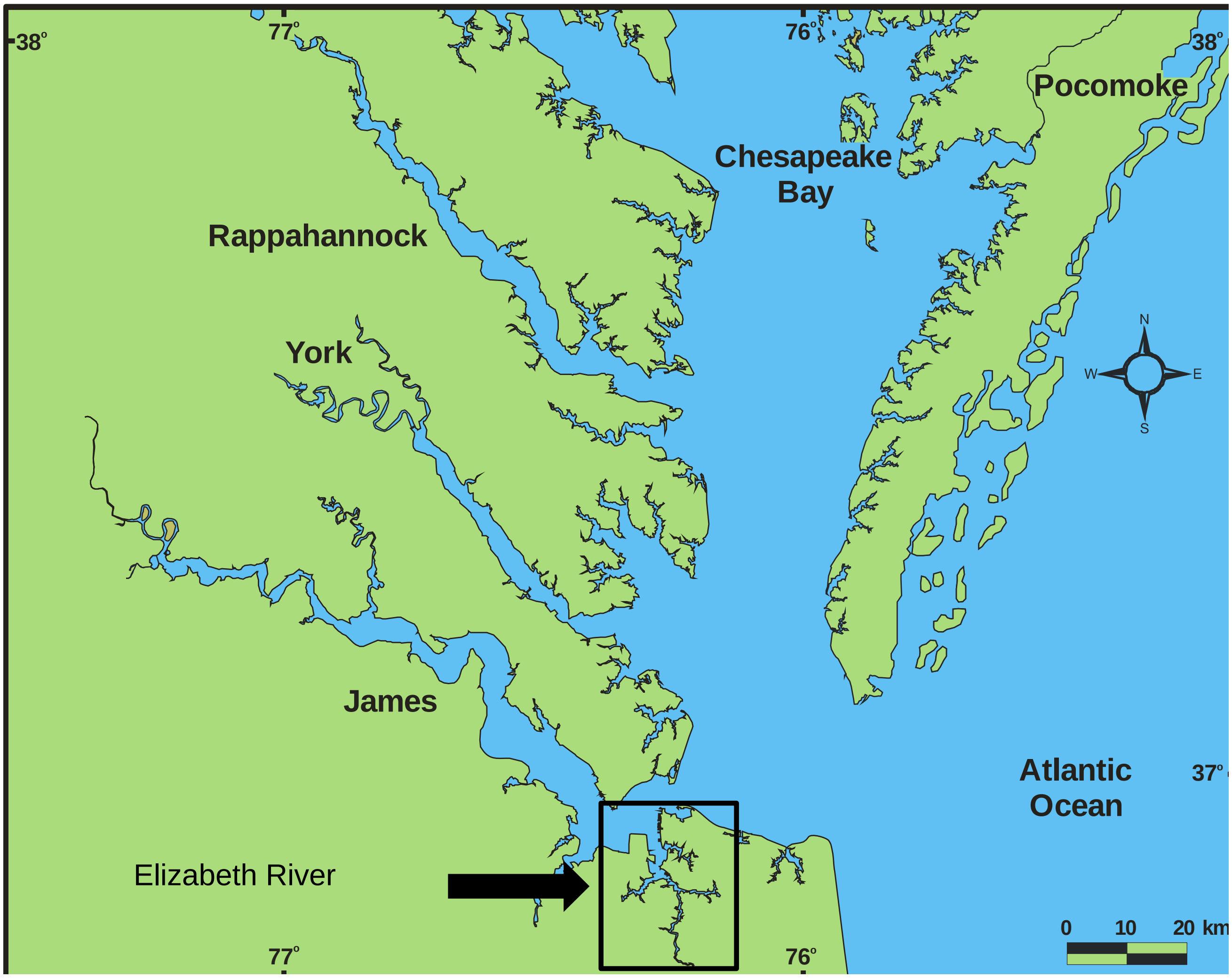


Figure 1. Lower Chesapeake Bay indicating the Elizabeth River watershed.

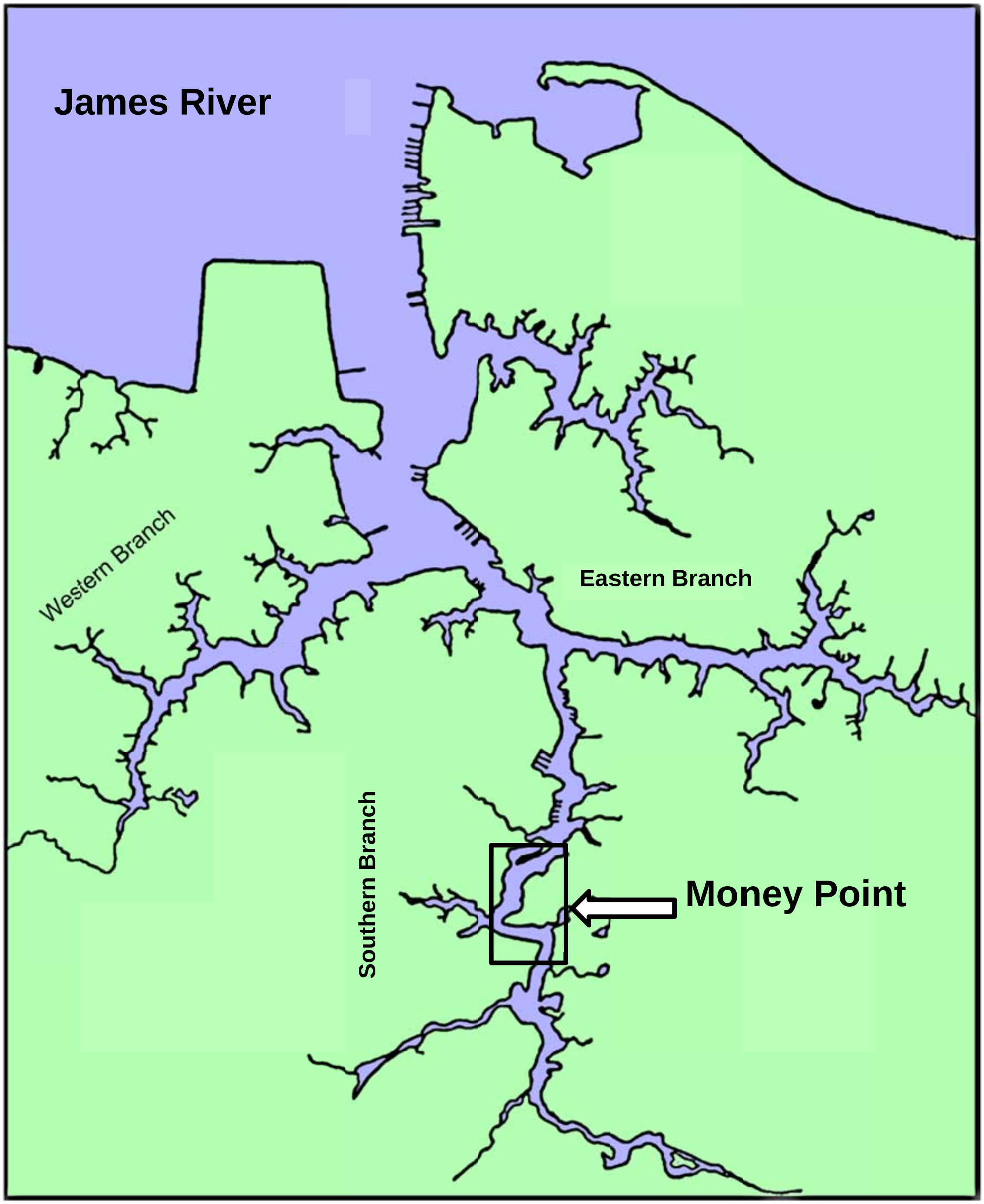


Figure 2. Elizabeth River Watershed indicating the Money Point region of the Southern Branch.

Figure 3. Money Point region of the Southern Branch of the Elizabeth River showing in red the benthic sampling stratum.

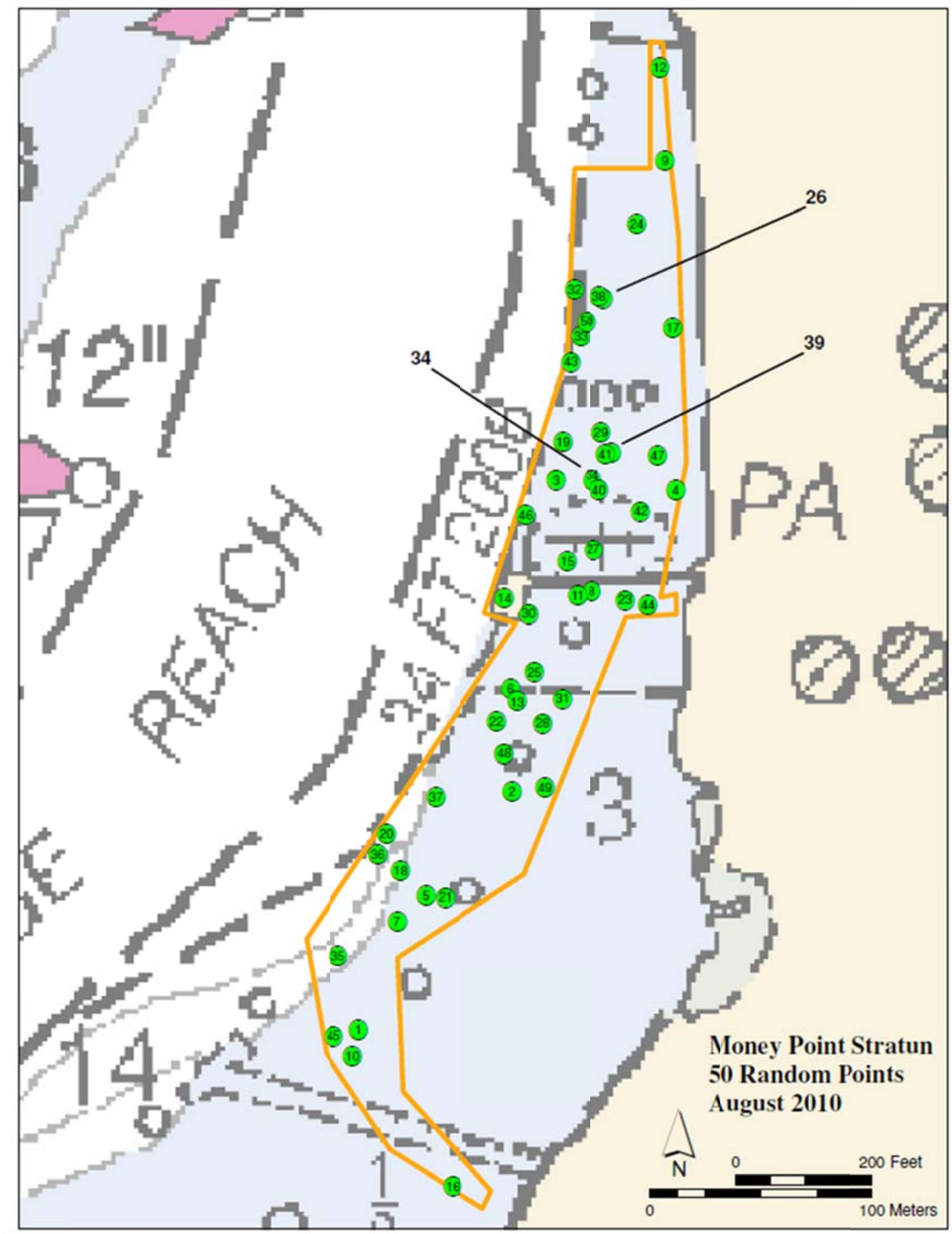


Figure 4. Money Point stratum random locations. Sample locations 1- 25 were collected. Locations 26-50 were back-up locations if any of the first 25 locations were rejected.

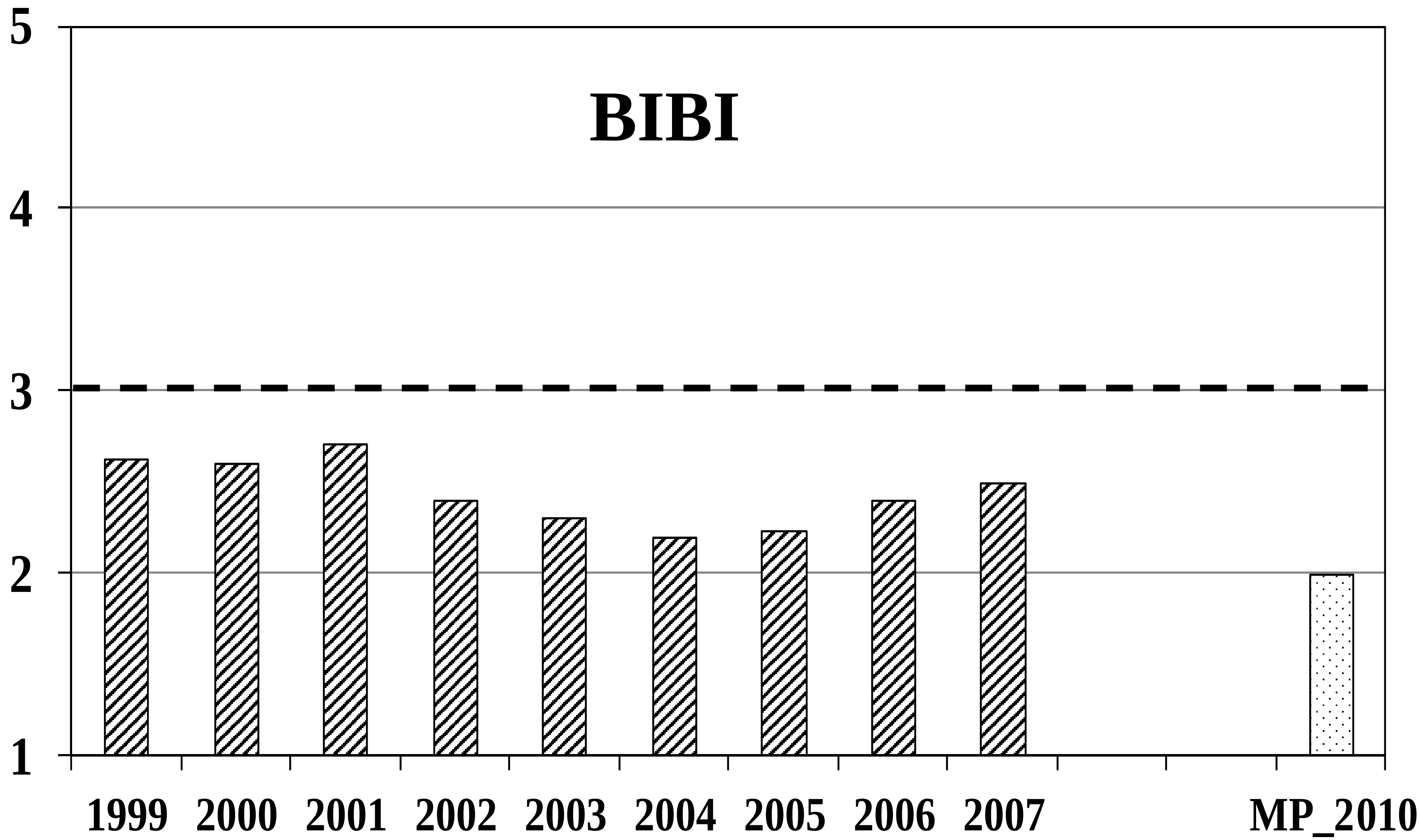


Figure 5. Mean BIBI values from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). BIBI values below 3.0 indicate degraded benthic community status.

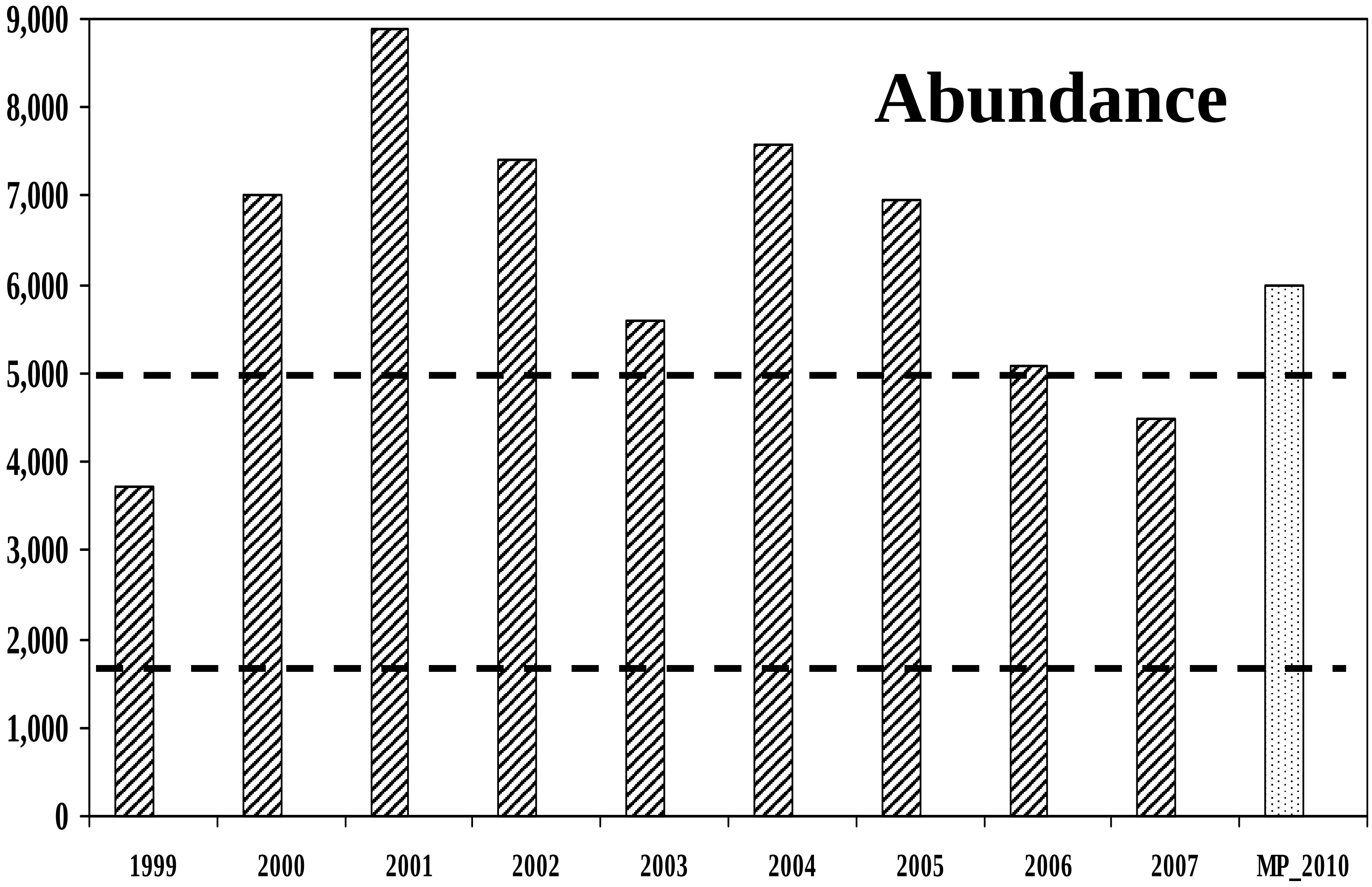


Figure 6. Abundance (individuals per m^2 from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). Dashed lines indicate benthic community restoration goal.

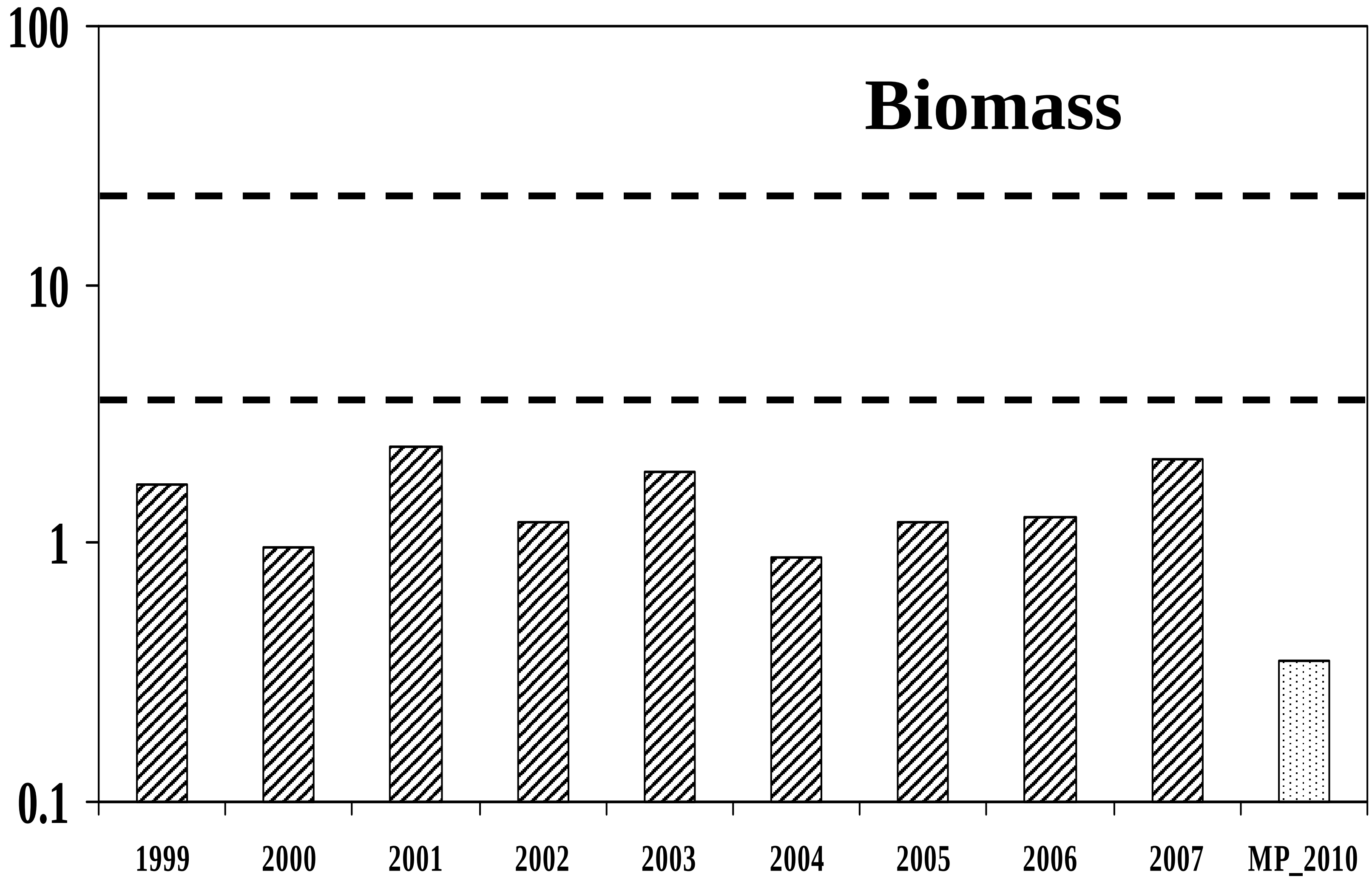


Figure 7. Biomass (AFDW g per m^2 from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). Dashed lines indicate benthic community restoration goal.

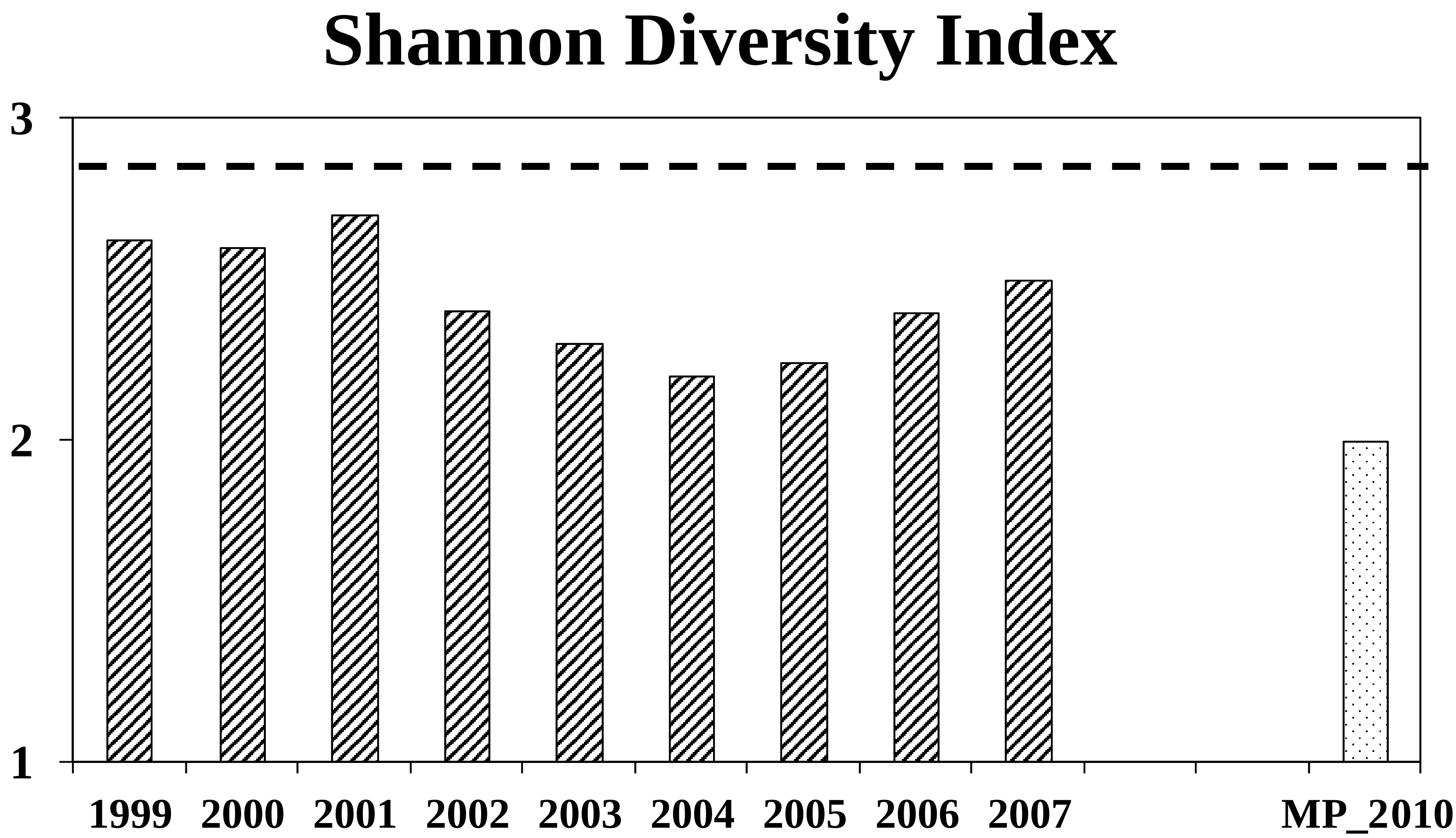


Figure 8. Shannon Diversity Index (bits per individual) from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). Dashed lines indicate benthic community restoration goal.

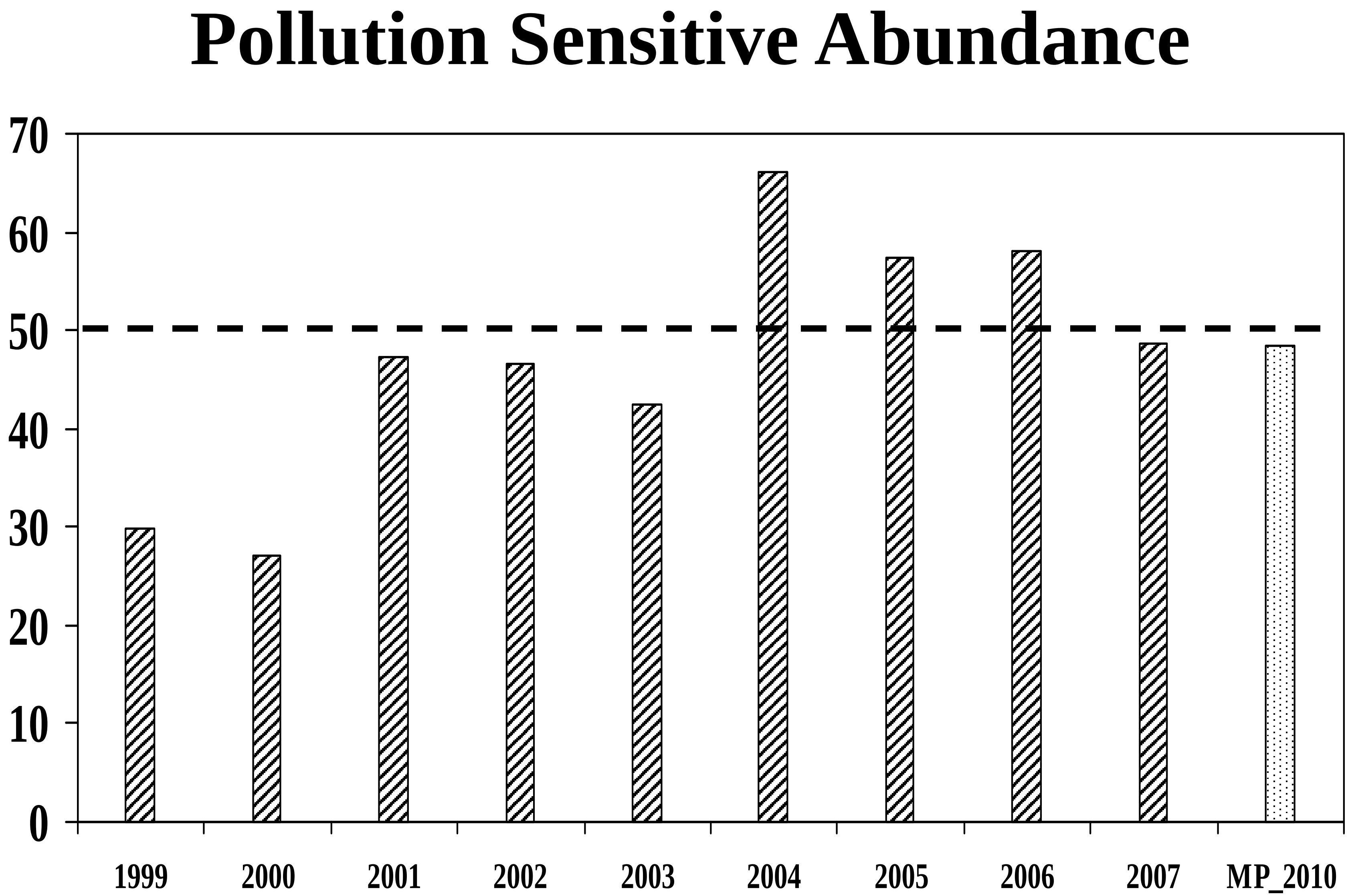


Figure 9. Pollution Sensitive Abundance (%) from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). Dashed lines indicate benthic community restoration goal.

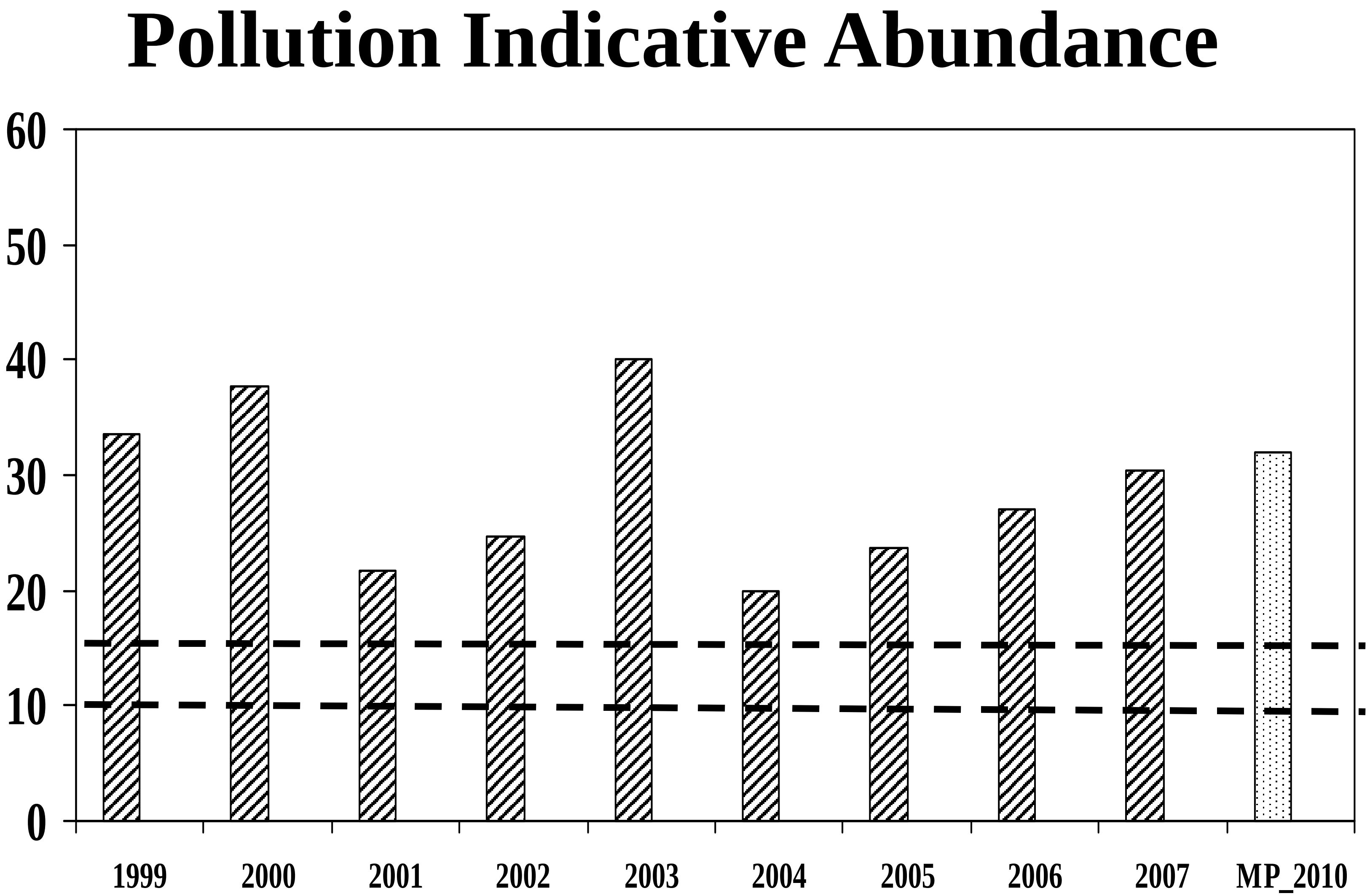


Figure 10. Pollution IndicativeAbundance (%) from the 1999-2007 Elizabeth River Monitoring Program (Dauer 2008) compared to the Money Point stratum random locations of this study (MP_2010). Dashed lines indicate benthic community restoration goal.

Tables 1-5

Table 1. Station Coordinates for MPP Project Monitoring Stations

Station	Latitude in Decimal Degrees	Longitude in Decimal Degrees
MP01	36.783122	-76.303236
MP02	36.784068	-76.302438
MP03	36.785324	-76.302182
MP04	36.785270	-76.301582
MP05	36.783658	-76.302885
MP06	36.784484	-76.302433
MP07	36.783557	-76.303030
MP08	36.784868	-76.302014
MP09	36.786599	-76.301597
MP10	36.783015	-76.303270
MP11	36.784856	-76.302089
MP12	36.786976	-76.301612
MP13	36.784434	-76.302402
MP14	36.784848	-76.302454
MP15	36.784992	-76.302137
MP16	36.782485	-76.302784
MP17	36.785922	-76.301577
MP18	36.783759	-76.303009
MP19	36.785473	-76.302145
MP20	36.783910	-76.303075
MP21	36.783647	-76.302789
MP22	36.784352	-76.302508
MP23	36.784831	-76.301846
MP24	36.786350	-76.301745
MP25	36.784551	-76.302314

Table 2. Physical Data for MPP Project Monitoring Stations .

CBP Station Name	Sampling Date	Depth (m)	Salinity (ppt)	Dissolved Oxygen (ppm)	Temperature (deg. C)
MP01	2010-09-21	2.0	21.9	4.6	25.7
MP02	2010-09-21	3.8	22.0	3.8	25.7
MP03	2010-09-21	6.2	21.8	4.4	26.5
MP04	2010-09-21	0.5	21.8	4.8	26.9
MP05	2010-09-21	3.4	22.0	4.0	25.8
MP06	2010-09-21	4.3	21.7	4.3	26.5
MP07	2010-09-21	4.4	22.0	3.6	25.9
MP08	2010-09-21	2.1	21.9	4.3	26.2
MP09	2010-09-21	0.7	21.8	4.7	26.8
MP10	2010-09-21	1.9	21.9	4.4	25.7
MP11	2010-09-21	2.9	21.8	4.6	26.5
MP12	2010-09-21	0.5	21.8	4.9	27.0
MP13	2010-09-21	4.1	21.7	4.4	26.6
MP14	2010-09-21	5.8	21.8	4.1	26.5
MP15	2010-09-21	3.5	21.8	4.4	26.5
MP16	2010-09-21	1.0	21.9	4.6	25.9
MP17	2010-09-21	0.7	21.8	4.7	26.8
MP18	2010-09-21	8.0	22.0	4.1	25.9
MP19	2010-09-21	7.5	21.8	4.1	26.5
MP20	2010-09-21	10.7	22.0	4.0	26.0
MP21	2010-09-21	4.0	22.0	4.1	25.9
MP22	2010-09-21	6.8	21.8	4.0	26.5
MP23	2010-09-21	3.2	21.9	4.0	26.3
MP24	2010-09-21	1.2	21.8	4.6	26.7
MP25	2010-09-21	3.5	21.8	4.2	26.7

Table 3. Sedimentary Data for MPP Project Monitoring Stations

Station	Sand (% Weight)	Silt-Clay (% Weight)	Volatile Solids (%)
MP01	67.4	32.6	7.7
MP02	27.9	72.1	9.4
MP03	54.9	45.1	6.1
MP04	97.8	2.2	1.2
MP05	46.8	53.2	7.9
MP06	12.8	87.2	9.4
MP07	17.0	83.0	6.5
MP08	75.8	24.2	4.9
MP09	91.5	8.5	5.1
MP10	63.6	36.4	7.2
MP11	61.3	38.7	7.7
MP12	94.0	6.0	6.7
MP13	68.1	31.9	10.8
MP14	36.8	63.2	9.2
MP15	62.8	37.2	7.9
MP16	90.5	9.5	2.2
MP17	94.2	5.8	2.6
MP18	14.6	85.4	10.1
MP19	70.6	29.4	4.1
MP20	5.0	95.0	11.7
MP21	38.0	62.0	9.9
MP22	14.2	85.8	5.9
MP23	76.8	23.2	6.6
MP24	72.2	27.8	3.3
MP25	49.1	50.9	8.7
Mean	56.1	43.9	6.9

Table 4. Random Stations of the Money Point Sampling Stratum 2010. Summary of benthic community parameters. Abundance in individuals/m^2, biomass as AFDW grams/m^2, Shannon Index in bits/ind, all other abundance and biomass parameters as percentages. PI – pollution indicative species. PS – pollution sensitive species.

Station	BIBI	Abundance	Biomass	Shannon Index	PI-Abundance	PS-Abundance	PI-Biomass	PS-Biomass	Carnivore Omnivore Abundance	Deep Deposit Feeder Abundance
MP01	2.7	6,464	0.181	1.40	31.9	64.9	25.0	25.0	4.2	66.7
MP04	2.3	7,212	0.816	2.15	39.9	42.1	19.4	27.8	23.6	43.4
MP08	2.7	3,924	0.227	1.45	7.5	29.5	20.0	20.0	63.6	30.6
MP09	1.7	6,396	0.408	1.17	81.2	16.3	27.8	11.1	7.8	16.3
MP10	2.3	12,429	0.363	0.88	11.3	86.1	31.3	37.5	3.6	86.9
MP11	2.7	3,810	0.340	1.91	8.9	42.3	26.7	20.0	49.4	42.3
MP12	2.3	5,511	0.249	1.82	49.8	38.3	45.5	27.3	16.9	37.4
MP13	3.0	3,515	0.204	1.18	1.9	77.4	33.3	22.2	22.6	75.5
MP15	2.3	9,253	0.363	1.44	10.8	71.3	18.8	25.0	18.4	70.3
MP16	2.0	10,115	0.476	1.65	48.7	43.3	42.9	23.8	10.5	42.8
MP17	2.0	11,907	0.680	1.82	39.4	49.7	26.7	33.3	13.7	49.5
MP19	1.0	431	0.113	1.47	73.7	5.3	40.0	20.0	10.5	0.0
MP23	2.7	14,356	0.204	0.55	6.5	91.8	11.1	55.6	2.2	91.0
MP24	1.3	1,905	0.181	1.11	82.1	2.4	37.5	12.5	6.0	2.4
MP02	1.7	2,313	0.181	1.36	11.8	71.6	50.0	25.0	16.7	71.6
MP03	1.0	953	0.159	1.34	81.0	0.0	28.6	0.0	7.1	2.4
MP05	1.7	15,989	0.567	1.07	10.6	84.8	24.0	40.0	5.1	84.0
MP06	2.7	1,497	0.340	2.80	7.6	51.5	20.0	20.0	43.9	40.9
MP07	2.3	1,043	0.386	2.78	41.3	13.0	35.3	23.5	45.7	13.0
MP14	1.7	14,946	0.522	1.09	14.9	80.9	34.8	43.5	3.8	81.0
MP18	1.7	2,200	0.340	2.08	21.6	43.3	46.7	20.0	5.2	74.2
MP20	1.7	2,654	0.318	2.21	67.5	17.1	42.9	14.3	7.7	22.2
MP21	2.0	1,950	0.318	2.69	24.4	51.2	28.6	21.4	24.4	45.3
MP22	2.0	2,291	0.363	2.23	18.8	50.5	50.0	18.8	27.7	50.5
MP25	1.7	6,600	0.363	0.75	9.3	89.0	50.0	37.5	1.7	88.3
Mean	**2.0**	**5,987**	**0.347**	**1.62**	**32.1**	**48.5**	**32.7**	**25.0**	**17.7**	**49.1**

Table 5. Money Point dominant species by density compared to the last random study of the entire Elizabeth River Watershed (ERW Random) (Dauer 2008) and the last sapling of the 14 fixed site stations in Elizabeth River Watershed (ERW Fixed) (Dauer 2009). Abbreviations: A – amphipod, C – cumacean, G – gastropod, O – oligochaete, P –polychaete.

	Money Point 2010	Abundance		ERW Random 2007	Abundance		ERW Fixed 2008	Abundance
1	Mediomastus ambiseta (P)	3,696		Mediomastus ambiseta (P)	2,101		Mediomastus ambiseta (P)	4,018
2	Streblospio benedicti(P)	1,260		Streblospio benedicti (P)	630		Streblospio benedicti (P)	647
3	Parandalia tricuspis(P)	514						
4	Paraprionospio pinnata(P)	104		Paraprionospio pinnata (P)	444		Paraprionospio pinnata (P)	233
5	Eteone heteropoda(P)	85						
6	Leitoscoloplos spp. (P)	59		Leitoscoloplos spp. (P)	51		Leitoscoloplos spp. (P)	202
7	Glycinde solitaria(P)	51		Glycinde solitaria (P)	64		Glycinde solitaria (P)	110
8	Leucon americanus (C)	42		Leucon americanus (C)	49		Leucon americanus (C)	104
9	Tubificoides spp. Group I (O)	34		Tubificoides spp. Group I(O)	232		Tubificoides spp. Group I (O)	88
10	Gitanopsis spp .(A)	24						
11	Podarke obscura(P)	17						
12	Apocorophium acutum	15						
13	Parahesione luteola(P)	15						
14	Spiochaetopterus costarum	14						
15	Haminoea solitaria(P)	11						
16	Neanthes succinea(P)	11		Neanthes succinea (P)	89		Neanthes succinea (P)	49
17	Polydora cornuta(P)	10						
18	Podarkeopsis levifuscina(P)	9		Podarkeopsis levifuscina (P)	38		Podarkeopsis levifuscina(P)	35
19	Grandidierella sp.(A)	7						
20	Gastropod asp. (G)	6						

Appendix A – Taxon List

Appendix A. Taxa collected at MPP Project Monitoring Stations Random 2010

Taxonomic Group	Taxon
Nemertea	Nemertea spp.
Annelida : Polychaeta	Demonax microphthalmus (Verrill)
	Diopatra cuprea Bosc
	Eteone heteropoda Hartman
	Glycera americana Leidy
	Glycera dibranchiata Ehlers
	Glycinde solitaria Webster
	Heteromastus filiformis Claparede
	Leitoscoloplos spp.
	Loimia medusa Savigny
	Mediomastus ambiseta Hartman
	Neanthes succinea Frey and Leuckart
	Parahesione luteola Webster
	Parandalia tricuspis (Muller)
	Paraprionospio pinnata Ehlers
	Podarke obscura Verrill
	Podarkeopsis levifuscina Hartmann-Schroder
	Polydora cornuta Webster
	Sabellidae sp.
	Serpula spp.
	Sigambra tentaculata Treadwell
	Spiochaetopterus costarum Webster
	Streblospio benedicti Webster
Annelida : Oligochaeta	Tubificoides spp. Group I
Mollusca : Gastropoda	Acteocina canaliculata Say
	Gastropoda spp. *
	Haminoea solitaria Say
	Rictaxis punctostriatus Adams
Mollusca : Bivalvia	Barnea truncata Say
	Bivalvia spp.
	Crassostrea virginica Gmelin*
	Macoma mitchelli Dall
	Mulinia lateralis Say
	Tagelus plebeius Lightfoot
	Tellinidae spp.
Arthropoda : Isopoda	Cyathura polita Stimpson

Taxonomic Group	Taxon
	Edotea triloba Say*
Arthropoda : Amphipoda	Ampelisca spp.
	Apocorophium acutum (Chevreux)*
	Gitanopsis spp.
	Grandidierella sp. *
	Microprotopus raneyi Wigley*
Arthropoda : Cumacea	Cyclaspis varians Calman
	Leucon americanus Zimmer
Arthropoda : Mysidacea	Americamysis bigelowi (Tattersall)*
	Mysidopsis bigelowi (Tattersall)*
Arthropoda : Tanaidacea	Hargeria rapax (Harger)
Arthropoda : Decapoda	Alpheus heterochaelis Say
	Panopeus herbstii Milne-Edwards*
Phoronida	Phoronis spp.

Appendix B – Raw Data by Site

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP01

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	5	0.001
	Leitoscoloplos spp.	10	0.001
	Mediomastus ambiseta	180	0.001
	Parandalia tricuspis	7	0.001
	Polydora cornuta	1	0.001
	Streblospio benedicti	81	0.001
Mollusca : Gastropoda	Gastropoda spp.	4	0.001
Arthropoda : Amphipoda	Apocorophium acutum	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**290**	**0.009**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP02

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	72	0.001
	Parandalia tricuspis	17	0.002
	Paraprionospio pinnata	4	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	7	0.001
STATION		**102**	**0.008**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP03

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Parahesione luteola	1	0.001
	Paraprionospio pinnata	2	0.001
	Podarkeopsis levifuscina	1	0.001
	Streblospio benedicti	32	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	1	0.001
Mollusca : Gastropoda	Haminoea solitaria	1	0.001
Arthropoda : Cumacea	Leucon americanus	4	0.001
STATION		**42**	**0.007**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP04

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	2	0.003
Annelida : Polychaeta	Diopatra cuprea	1	0.005
	Eteone heteropoda	23	0.001
	Leitoscoloplos spp.	6	0.005
	Mediomastus ambiseta	132	0.004
	Parandalia tricuspis	45	0.011
	Streblospio benedicti	98	0.001
Mollusca : Gastropoda	Gastropoda spp.	1	0.001
	Haminoea solitaria	2	0.001
	Rictaxis punctostriatus	2	0.001
Arthropoda : Isopoda	Edotea triloba	2	0.001
Arthropoda : Amphipoda	Apocorophium acutum	1	0.001
	Grandidierella sp.	3	0.001
Arthropoda : Tanaidacea	Hargeria rapax	3	0.001
Phoronida	Phoronis spp.	1	0.001
STATION		**322**	**0.038**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP05

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	3	0.001
	Glycinde solitaria	8	0.002
	Leitoscoloplos spp.	4	0.002
	Mediomastus ambiseta	588	0.006
	Parahesione luteola	1	0.001
	Parandalia tricuspis	23	0.004
	Paraprionospio pinnata	18	0.002
	Podarke obscura	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	50	0.001
Arthropoda : Amphipoda	Ampelisca spp.	2	0.001
Arthropoda : Cumacea	Cyclaspis varians	1	0.001
	Leucon americanus	4	0.001
Phoronida	Phoronis spp.	1	0.001
STATION		**705**	**0.025**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP06

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	7	0.001
	Leitoscoloplos spp.	1	0.001
	Mediomastus ambiseta	26	0.001
	Neanthes succinea	3	0.001
	Parahesione luteola	1	0.001
	Parandalia tricuspis	11	0.003
	Paraprionospio pinnata	3	0.001
	Podarke obscura	7	0.001
	Polydora cornuta	1	0.001
	Serpula spp.	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	1	0.001
Mollusca : Bivalvia	Barnea truncata	1	0.001
	Crassostrea virginica	4	0.342
Arthropoda : Amphipoda	Apocorophium acutum	5	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
Arthropoda : Decapoda	Panopeus herbstii	1	0.013
STATION		**77**	**0.372**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP07

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycera americana	1	0.002
	Glycinde solitaria	3	0.001
	Leitoscoloplos spp.	4	0.004
	Mediomastus ambiseta	2	0.001
	Parahesione luteola	3	0.001
	Parandalia tricuspis	11	0.003
	Paraprionospio pinnata	15	0.002
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	2	0.001
Arthropoda : Amphipoda	Apocorophium acutum	1	0.001
Arthropoda : Cumacea	Leucon americanus	4	0.001
STATION		**47**	**0.018**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP08

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	2	0.001
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Leitoscoloplos spp.	3	0.001
	Mediomastus ambiseta	50	0.001
	Neanthes succinea	1	0.001
	Parandalia tricuspis	106	0.004
	Streblospio benedicti	10	0.001
STATION		**173**	**0.010**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP09

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
	Eteone heteropoda	15	0.001
	Leitoscoloplos spp.	1	0.001
	Mediomastus ambiseta	45	0.001
	Neanthes succinea	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	213	0.003
Mollusca : Gastropoda	Haminoea solitaria	5	0.006
Arthropoda : Amphipoda	Microprotopus raneyi	3	0.001
Arthropoda : Decapoda	Alpheus heterochaelis	1	0.004
STATION		**285**	**0.019**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP10

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	3	0.001
	Glycinde solitaria	4	0.001
	Leitoscoloplos spp.	8	0.002
	Mediomastus ambiseta	468	0.005
	Parandalia tricuspis	10	0.002
	Paraprionospio pinnata	1	0.001
	Podarke obscura	1	0.001
	Streblospio benedicti	50	0.001
Mollusca : Gastropoda	Haminoea solitaria	2	0.001
Mollusca : Bivalvia	Tellinidae spp.	1	0.001
STATION		**548**	**0.016**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP11

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	2	0.001
	Glycera dibranchiata	1	0.001
	Glycinde solitaria	2	0.001
	Leitoscoloplos spp.	2	0.001
	Mediomastus ambiseta	69	0.002
	Neanthes succinea	1	0.001
	Parandalia tricuspis	74	0.002
	Paraprionospio pinnata	3	0.001
	Podarke obscura	3	0.001
	Streblospio benedicti	8	0.001
Mollusca : Bivalvia	Barnea truncata	1	0.001
Arthropoda : Amphipoda	Apocorophium acutum	9	0.001
	Gitanopsis spp.	14	0.001
	Grandidierella sp.	1	0.001
Arthropoda : Tanaidacea	Hargeria rapax	1	0.001
STATION		**191**	**0.017**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP12

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	12	0.001
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	90	0.001
	Neanthes succinea	2	0.001
	Parandalia tricuspis	26	0.001
	Spiochaetopterus costarum	2	0.001
	Streblospio benedicti	108	0.002
Mollusca : Gastropoda	Rictaxis punctostriatus	1	0.001
Mollusca : Bivalvia	Tagelus plebeius	1	0.001
STATION		**243**	**0.011**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP13

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	4	0.001
	Leitoscoloplos spp.	1	0.001
	Mediomastus ambiseta	116	0.001
	Parahesione luteola	1	0.001
	Parandalia tricuspis	29	0.001
	Paraprionospio pinnata	1	0.001
	Podarke obscura	1	0.001
	Streblospio benedicti	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**155**	**0.009**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP14

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Glycinde solitaria	1	0.001
	Leitoscoloplos spp.	3	0.003
	Mediomastus ambiseta	530	0.007
	Parandalia tricuspis	21	0.002
	Paraprionospio pinnata	21	0.003
	Podarke obscura	2	0.001
	Spiochaetopterus costarum	2	0.002
	Streblospio benedicti	73	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	1	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Gitanopsis spp.	4	0.001
Arthropoda : Cumacea	Leucon americanus	4	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
STATION		**665**	**0.026**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP15

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Eteone heteropoda	3	0.001
	Glycinde solitaria	4	0.001
	Mediomastus ambiseta	287	0.003
	Parahesione luteola	1	0.001
	Parandalia tricuspis	66	0.004
	Paraprionospio pinnata	7	0.001
	Podarke obscura	1	0.001
	Streblospio benedicti	34	0.001
Arthropoda : Isopoda	Edotea triloba	1	0.001
Arthropoda : Amphipoda	Gitanopsis spp.	9	0.001
Arthropoda : Cumacea	Cyclaspis varians	1	0.001
	Leucon americanus	3	0.001
STATION		**418**	**0.018**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP16

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Eteone heteropoda	11	0.001
	Leitoscoloplos spp.	2	0.006
	Mediomastus ambiseta	189	0.004
	Parandalia tricuspis	29	0.003
	Streblospio benedicti	204	0.002
Mollusca : Gastropoda	Haminoea solitaria	2	0.001
	Rictaxis punctostriatus	1	0.001
Arthropoda : Isopoda	Cyathura polita	4	0.001
Arthropoda : Cumacea	Cyclaspis varians	3	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	2	0.001
STATION		**448**	**0.022**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP17

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Diopatra cuprea	1	0.001
	Eteone heteropoda	17	0.001
	Leitoscoloplos spp.	7	0.004
	Loimia medusa	3	0.001
	Mediomastus ambiseta	253	0.006
	Neanthes succinea	1	0.001
	Parandalia tricuspis	51	0.007
	Podarke obscura	1	0.001
	Spiochaetopterus costarum	3	0.001
	Streblospio benedicti	183	0.003
Mollusca : Gastropoda	Gastropoda spp.	2	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Amphipoda	Grandidierella sp.	3	0.001
Arthropoda : Cumacea	Cyclaspis varians	1	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
STATION		**528**	**0.031**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP18

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Leitoscoloplos spp.	2	0.004
	Mediomastus ambiseta	41	0.002
	Paraprionospio pinnata	2	0.001
	Podarkeopsis levifuscina	3	0.001
	Sigambra tentaculata	1	0.001
	Streblospio benedicti	17	0.002
Annelida : Oligochaeta	Tubificoides spp. Group I	29	0.002
Mollusca : Gastropoda	Acteocina canaliculata	1	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
STATION		**97**	**0.015**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP19

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Streblospio benedicti	13	0.001
Mollusca : Bivalvia	Bivalvia spp.	1	0.001
Arthropoda : Isopoda	Cyathura polita	1	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
STATION		**19**	**0.005**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP20

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Eteone heteropoda	1	0.001
	Glycinde solitaria	1	0.001
	Leitoscoloplos spp.	1	0.002
	Mediomastus ambiseta	19	0.001
	Parandalia tricuspis	1	0.001
	Paraprionospio pinnata	14	0.002
	Podarke obscura	1	0.001
	Podarkeopsis levifuscina	4	0.001
	Sigambra tentaculata	1	0.001
	Streblospio benedicti	63	0.001
Annelida : Oligochaeta	Tubificoides spp. Group I	6	0.001
Arthropoda : Cumacea	Leucon americanus	5	0.001
STATION		**117**	**0.014**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP21

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	1	0.002
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Glycinde solitaria	7	0.001
	Leitoscoloplos spp.	4	0.002
	Mediomastus ambiseta	35	0.001
	Parandalia tricuspis	12	0.002
	Paraprionospio pinnata	6	0.001
	Sigambra tentaculata	1	0.001
	Spiochaetopterus costarum	2	0.001
	Streblospio benedicti	11	0.001
Arthropoda : Isopoda	Edotea triloba	2	0.001
Arthropoda : Cumacea	Leucon americanus	6	0.001
STATION		**88**	**0.015**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP22

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Nemertea	Nemertea spp.	2	0.001
Annelida : Polychaeta	Glycinde solitaria	1	0.001
	Leitoscoloplos spp.	2	0.003
	Mediomastus ambiseta	49	0.001
	Parahesione luteola	8	0.001
	Parandalia tricuspis	17	0.001
	Paraprionospio pinnata	17	0.005
	Spiochaetopterus costarum	1	0.001
Arthropoda : Amphipoda	Grandidierella sp.	1	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
STATION		**101**	**0.016**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP23

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	5	0.001
	Mediomastus ambiseta	576	0.004
	Parandalia tricuspis	9	0.001
	Sabellidae sp.	1	0.001
	Streblospio benedicti	41	0.001
Arthropoda : Cumacea	Leucon americanus	1	0.001
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
STATION		**634**	**0.010**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP24

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Demonax microphthalmus	1	0.001
	Eteone heteropoda	2	0.001
	Mediomastus ambiseta	2	0.001
	Neanthes succinea	3	0.002
	Polydora cornuta	9	0.001
	Streblospio benedicti	67	0.002
Arthropoda : Mysidacea	Americamysis bigelowi	1	0.001
STATION		**85**	**0.009**

Numbers of individuals and Ash-Free Dry Weight Biomass at MPP Project Monitoring Stations (Random Cruise 2010) .

Station=MP25

Taxonomic Group	Taxon	Abundance	Ash Free Dry Wt. (g C)
Annelida : Polychaeta	Glycinde solitaria	3	0.002
	Leitoscoloplos spp.	2	0.006
	Mediomastus ambiseta	255	0.003
	Parandalia tricuspis	2	0.001
	Paraprionospio pinnata	1	0.001
	Spiochaetopterus costarum	1	0.001
	Streblospio benedicti	24	0.001
Arthropoda : Cumacea	Leucon americanus	3	0.001
STATION		**291**	**0.016**

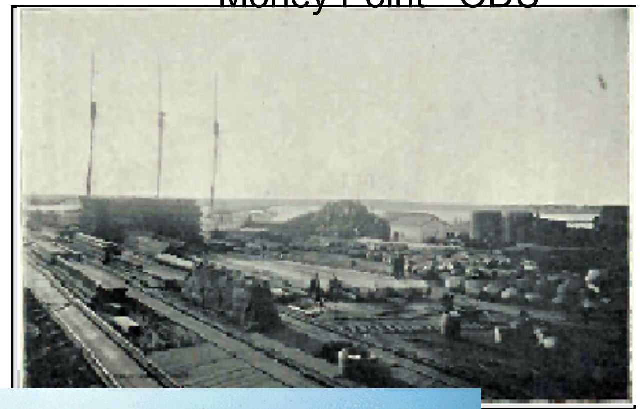
Appendix C – Money Point History and Remediation

A Brief History of Money Point

in Chesapeake, Virginia
on the Southern Branch
of the Elizabeth River

Money Point 2000

Spring 2005



Above: the Norfolk Creosoting Plant employed many residents in the area.

Left: A current view of Money Point from the South Branch of the Elizabeth River

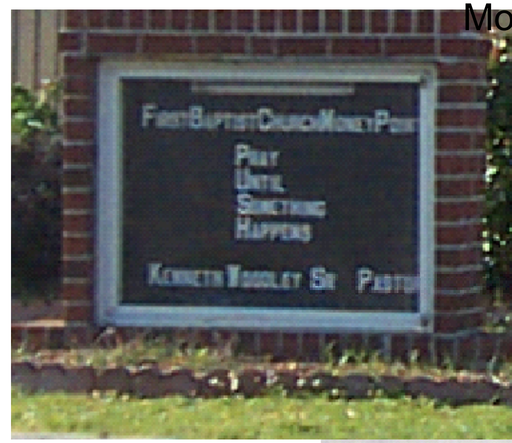
Money Point was named, as local folklore goes, for treasure the pirate Blackbeard buried off of the shores of Money Point. Others say it was the place where everyone made money - hence the name. Money Point was once a thriving community of approximately 1000 residents (by some accounts, 3000 residents lived at Money Point at one point). Money Point, also known as Buell and Reidsville, had the amenities of a small town in its heyday. Homes lined the prominent streets at Money Point, and residents described community life as:

"It used to be a tight knit, close community. Everybody knew everybody. People were out in the street communicating; people didn't stay in their houses. People raised each other's kids. If the ambulance came, everybody came out of their houses to see what was happening. There was free movement across the community."

Freeman Avenue, Money Point, 1942

Many Money Point residents were active in the Money Point Civic Group. There were a number of amenities available to Money Point residents. A Post Office serving Buell, VA, was located at the end of Freeman Avenue, a dance hall and night club was a main gathering place for residents, and many of the children at Money Point played at the centrally-located baseball diamond. There were two grocery stores located at opposite ends of Money Point (one near the church at Robertson Blvd, and one near Buell Street owned by brothers Larry and George Costen). Residents lived above the grocery stores, and residents bought most of their groceries from these stores.

Streetcars were a principal mode of transportation at Money Point until an overpass was built in 1937, when the streetcars were replaced by buses. Recreational opportunities abounded at Money Point - there was a horseback trail, and people used to go across the river to Gilmerton in a row boat, and ships used to pick people up on Buck Road.

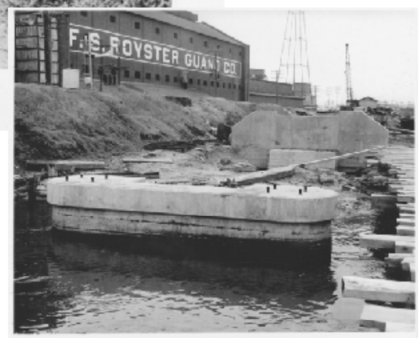


Left: Sign for the First Baptist Church, Money Point

Below: View of the railroad yard at the Norfolk Creosote Plant

Bottom left: Water view of Norfolk Creosote

The First Money Point Baptist Church has been the center of life at Money Point throughout its 100 year history. Money Point residents have been active in Vacation Bible School and church gatherings throughout time, in homecoming dinners and reunions, and residents lent labor and love to the Church's reconstruction in 1980's. Today, the Church serves as a community anchor and place of gathering for residents of Money Point and the Hampton Roads region.



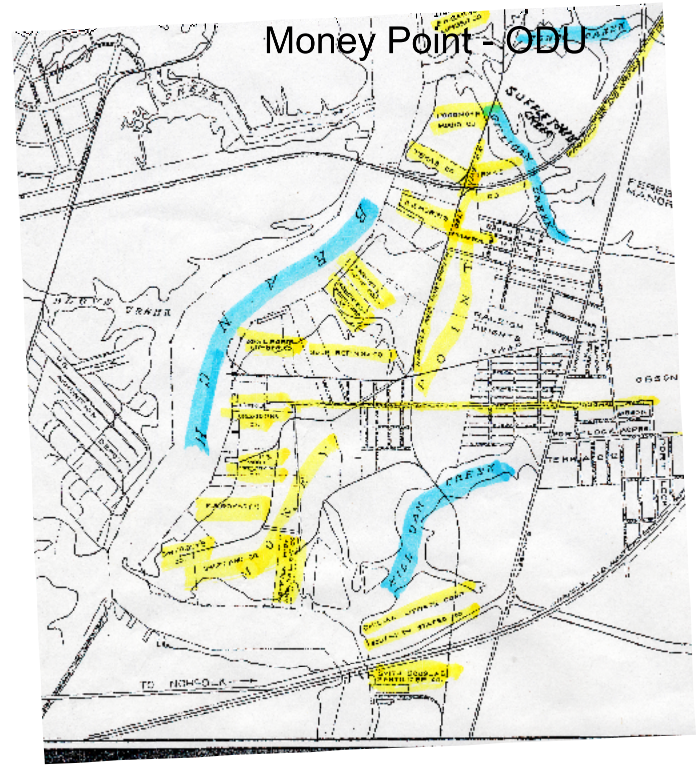
Left: Railroad tracks by the former Nichols Fertilizer Plant

Below: Former Royster Guano Plant

Many people historically earned their living at businesses located at Money Point at one of the fertilizer plants, the plastic and leather shop, or at one of the creosote plants. A number of businesses were located at Money Point over time. According to a 1921 Norfolk City Planning Commission map, businesses at Money Point included
(from north to south)

- Farmers Guano Co
- Robertson Fertilizer Co.
- John L. Roper Lumber Co.
- Gulf Refining Co.
- Norfolk Creosoting Co.
- U.S. Wood Preserving Co.
- F.S. Royster
- C.W. Priddy's Co
- Swift and Co. Fertilizer Company
- Norfolk Hide and Tallow Co.

Railcars used to move through Money Point frequently to the fertilizer and creosote plants, as well as transporting coal to the area. People used to go down to the railroad tracks pick coal up that fell off of the railcars and use it for heating and cooking.



Right: 1921 Norfolk City Planning Commission Map of businesses at Money Point

As Money Point grew as a commercial and industrial center, many residential areas disappeared to make way for the new growth. Many of the homes along Buell Avenue were rentals, so when the landowner wanted to covert the land from residential to commercial, several residents were forced to move. In addition to this land transition, many homes were bulldozed to make way to new commercial areas. Only a few people owned their own homes at Money Point, many of which are still standing today.

During the same period of land use transition at Money Point, the modes of transportation shifted as well. When the streetcar was replaced by buses, many people felt that transportation choices decreased. In addition, many people didn't have city water, and residents stated that it took a long time for water to be piped into residential areas from the city during that time. Eventually, Money Point transitioned to a more urban and industrial area as street lights, industries, and trucks replaced the baseball diamond, the local stores, and the street car.

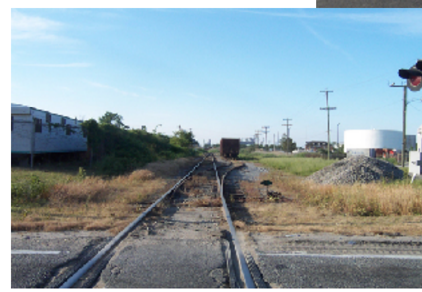
Left: Current view of the intersection of Freeman and Buell Ave at Money Point

Bottom: View of the 1967 fire at the Eppinger and Russell Creosote plant.

During this same time, another conversion took place. Community members stated that hundreds of residents were displaced during the 1960‘s and 1970’s during a federal Housing and Urban Development Urban Renewal project that moved residents to make way for Interstate 464. Residents stated it took twenty years to construct the interstate, numerous homes were destroyed, and hundreds of residents were moved during this period. Community members say that this displaced and divided the community,

Concurrently, while Money Point served as an important industrial area, significant pollution resulted from industrial activities. The 1967 fire at the former Eppinger and Russell creosote plant released large amounts of creosote into the River. Today, very high levels of contamination and pollution remain from this spill in the sediment of the Elizabeth River.

Lleft:Tthe intersection of Buell and Freeman Avenues.



Above right: Looking east down Freeman Avenue

Left: Railroad tracks at Money Point

Money Point is a community that has experienced significant transition. Approximately one dozen houses are owned at Money Point today. Money Point is zoned “heavy waterfront industrial,” and as a result, many residents are not able to tear their homes down to construct new homes, or significantly add to their homes. Residents say that they can‘t sell their homes because they have experienced a significant loss of value (many houses are now assessed at $20,000 - $30,000). Many of the residents are over 65 years old and aren’t able to afford rent in a different location or aren‘t able or interested in purchasing a new home.

In light of these difficulties, current Money Point residents love where they live. Residents say they value the serenity and peace at Money Point. They say once you come across the railroad tracks, you don’t have to worry about crime, drugs, or violence. They say there are “no street gangs because there is no where to hang out. This is a safe haven. It is rough across the railroad tracks, but Money Point is a peaceful community.

First Baptist Church, Money Point

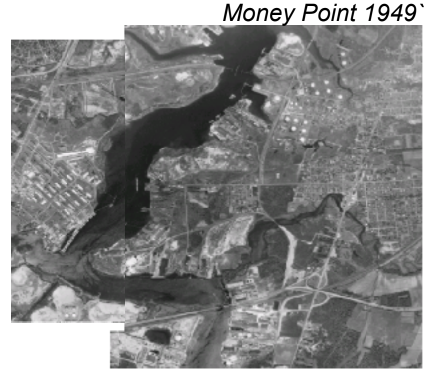
First Baptist Church Money Point Trustee, Bernard Wilson, describing Money Point's history at a recent Task Force meeting.

When asked about what they would like to see in the future, many people say they would like to see the Church continue to be a community anchor, as it has been the focus of the community over time. Although many children and grandchildren have moved away from Money Point, people still come back to visit the Church. Many residents agree that keeping the Church as a civic center is very important - stating that people still call the Church home, even if the Money Point community residents once knew is no longer there.

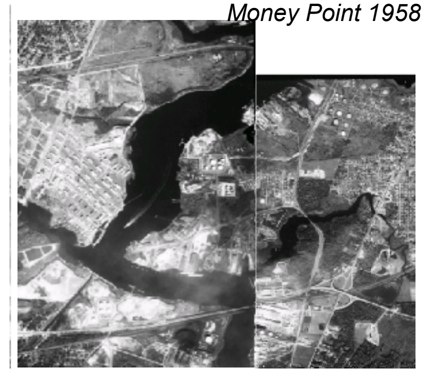
Today, the Money Point Revitalization Task Force, comprised of community partners and public agencies, is working with the Elizabeth River Project and UVA's Institute for Environmental Negotiation in setting a vision and goals for the environmental restoration and sustainable redevelopment of Money Point. As this process is carried out, Money Point will continue to go through transition, yet its rich history is a strong beacon to what is possible on its rich shores.

Money Point 1937

Money Point 1949`

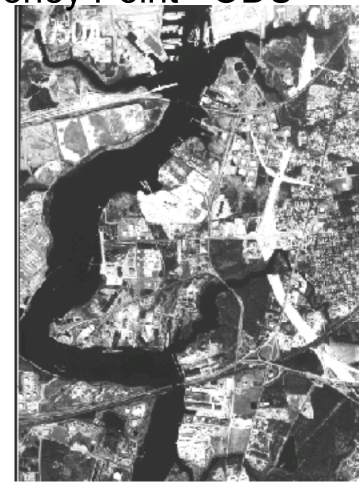


Money Point 1958



Money Point 1964

Money Point - ODU



Sources:
[1] Community Interviews, First Money Point Baptist Church, March 30, 2005
[2] Harper, Raymond L. Chesapeake, Virginia: The Making of America Series. Arcadia Publishing, 2002.

This booklet was created in the spring of 2005 by the students of the University of Virginia's Collaborative Planning Class.

We would like to thank the Money Point residents that shared their time and stories with us on March 30, 2005 at the First Baptist Church Money Point. Their stories have enriched our lives.

We are also grateful to the work of Ray Harper, the information provided by the City of Chesapeake, The Elizabeth River Project, the Hampton Roads Planning District Commission, and the members of the Money Point Revitalization Task Force.

Rediscover the Treasure

Money Point Revitalization

A 10-Year Plan

Money Point Revitalization Task Force

October 2006

University of Virginia Institute for Environmental Negotiation

Elizabeth River Project
Making restoration a reality.

Plan Sponsors

Andrus Family Fund
The Virginian-Pilot
Living River Restoration Trust
Virginia Environmental Endowment
The Elizabeth River Project members and donors

Additional Implementation Partners

CITGO Petroleum Corporation
City of Chesapeake
Elizabeth River Terminals
First Baptist Church Money Point
Ford Motor Company
Hampton Roads Sanitation District Environmental Improvement Fund
Hess Corporation
Kinder Morgan, Inc
Lafarge Cement
National Fish and Wildlife Foundation
National Oceanic and Atmospheric Administration Restoration Center
National Oceanic and Atmospheric Administration Office of Response and Restoration
Old Dominion University
Sims|Hugo Neu Corporation
Small Watershed Grant Program, Chesapeake Bay Program
South Norfolk Civic League
Southern Aggregates, LLC
US Army Corps of Engineers
US Environmental Protection Agency
Virginia Department of Conservation and Recreation
Virginia Department of Environmental Quality
Virginia Department of Housing and Community Development
Virginia Institute of Marine Science
Virginia Marine Resources Commission

Keepers of the Vision

Recognized October 19, 2006 as key leaders for implementation of the Money Point Revitalization.

Bob Alvis, *CITGO Petroleum Corporation*
Col. Dionysios Anninos, *US Army Corps of Engineers*
Steven Bowman, *Virginia Marine Resources Commission*
Bruce Bradley, *The Virginian-Pilot*
L. Preston Bryant, Jr., *Commonwealth of Virginia*
Christopher S. Colman, *Hess Corporation*
Rod Colton, *Sims|Hugo Neu Corporation*
Hon. Dalton S. Edge, *Mayor, City of Chesapeake*
Hon. Randy J. Forbes, *US Congressman*
Raymond L. & Emma Harper, *Chesapeake Revitalization Committee*
Timothy R. E. Keeney, *NOAA, Department of Commerce*
Steven Kelben, *Andrus Family Fund*
Frank Lilley, *South Norfolk Civic League*
Burnie Mansfield, *Lafarge Cement*
Joseph H. Maroon, *VA Department of Conservation and Recreation*
Gerald P. McCarthy, *Virginia Environmental Endowment*
David K. Paylor, *Virginia Department of Environmental Quality*
Peter Schmidt, *Southern Aggregates, LLC*
Phil A. Stedfast, *Kinder Morgan Elizabeth River Terminals*
Nicholas P. Taro, *APM Terminals/Universal Maritime Services Corporation*
Joseph J. Thomas, *President, Living River Restoration Trust*
Dean Karen Van Lengen, *University of Virginia School of Architecture*
Donald Welsh, *US EPA, Region III*
Pastor Kenneth Woodley, *First Baptist Church Money Point*

Presented by:
The Elizabeth River Project
475 Water Street, Suite C103A
Portsmouth, VA 23704
757-399-7487
www.elizabethriver.org

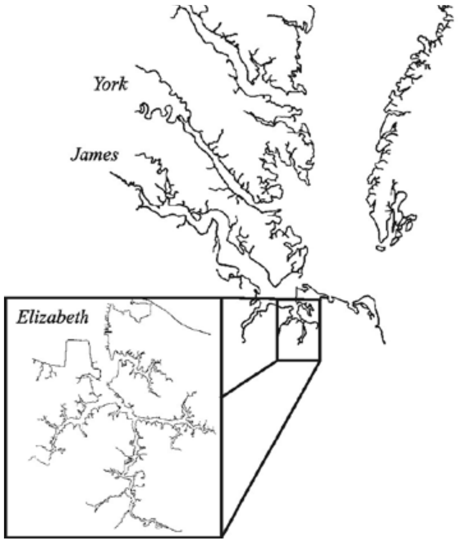
Facilitated by:
Institute for Environmental Negotiation
School of Architecture University of Virginia
www.virginia.edu/ien/moneypoint

Sediment Restoration made possible by:
Living River Restoration Trust with mitigation funds from APM Terminals.
www.livingrivertrust.org

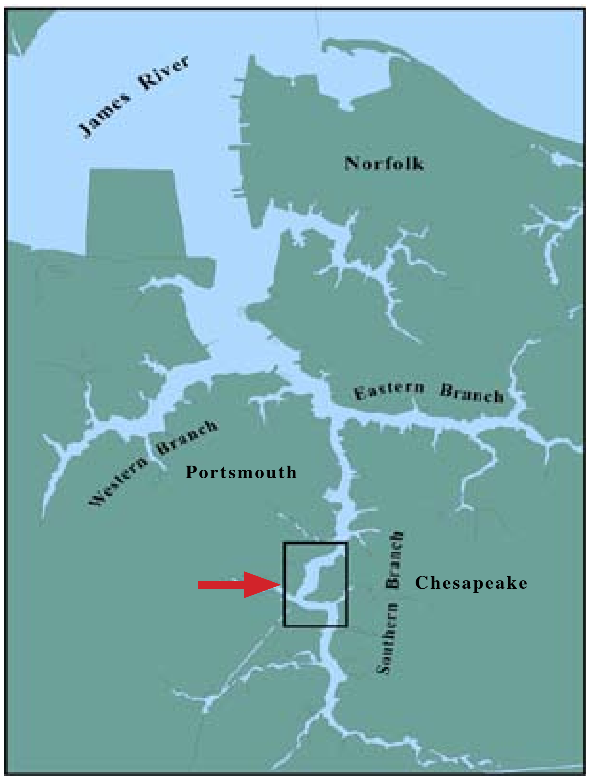
Living River TRUST

Urban Design + Graphics by:
Crisman+Petrus Architects
Charlottesville, Virginia
www.crismanpetrus.us

Vision: Money Point will be a model for the co-existence of thriving waterfront industry and ecological regeneration, while affirming community history, safety and aesthetics.



The Elizabeth River is a critical estuary of the lower Chesapeake.



Money Point is a bend on the Southern Branch of the Elizabeth.

Rediscover the Treasure:
Summary

For decades, the Elizabeth River off Money Point has been a 35-acre biological dead zone. Little can survive along the river bottom, laced with some of the highest concentrations of cancer-causing polycyclic aromatic hydrocarbons (PAHs) in the world. Liver cancer, deformities, cataracts and lesions are found in the fish. Until 2005, the river bottom at Money Point was considered a lost cause. No one imagined it was possible to clean it up.

Back in history though, Money Point got its name, locals say, because of the jobs and wealth created during its heyday of flourishing shipping terminals, factories and wood treatment plants. Others say Money Point obtained its name from the pirate Blackbeard who buried his treasure along these shores.

This plan invites you to rediscover the treasure. Money Point, almost a mile of prominent waterfront at the gateway to Chesapeake, Virginia, will again be celebrated as a hub for maritime activities, this time co-existing with **one of the largest environmental restoration efforts on the Chesapeake Bay,** thanks to the five revitalization goals presented here.

The best sign of a strong plan is when implementation is rolling before the plan is finished. As we go to press, **more than $6.5 million is already underway to implement actions under every goal in the Money Point Revitalization Plan.** These range from historic cleanup of the contaminated sediments through a new trust fund, to NOAA's help with the largest voluntary wetland restoration on the Elizabeth River, to virtually every waterfront industry doing its part through voluntary stewardship. The City of Chesapeake is revamping stormwater controls. The US Environmental Protection Agency is focusing efforts here to ensure no recontamination of the river bottom – and the University of Virginia is designing an international first, a "Learning Barge," to bring the public up close to this and other river restoration activities.

The plan was born when The Elizabeth River Project, a community-based non-profit leading restoration of the Elizabeth River, was contracted to oversee a sediment cleanup project at Money Point by a new sister organization, the Living River Restoration Trust. We believed the cleanup of the severe contamination at Money Point would not move forward unless every interest group was involved in setting the course and taking a role in ensuring the holistic revitalization of the entire Money Point corridor. Cleaning up the toxics in the river bottom alone would be short-lived if contamination continued to seep in from a degraded shore.

The result is an uncommon accomplishment which, when it happens, creates a special euphoria: industries, government and citizens, all agreeing to a common course of environmental action. The Money Point Revitalization Task Force met from January 2005 to August 2006, convened by The Elizabeth River Project and facilitated by University of Virginia's Institute for Environmental Negotiation. Nearly 100 participants came from groups as diverse as a Baptist church, the US EPA and one of the world's largest oil companies. They set the vision – to be the model to the nation for thriving waterfront industry that co-exists with ecological regeneration and yet affirms a residential community's history and safety.

The Task Force also set the 10-year goals, and led the charge to get them underway:

Goal 1 – Clean up one of the most polluted spots on the Chesapeake Bay – the river bottom at Money Point. The task force selected its preference for the most feasible cleanup design, presented by the engineering firm SAIC - under contract for the first phase of a $5 million cleanup. A combination is prescribed that would carefully remove all of the most toxic hotspots, and enhance the habitat value of the southern portion of the site with placement of clean sand, anchored by oyster reef and new wetland grasses. The Living River Restoration Trust has most of the funds in hand for this cleanup, thanks to a mitigation payment from APM Terminals for impacts from a new port facility. The Trust is the first government-approved fund in the nation to offset impacts to healthy river bottom by cleaning up contaminated bottom.

Goal 2 – Prevent upland pollution from entering the river at Money Point, improving and maintaining water quality. Activities onshore at long defunct wood treatment facilities, including Eppinger and Russell and Republic Creosoting, created much of the toxic legacy at Money Point. Hess Corporation, current owner of the largest related site, is helping to fund the offshore cleanup while conducting a major, voluntary onshore cleanup of contamination on its property, the legacy of the defunct Eppinger and Russell wood treatment facility that operated through 1979. **Hess in 2005-06 pioneered use of native trees such as poplars for "phytoremediation"** of creosote remaining on its site. Hess planted more than 1,200 of the trees while also beginning the work of direct removal of some upland hotspots. Hess also plans to construct a large barrier wall between its upland property and the sediment cleanup, to prevent seepage of any possible remaining contamination into the river.

Meanwhile, the main thoroughfare at Money Point, two-lane Freeman Avenue, was creating a hazard as well as stormwater runoff contamination due to a lack of virtually any stormwater controls. Large trucks carrying petroleum regularly travel the street, in winter navigating frozen puddles of standing stormwater and risking petroleum spills. **To implement this plan, the City of Chesapeake obtained a $370,000 grant to begin the work of improving stormwater management at Money Point.**

Goal 3 - Enhance community quality of life at Money Point and promote the co-existence of industrial, community and ecological health. "Pray Until Something Happens," read the marquee at First Baptist Church Money Point, when The Elizabeth River Project and University of Virginia first arrived to organize the revitalization. While only two dozen homes remain at Money Point, many more former residents return to reunions and services at First Baptist Church Money Point, remembering the proud history of the former independent city of Buell, Virginia, with its own Post Office, two grocery stores, a dance hall and night club. Today the small nucleus of remaining residents remember the explosion in 1963, when a fire burst a tank at Eppinger and Russell, adding to the pollution. They celebrate the cleanup plans. Community goals include a small park, "pervious" sidewalks that don't contribute to runoff, and redevelopment of derelict sites. University of Virginia students conducted interviews and produced a history of Money Point during the planning process.

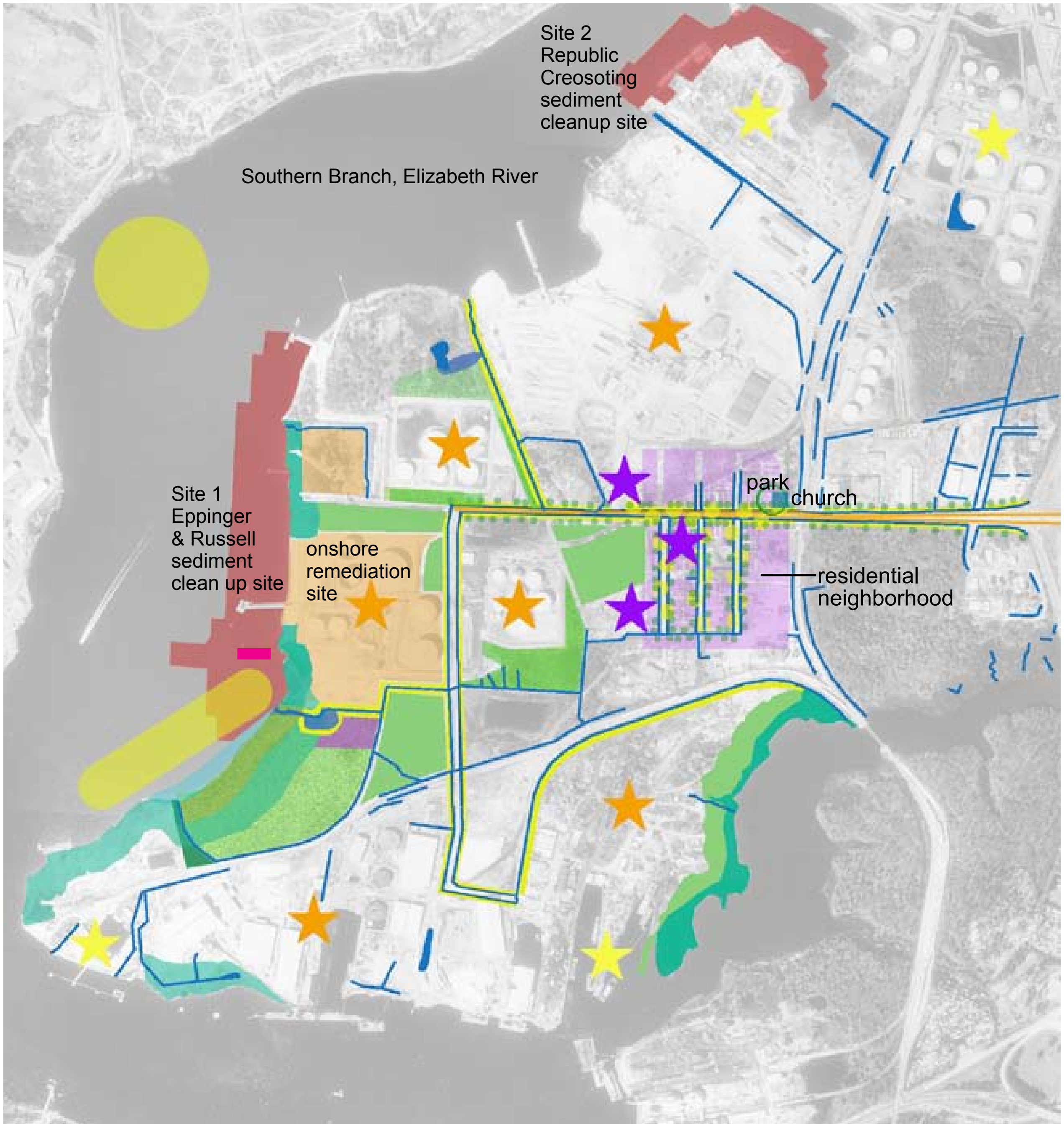

The Virginian-Pilot

Long defunct wood treatment facilities were a source of creosote pollution. At the former Eppinger and Russell facility, a fire ruptured tanks of creosote, contributing to routine industrial contamination.


SIMS, a metal recycling yard at Money Point, gets a new vegetated buffer on its shores. Before the plan was done, this facility had joined the majority of industries at Money Point in doing their part.


Joe Rieger, Elizabeth River Project, briefs potential bidders for the first wetland restoration at Money Point. The project will be the largest voluntary wetland restoration on the Elizabeth River.

Composite Map of Proposed Restoration Projects



Ten-year plan includes actions for revitalizing the 330-acre peninsula known as Money Point in Chesapeake, Virginia.

Sediment cleanup site

Onshore cleanup site

Stormwater Management

Bioswales/habitat corridor

Retention Ponds (BMPs)

Pervious Paving

Wildlife Habitat

Riparian Buffers

Tidal Wetlands Restoration

No-mow+urban forest area

Street Trees

Shellfish restoration

Community Quality of Life

Public park/playground

Learning Barge

Pervious Sidewalks

“Dark skies” Street lighting

River Star Industries:

Current

In the making

Future target

At the same time, University of Virginia Professor Phoebe Crisman, advising the planning effort as an expert in sustainable redevelopment, thought of a way to engage the larger community and make the revitalization process visible, despite Homeland Security restrictions to public access at industrial waterfront properties. **Crisman has won a 2006 national award from the American Society of Landscape Architects for her students' design of a "Learning Barge," a floating classroom now in final design.** The Elizabeth River Project will use the 120-foot vessel to bring the public to view restoration efforts wherever they occur on the river.

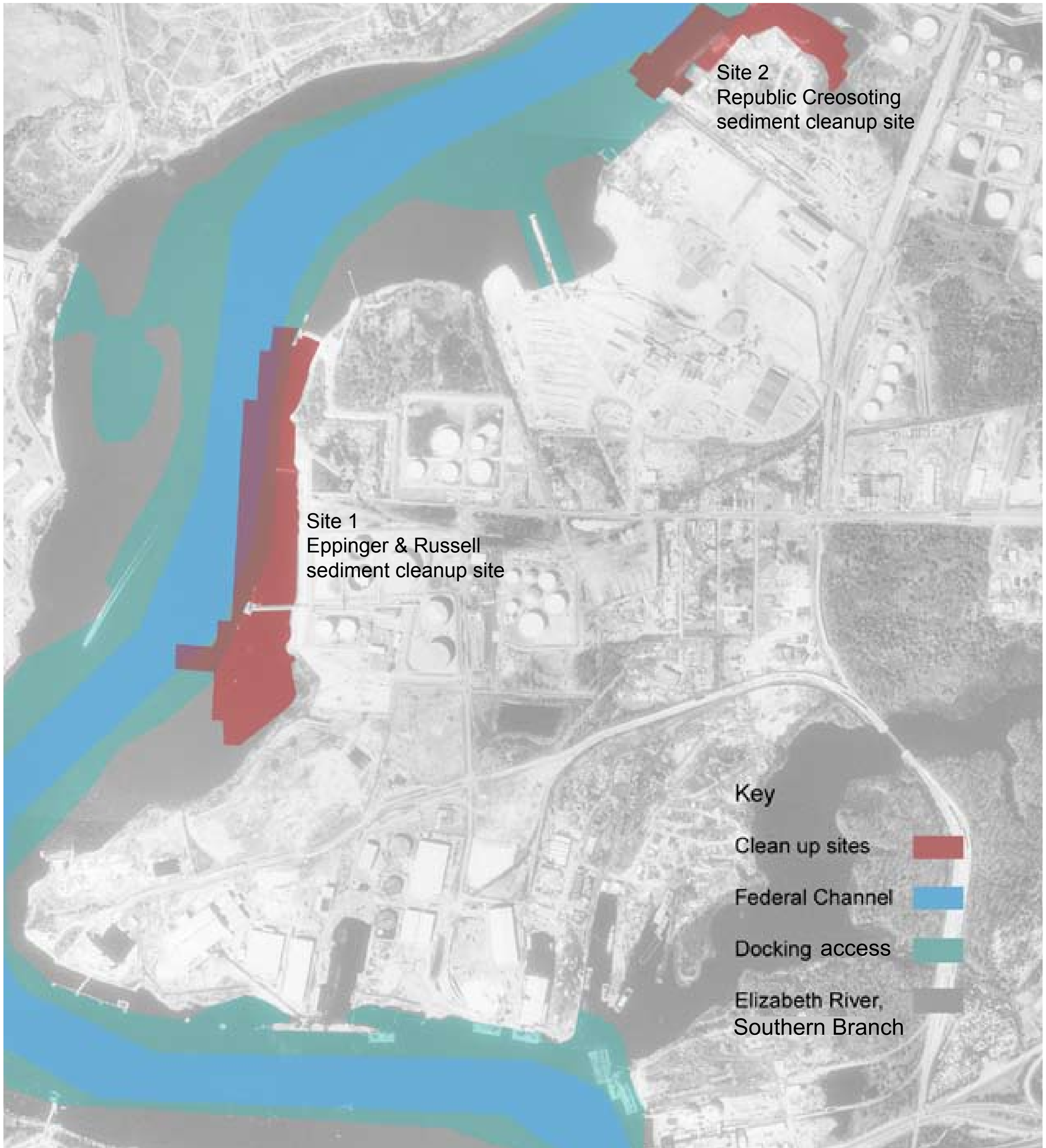
Goal 4 - Establish environmental stewardship as the industrial ethic at Money Point, primarily through the River Stars program. The revitalization would not work unless **virtually every one of the industrial properties lined up along the shore agreed to become voluntary participants** – adding native trees, shrubs and wetlands where they could to filter runoff and restore habitat, assessing and improving their stormwater controls to prevent recontamination offshore, and adding new pollution prevention measures to become the prescribed "model" for industries co-existing with ecological regeneration. Southern Aggregates was the first Money Point industry to sign up with The Elizabeth River Project in its River Stars program, documenting voluntary stewardship results. Citgo, Kinder-Morgan, Hess Corporation, Elizabeth River Terminals and SIMS|Hugo Neu also came on board, with projects as significant in size as Elizabeth River Terminals setting aside 16 acres for active conservation, four of them for a major voluntary wetland restoration. As the plan goes to print, LaFarge Cement is a River Star in the making – hosting the public unveiling of the plan with a habitat planting on its shores.

Goal 5 – Restore and conserve wetlands, vegetated buffers, shellfish beds and urban forest, creating an integrated network of habitat for wildlife. Much of the mile-long shore at Money Point is either concrete or rubble, scarcely the ideal nursery for wildlife that would be created by the wetlands and oyster reefs once there. The 10-year goals, including restoring 20 acres of tidal wetland habitat and five acres of oyster reefs, have been launched with one of the most ambitious projects already underway. A NOAA grant to The Elizabeth River Project, and the cooperation of landowner Elizabeth River Terminals, has allowed for design of **a four-acre wetland restoration at Money Point, the largest voluntary wetland in the history of the restoration of the Elizabeth River.**

Implemented together, these five goals will achieve comprehensive, integrated revitalization of one of the most severely contaminated stretches of river in the world. In the long effort to restore the Chesapeake Bay, one of the great estuaries of the world, the Revitalization of Money Point will remove a major source of toxins endangering Bay health. In the restoration of our home river in Hampton Roads, the Elizabeth, **no initiative is more important for achieving our vision - that a healthy ecosystem can be restored alongside a thriving port economy.**

The plan would make the late CBS commentator Charles Kuralt proud. "When the wetlands really come back," he said on the shores of the Elizabeth in 1996, launching our vision, "… when healthy fish and clams and oysters find a home in the Southern reaches of the river again, and the sun rises off the Atlantic in the morning to reflect itself in the serene, pure waters of the Elizabeth River, our children and grandchildren will know that we had them in mind." **His words once sounded like a far-off dream. But just keep watching at Money Point.**

Table of Contents



Two defunct wood treatment plants will be the focus of some of the first and largest offshore sediment cleanups on the Chesapeake Bay.

Goal 1: Clean up one of the most polluted spots on the Chesapeake Bay - the river bottom at Money Point.

- By 2009, clean up contaminated sediments offshore of the former Eppinger and Russell facility, and by 2016, offshore of Republic Creosoting.
- Clean the sediments at these sites to no more than 45 parts per million of the contaminant, PAH (polycyclic aromatic hydrocarbons), correlated with cancer in fish. Contamination above this level shows harmful effects on river life.

Summary

In a recent experiment, the popular sport fish, spot, survived for only two hours after being exposed in an aquarium to contaminated sediments removed from the Elizabeth River bottom at Money Point. This research by the Virginia Institute of Marine Science is only one of a series of studies documenting the effects of severe contamination in this stretch of waterway, intensely industrialized since the 1800s.

Now the powerful good news: to implement this plan, a $5 million initiative is already underway to clean up the largest problem area at Money Point, offshore of the notorious former Eppinger and Russell wood treatment facility. Funds primarily from the new Living River

Restoration Trust in Portsmouth, Virginia, have allowed The Elizabeth River Project to obtain an engineering design for the cleanup that has the full support of the Money Point Revitalization Task Force, from industries along the shore, to residents, to government reviewers.

The engineering conceptual design, part of a comprehensive feasibility study for the Eppinger and Russell site, calls for carefully removing all the worst hotspots by dredging, then placing clean sand in the Southern area, where oyster reefs and wetlands will be added to enhance the habitat value and anchor the sand in place.

The plan calls for a second offshore cleanup project at another former wood treatment facility, Republic Creosoting, once the first is well underway. Together, the two will alleviate some of the Chesapeake Bay's highest levels of polycyclic aromatic hydrocarbons (PAHs). High levels of this contaminant have been correlated with elevated cancer in an indicator species, the bottom-dwelling "mummichog." The health of the mummichog will be tracked as we judge the success of cleanup efforts in reviving the "benthic" or bottom-dwelling community of the river - the foundation of the food chain.

Action Steps

Action 1 – Clean up Eppinger and Russell site.

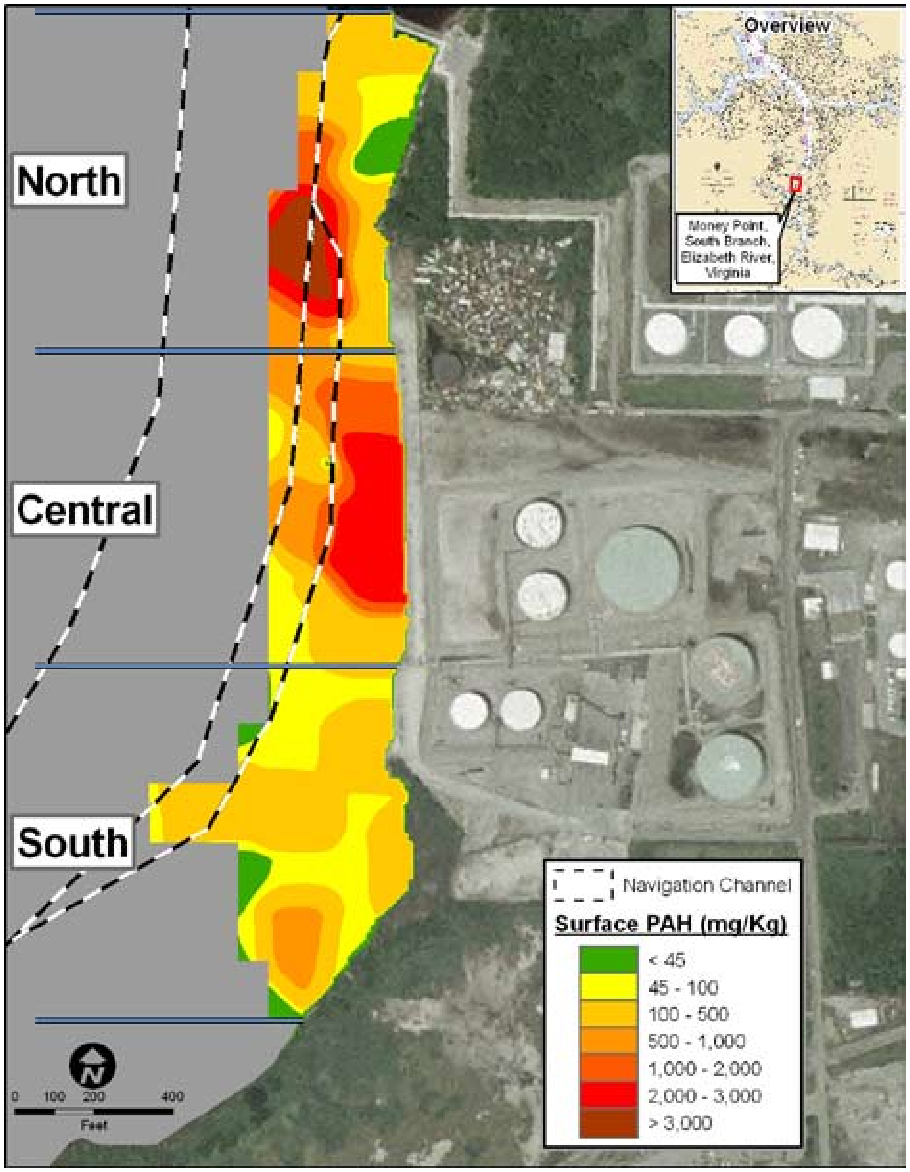
- **DONE! Complete a focused sediment remediation feasibility study to locate highly contaminated sediment areas or "hotspots" near the defunct Eppinger and Russell facility at Money Point**. Determine which remedial alternatives would be effective, acceptable, and affordable to all major stakeholders. Make sure that the strategy reflects the navigation and development needs of onshore landowners, as well as addressing regulatory agency and community concerns and interests.
- **Implement an agreed upon remediation strategy to eliminate toxic effects from contamination in the river bottom at Money Point.**

In Spring 2005 with funding from the Living River Restoration Trust, The Elizabeth River Project contracted with Science Applications International Corporation (SAIC) to conduct a study at Money Point to determine the full extent and nature of river bottom contamination and methods for cleanup. SAIC reviewed extensive historical data for the area and conducted a comprehensive survey with sampling of the site that included:
1) assessment of upland sources and controls; 2) a depth survey; 3) a survey for underwater debris; 4) a photo survey of the bottom sediments; 5) sediment sampling; and 6) the potential treatability of the contaminated sediments.

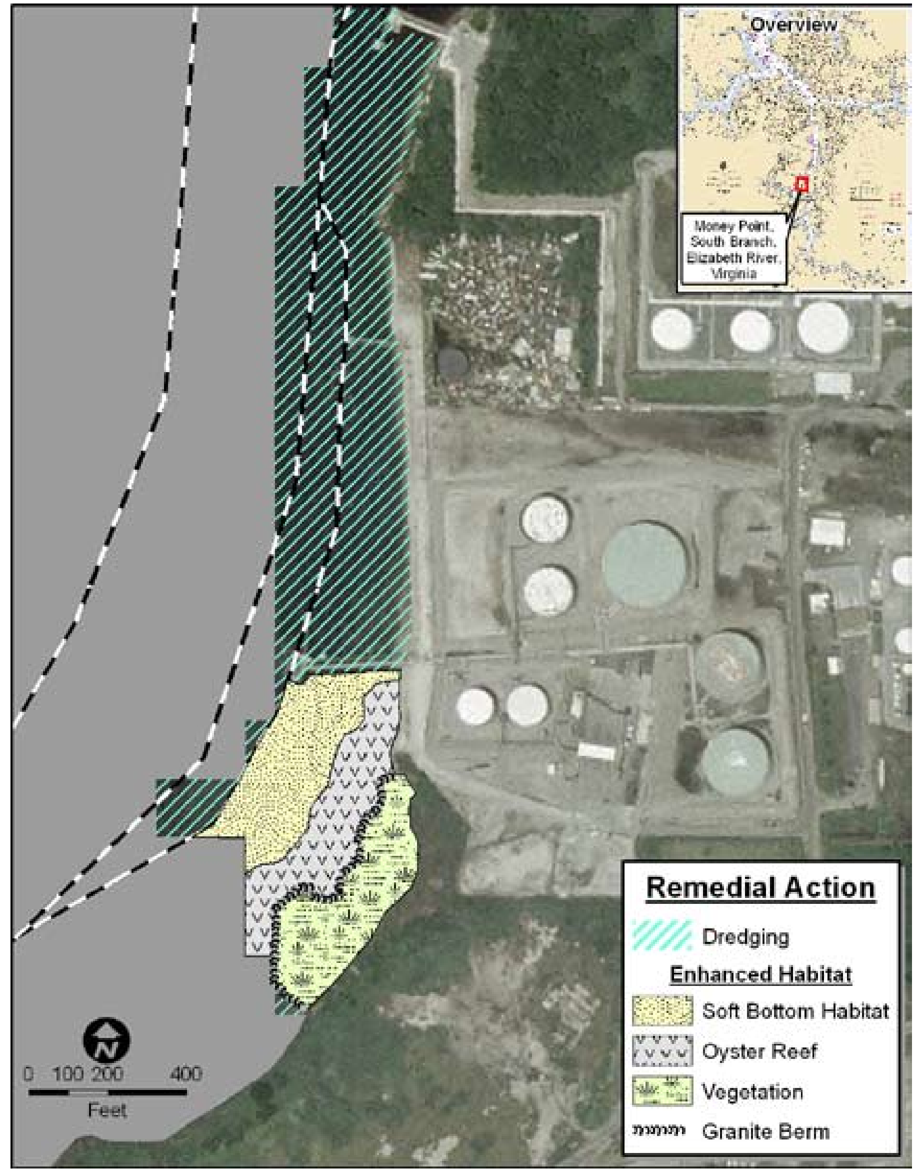
A Technical Advisory Committee to the Living River Restoration Trust advised SAIC. Results showed about 35 acres of river bottom impacted by PAHs, the primary contamination of concern. Three major sediment "hotspots" in the north, central, and southern areas of Money Point showed PAH levels exceeding 500 parts per million (maximum concentration observed was 6000 parts per million; acute harmful effects on aquatic life start at 45 parts per million).

SAIC engineer lowers underwater camera as part of historic clean-up of toxics correlated with cancers.

SAIC presented four cleanup options to the Money Point Task Force and the Technical Advisory Committee in late 2005. The options ranged from dredging all sediments even mildly contaminated, to placement of clean sand on all contaminated sediments to isolate the toxics from marine life, to a combination of removal in some areas and habitat restoration in others. Stakeholders and technical advisors focused on a desire to remove all severely contaminated hotspots, the need to safeguard the option for future navigational dredging next to industrial facilities, and a preference for restoring maximum habitat value for river life. The Task Force recommended a hybrid, fifth option combining elements of the earlier four. The most "acceptable, effective and affordable" option evolved, as illustrated on the next page.



Toxic River Bottom *– Contamination at Money Point shows three "hotspots" with polycyclic aromatic hydrocarbons (PAH) greater than 500 parts per million (at above 45 parts per million, harmful effects are seen in aquatic life).*



Maximum Restoration *- Cleanup will include dredging all three hotspots, as well as the lower contamination in the northern area. In a shallow southern area, habitat restoration will also include a layer of new sand and pending additional funds, an oyster reef and new wetlands.*

- Remove all severely contaminated "hotspots" at the Eppinger and Russell site through dredging and treatment onshore with beneficial reuse of any suitable dredged material.

- Place clean sand along the less contaminated river bottom habitat on the southeastern shoreline - a shallow area where no future need for navigational dredging is identified.

- Further enhance the habitat value of this area with oyster reefs and wetlands.

As a final step, SAIC is working with the US EPA and upland sites to ensure that all possible sources of recontamination are addressed. The Eppinger and Russell cleanup project is expected to move to final design in 2007 and construction by 2009.

Action 2 – Explore potential synergy for cleaning up the channel while deepening it for navigation.

- **Continue dialogue to explore a potential Army Corps of Engineers project to deepen the channel at Money Point**, if a "win-win" solution can be identified to address contamination in the river bottom while also deepening the channel to meet navigation interests. The channel is currently 35 feet deep but is authorized for deepening to 40 feet. Hampton Roads Maritime Association has convened a dialogue on this issue.

Action 3 – Clean up site two, offshore of the Republic Creosoting facility.

- **Initiate a focused sediment remediation feasibility study at the former Republic Creosoting facility to locate highly contaminated sediment areas ("hotspots")** and determine which remedial alternatives would be effective, acceptable, and affordable to all major stakeholders.

- **Complete a detailed design for sediment remediation offshore of the former Republic Creosoting facility.**

- **Implement a cleanup** project with stakeholders' support.

Key implementers

- The Elizabeth River Project
- Living River Restoration Trust
- Science Applications International Corporation (SAIC)
- Hess Corporation and other waterfront industries
- NOAA Office of Reponse and Restoration
- Navigation issue: Hampton Roads Maritime Association, Army Corps of Engineers, Chesapeake Port Authority, City of Chesapeake and Virginia Port Authority

Resources

- The Living River Restoration Trust - $5 million for sediment cleanup at Money Point
- Additional mitigation funds may be available from other large port projects
- NOAA Office of Reponse and Restoration
- Hess Corporation - $100,000 toward feasibility study
- VA Dept. of Environmental Quality (DEQ) mummichog monitoring
- Navigational deepening could be cost shared by the federal government and local sponsors
- The Elizabeth River Project members and donors

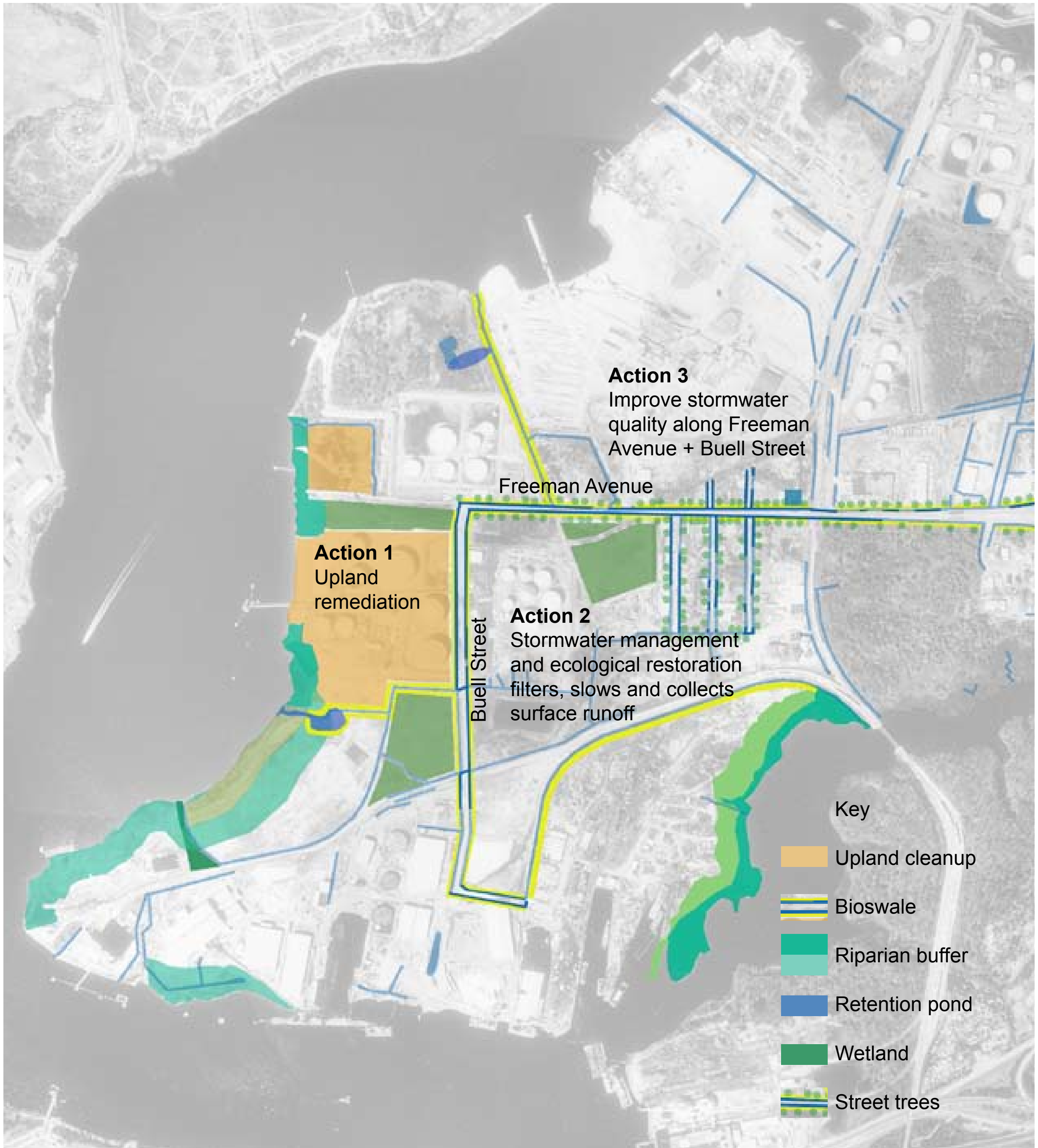
Milestones

Eppinger & Russell Site

- Complete detailed design by 2007-2008
- Clean up sediments 2008-2010
- Monitor environmental conditions 2010-2015

Republic Creosoting Site

- Initiate feasibility study by 2008 and complete by 2009-2010
- Complete remediation project by 2016
- Monitor environmental conditions 2017-2020



Actions underway to improve stormwater control include a $370,000 city project and upland cleanups at old creosote plant.

Goal 2: Prevent upland pollution from entering the river at Money Point, improving and maintaining water quality.

Summary

The contamination in the river bottom at Money Point cannot be addressed until potential sources of recontamination onshore, within the 330-acre revitalization area, are fully identified and addressed. Currently, contamination washes into the river during each rain, carried as stormwater from the uplands. The uplands at Money Point are particularly challenging. The area has a long history of activities associated with creosote, a wood treatment material correlated with cancer in fish. A fire at the Eppinger and Russell site in 1963 ruptured large tanks of creosote.

Meanwhile, virtually no municipal control or treatment of stormwater runoff is in place at Money Point. In winter, freezing water on Freeman Avenue, the main thoroughfare, poses an additional risk - skidding trucks loaded with petroleum from the port terminals.

As with every other goal in the plan, however, the community took ownership and began implementation before the plan was finished. The City of Chesapeake, responding to the draft plan, landed a $370,000 grant to begin improved stormwater controls at Money Point. Hess Corporation, the largest landowner of the former Eppinger and Russell site, launched a significant cleanup of its upland site as a participant in the Virginia

Voluntary Remediation Program. Hess' efforts include an ongoing phytoremediation initiative and the planned placement of a cutoff wall to stop river recontamination.

Action Steps

Action 1 - Achieve onshore cleanup of any contamination that poses the risk of recontamination to the river.

- Hess is implementing voluntary remediation plans, including isolation of contaminants, limited removal of onshore hotspots and phytoremediation (plants that take up pollutants via their roots) through the Virginia Voluntary Remediation Program.
- Work with state and federal agencies along with other land owners to ensure any soil or groundwater contamination is addressed prior to sediment remediation.

Action 2 - Use a phased approach that integrates stormwater management and ecological restoration to slow, filter, and collect stormwater.

- Use a network of vegetated swales and Low Impact Development (LID) or conventional practices to reduce standing water and other stormwater hazards for pedestrians and vehicles on major streets, as well as provide habitat. Stormwater improvements on private property are encouraged and could connect with the public system.

Action 3 - Improve stormwater quality along Freeman Avenue and Buell Street.

The sharp turn at these streets floods during rain events and standing water freezes during winter months, creating both a safety and environmental hazard as three large petroleum industries transport large volumes of gas and oil around this dangerous corner daily. The City of Chesapeake is studying and engineering the components along Freeman Avenue and Buell Street, and will implement them in partnership with The Elizabeth River Project. Initial plans include:

- Clean out the ditches along the northwest side of Freeman Avenue, including two 90-degree turns that are clogged and ineffective.

Existing transportation and industrial infrastructure, including extensive impervious areas

Proposed integrated biological network of stormwater management and habitat corridors

Co-existence: plan integrating the existing industrial and restored biological infrastructure

Standing stormwater along Freeman Avenue at Money Point.

By 2006, the cleanup was underway. Here workers for the US EPA remove creosote in old tanks, reducing the potential for recontaminating cleanup areas in the river bottom.

- Construct engineered swales, bioswales or conventional stormwater controls along Freeman Avenue to collect, filter and convey runoff to a stormwater wetland.
- Consider a stormwater wetland at the southeast corner of the Buell and Freeman intersection (with adjacent property owners). Consider adding additional practices downstream of the stormwater wetland, such as a treatment train process for further improvement of stormwater.

Action 4 - Encourage additional stormwater treatment measures at other industrial sites including SIMS, Elizabeth River Terminals, Hess Corporation and Southern Aggregates. Explore regional stormwater treatment in the 3-acre vacant, phragmites-infested field north of Citgo.

- Recruit and assist industries in achieving stormwater improvements through the River Stars program of The Elizabeth River Project.

Action 5 - Introduce biostrips at parking areas to filter stormwater runoff.

Action 6 - Create a guide to sustainable redevelopment Best Management Practices for the Elizabeth River watershed, including Money Point.

Key implementers

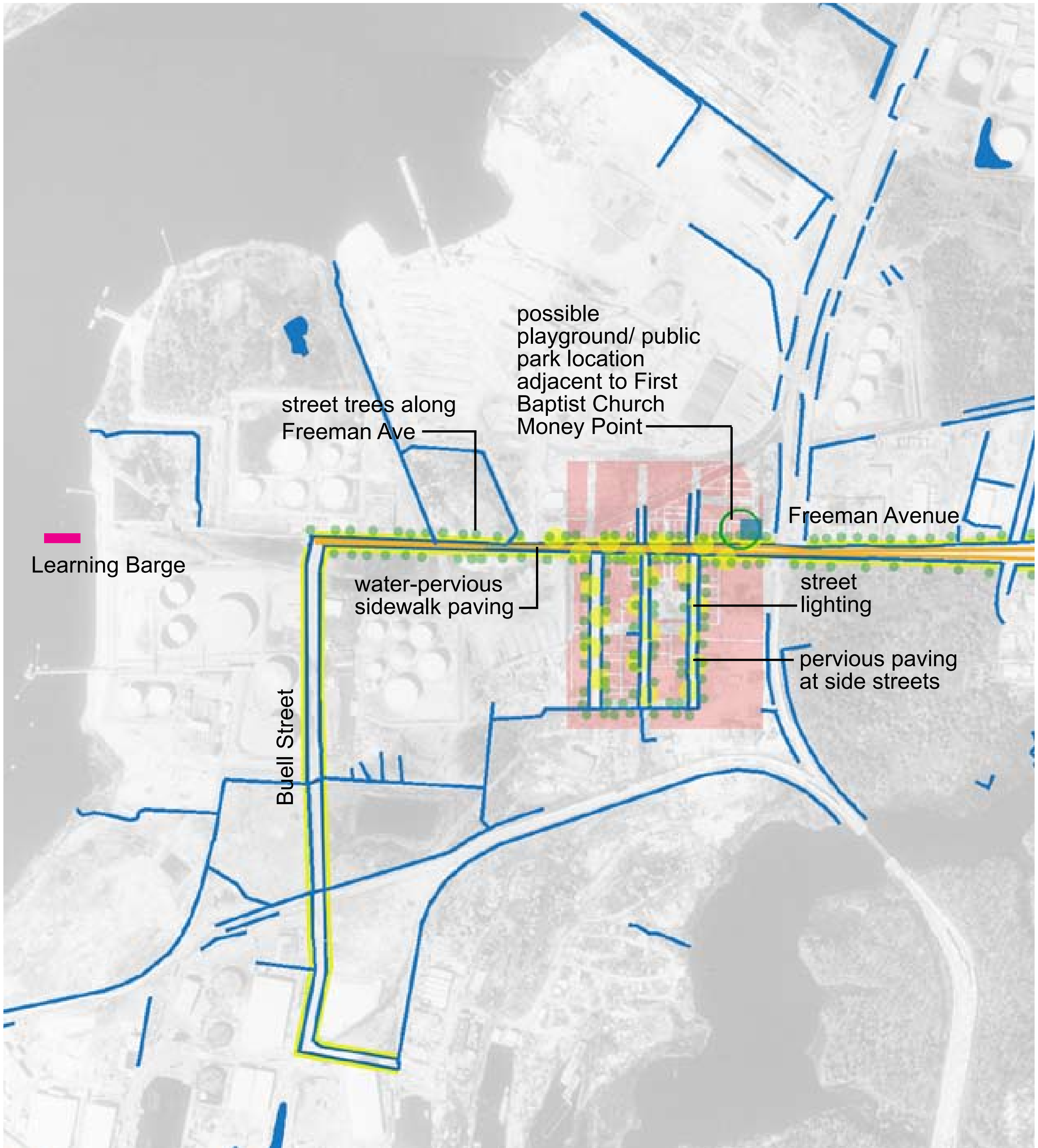
- All property owners at Money Point, especially current owners of the former Eppinger and Russell site and adjacent landowners
- VA DEQ
- City of Chesapeake
- US EPA
- The Elizabeth River Project
- Crisman+Petrus Architects
- University of Virginia
- River Stars and other Money Point Industries

Resources

- Hess and other industries conducting their own voluntary efforts
- US EPA - removal of contaminated uplands at some sites
- Living River Trust - engineering evaluation of potential recontamination from uplands
- The Elizabeth River Project members and donors
- Possible grants, EPA Brownfields assessment funds, EPA Targeted Watershed Grants, VA DCR Water Quality Improvement Fund, Small Watershed Grants Program
- City of Chesapeake - $367,747 grant, VA Dept. of Housing and Community Development

Milestones

- SAIC complete final evaluation of upland contamination, early 2007
- Clean up major upland sources of concern prior to offshore cleanup by 2008
- The City of Chesapeake complete stormwater project along Freeman and Buell by 2009
- Sustainable Development Guide for Urban Watersheds completed by 2007-2008



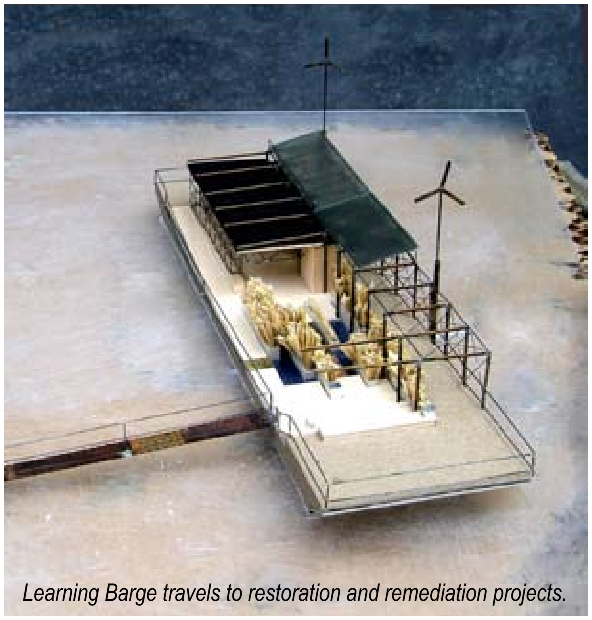
The plan seeks to affirm the proud history of the residential community of former Buell, VA, once home to as many as 3,000 residents.

Goal 3: Enhance community quality of life at Money Point and promote the co-existence of industrial, community and ecological health.

Summary

Money Point received its name as the primary area of employment for much of what is now South Norfolk, Chesapeake. The area was once the independent town of Buell, with as many as 3000 residents, its own post office, dance hall and thriving wood treatment facilities as well as other large waterfront industries. Some of the largest employers are now defunct, while changes in road patterns and rezoning have been part of reducing the population to about two dozen remaining homes - a close-knit community in direct proximity to industry. The First Baptist Church Money Point, celebrating its 100th anniversary in 2006, continues to draw former residents back to the area as an historic social center and active church.

One of the challenges in formulating this plan was the need to achieve a balanced co-existence: ecological regeneration alongside thriving waterfront industries, while also affirming the proud residential history of the community. Part of the solution involves getting the Money Point story to the public.


Learning Barge travels to restoration and remediation projects.


Visitors view ongoing restoration projects from the upper deck.


Visitors gather on outdoor theater steps at living wetlands garden.


Native plants purify rainwater used onboard before release into the Elizabeth River.

Action Steps

Action 1 - Construct the "Learning Barge," a floating classroom for education about environmental revitalization initiatives such as Money Point.

- The University of Virginia School of Architecture is designing the barge for use by The Elizabeth River Project to bring students and the public up close to restoration activities, especially where land access is restricted, as at Money Point's industrialized shoreline. Use wind and solar energy to teach alternatives to pollution-causing forms of energy. Include a display on sediment contamination and a living wetlands garden with native plants to filter graywater. Move the barge to restoration sites around the river.

Action 2 - Create a small picnic area or other small park that could be used by workers and Money Point residents. Consider locating this community gathering and recreation place near the First Baptist Church Money Point. Convene dialogue involving residents and the City to discuss zoning issues.

Action 3 - Consider constructing "pervious," or porous sidewalks on Freeman Avenue that link Money Point to Portlock at Bainbridge Boulevard while absorbing runoff. Potentially repave neighborhood streets and parking areas using pervious paving.

Action 4 - Implement street lighting on Freeman Avenue using a "dark skies"/down-lighting approach to improve safety while minimizing light pollution.

Action 5 - Identify derelict buildings or sites where Brownfield Revitalization funds might be applied to redevelop the property for productive use.

Action 6 - Preserve and celebrate Money Point history.

- List the First Baptist Church Money Point on national or regional historic register.
- DONE - Record and preserve the history of Money Point. Students from the University of Virginia conducted community interviews and historical research and prepared a booklet, "Brief History of Money Point," on UVA's website: www.virginia.edu/ien/moneypoint.
- Distribute 100 "Brief History of Money Point" booklets around the Portlock and Chesapeake communities, at The Elizabeth River Project's Information Center and online at: www.elizabethriver.org.

Action 7 - Publicize the Money Point "co-existence" strategy as an important model. Create a guide to Sustainable Redevelopment Best Management Practices for the Elizabeth River watershed.

- US EPA has funded The Elizabeth River Project to develop this guide in 2007-08.

Action 8 - Remove debris from residential areas, especially at end of Robertson Road and Reid Street.

Action 9 - Plant street trees and native vegetation along streets at Money Point, particularly along Freeman Avenue.

Key implementers

- UVA School of Architecture (Learning Barge)
- Elizabeth River Project and partners
- First Baptist Church Money Point
- Money Point residents and property owners
- City of Chesapeake
- South Norfolk Library and South Norfolk Historical Society
- Hampton Roads Planning District Commission
- Virginia Commonwealth University
- Volunteers

Resources

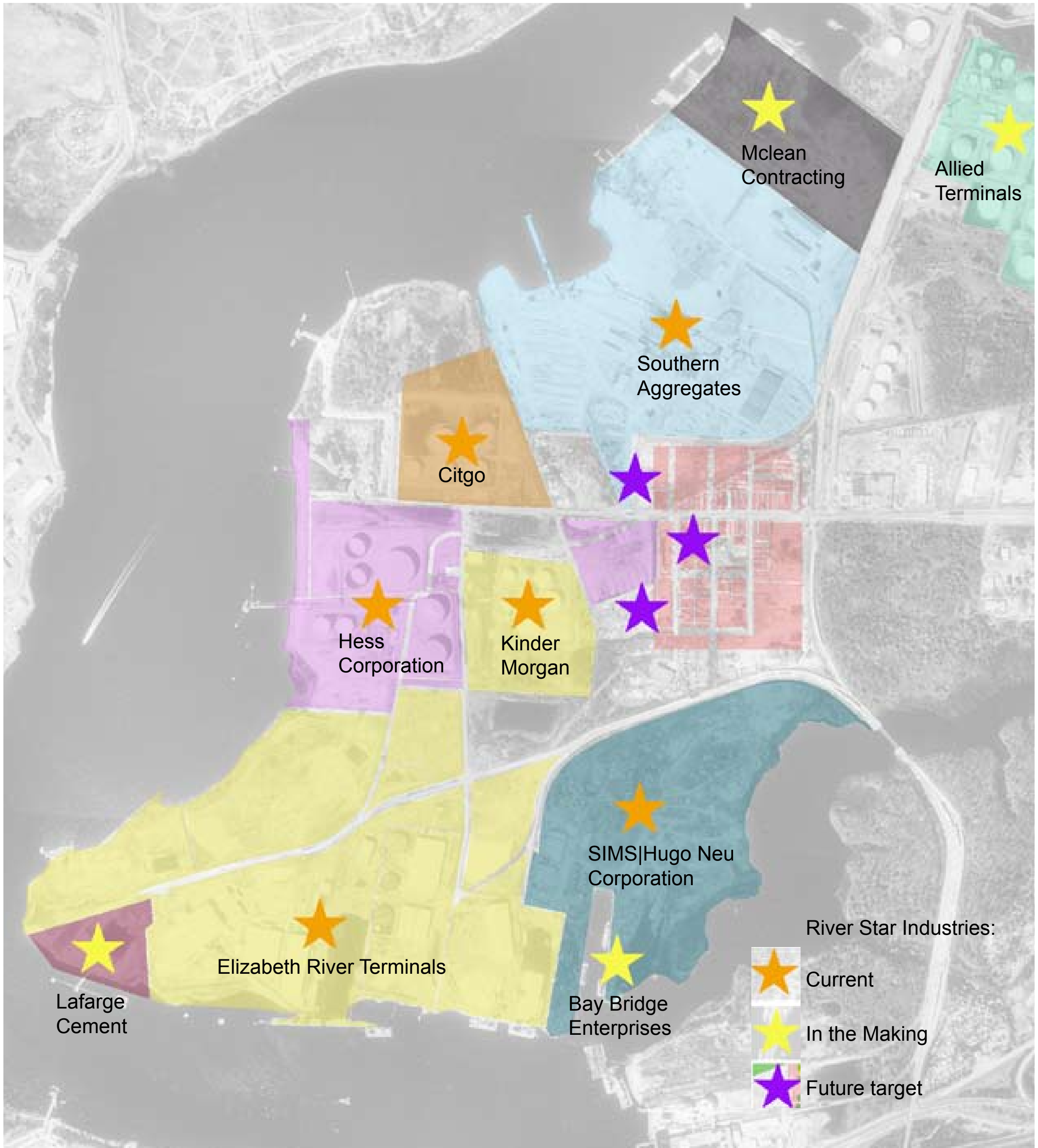
- Learning Barge Grants in-hand: EPA P3 and Virginia Environmental Endowment. Funds applied for: EPA Watershed Initiatives Grant, NOAA Ocean Literacy Grant, EPA Education grants, and private foundations. Donated barge and barge maintenance.
- University of Virginia
- Elizabeth River Project members and donors
- DEQ water quality loan
- City of Chesapeake
- Money Point residents, industrial neighbors
- VA Department of Conservation and Recreation Water Quality Improvement Fund

Milestones

- Learning Barge construction by 2008-2009
- Sustainable Development Guide available by 2007-2008
- Identify derelict buildings by 2008
- Remove debris from residential areas and plant trees along streets by 2007-2010
- Construct impervious sidewalks and implement street lighting by 2011
- Establish small park by 2008

First Baptist Church Money Point - site of community reunions for former residents.

Tree planting at the First Baptist Church Money Point celebrates birth of cleanup plan.



Almost all the major industries at Money Point are actively implementing the plan through high levels of stewardship.

Goal 4: Establish environmental stewardship as the industrial ethic at Money Point, primarily through the River Stars program.

Summary

The entire waterfront at Money Point is owned by industrial or commercial companies, virtually all of whom actively use the shoreline. The participation of all industrial partners is key to achieving the Money Point vision of a thriving economic coexistence with ecological regeneration. The Elizabeth River Project's River Stars program offers a "win-win" approach for engaging the industries in a positive, voluntary partnership that typically results in measurable pollution prevention and habitat enhancements, while also benefiting the company through reduced costs, improved worker safety and public recognition. The program provides free technical assistance and public recognition for documented, significant results in voluntary stewardship.

Most of the major industries at Money Point have already achieved impressive progress as River Stars. Others are actively pursuing startup activities.

Action Steps

Action 1 - Recruit the majority of industries at Money Point as active River Star environmental stewards by 2016. Document achievements of 10 River Star industries at Money Point.

- **In advance implementation of this plan, Elizabeth River Terminals, Citgo, Hess, Sims|Hugo Neu, Exxon (Kinder Morgan) and Southern Aggregates have already been recognized as River Stars** through peer review of achievements, based on The Elizabeth River Project focusing on Money Point for the past several years. Achievements range from a 16-acre conservation area to wildlife plantings, pollution prevention and osprey platforms (Kinder Morgan has a real-time camera watching the ospreys hatch!)

Action 2 - Assist at least one industry at Money Point to achieve "Model Level" in the program within 5 years and two within 10 years. Model Level is the highest level of recognition for facilities achieving exemplary results as environmental leaders in the community.

Action 3 - Emphasize related goals, such as stormwater treatment, wetlands and forested areas, while developing River Stars recommendations.

Key implementers

- Industries now participating in The Elizabeth River Project's River Stars program and high-opportunity industries to be recruited.
- Cooperating agencies such as VA DEQ and Chesapeake Bay Program's Businesses for the Bay.

Resources

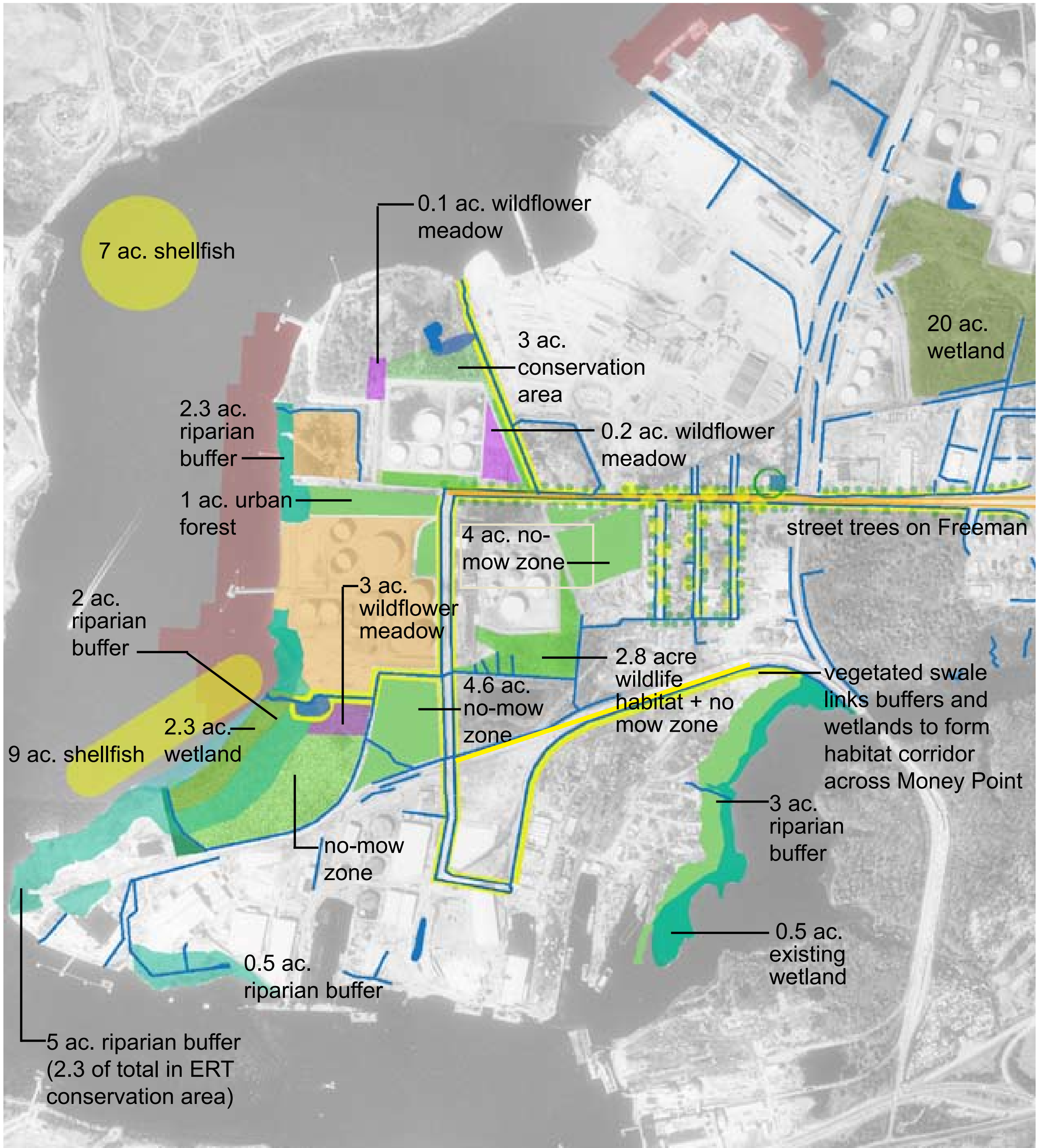
- Current grantors to the River Stars program, including Chesapeake Bay Small Watershed Grants program, National Fish and Wildlife Foundation, US EPA, Chesapeake Bay Program, Hampton Roads Sanitation District, Ford Motor Company
- Potential grants such as EPA's Targeted Watershed Initiatives Grant

Milestones

- Establish one Model Level River Star at Money Point by 2010; two by 2016
- Money Point River Stars restore/conserve 30 acres of wildlife habitat and reduce pollution to the river by one million pounds by 2016

Before - CITGO is one of multiple industry plantings (planting day)

After - CITGO's nearshore site flourishes in wildflowers. Industries are doing their part as River Stars.



The largest wetland restoration to date on the Elizabeth River is just one of the projects to bring back a healthy ecosystem along the shore.

Goal 5: Restore and conserve wetlands, vegetated buffers, shellfish beds and urban forest, creating an integrated network of habitat for wildlife.

Summary

One of the major projects already underway, resulting from the momentum created by this Plan, is the largest voluntary wetland restoration on the Elizabeth - up to four acres along the Elizabeth River Terminals shore. Such efforts reverse a 50 percent loss of tidal wetlands in the Elizabeth River since World War II. Restoring wetlands and vegetated buffers along the shoreline are key steps that decrease and filter stormwater, support wildlife and improve the aesthetic experience for humans. A well-connected and integrated network of green spaces nested within an industrial area can allow the development of a productive ecosystem by providing wildlife with much-needed habitat in an industrial setting.

Although Money Point has a heavily industrialized waterfront, there are still a few areas of open green space that provide wildlife with habitat opportunities. The open space also provides for large scale landscape restoration - by restoring oyster, wetland, and vegetative habitats adjacent to one another. This type of restoration allows for a continuum of various habitats from the river to the uplands area. Due to the importance of these, The Elizabeth River Project has set long-range goals including establishing contiguous green corridors of wetlands, buffers and forest in priority areas including the Southern Branch from Scuffletown Creek to Great Bridge.

Action steps

Action 1 - Restore and/or conserve a minimum of 20 acres of tidal wetland habitat to maximize marsh habitat for living resources by 2016.

- Thanks to Elizabeth River Terminals and a grant from NOAA's Restoration Center to The Elizabeth River Project, a major project is under design to restore four acres of tidal wetlands and associated vegetated buffers. Elizabeth River Terminals has provided an appropriate site despite the industrial nature of most of the shoreline, otherwise typically concrete and debris. The proposed site is adjacent to high quality habitat, 16 acres of open space that Elizabeth River Terminals has placed in voluntary conservation with The Elizabeth River Project.
- Additional wetland restoration efforts should also focus on the corridor from Southern Aggregates to SIMS, the area of largest need and highest potential for wetland restoration. Recruit waterfront owner participation; design and construct as funds become available.
- Consider feasibility of a large wetland restoration project adjacent to Allied Terminals reconnecting a marsh that appears to have been severed by the railroad. Size the culvert beneath the railroad to improve flow and restore tidal wetland function upstream of the railroad track.

Action 2 - Create habitat corridors across Money Point along the railroad right-of-way, extending from the Elizabeth River Terminals conservation area to Milldam Creek at SIMS.

- Further analyze 330-acre Money Point area as a whole, then focus on all restoration projects as part of a restored biological system.
- Design a viable network of water and habitat movement that integrates individual restoration projects, the river and Milldam Creek. The network would use elements such as bioswales and buffers.

Action 3 - Restore and conserve riparian buffers along the Elizabeth River and Milldam Creek.

- Place a minimum of 25 acres in long-term conservation, including 19 acres already pledged by Elizabeth River Terminals and Citgo.

Action 4 - Plant street trees on Freeman Avenue and augment trees on neighborhood side streets.

Action 5 - Restore shellfish beds at Money Point.

- Request VA Marine Resources Commission to survey the Money Point area for potential sites for oyster, clam, and mussel replenishment.
- Restore a minimum of 5 acres of oyster reef, hard clam and mussel habitat. Potential sites are sandy areas off Elizabeth River Terminal and at mouth of Blows Creek.

Key implementers

- Elizabeth River Project
- Waterfront Industries
- Money Point Community
- City of Chesapeake
- VA DEQ
- US EPA
- VA Marine Resources Commission
- Virginia Institute of Marine Science
- NOAA's Restoration Center

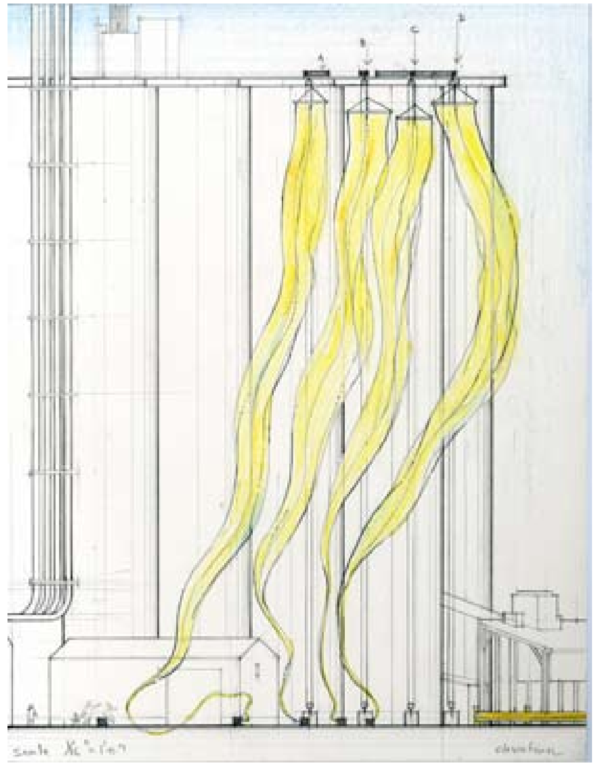
Resources

- Elizabeth River Project members and contributors, including funds from VA DEQ
- Grantors including: NOAA Community-based Restoration Program, Virginia Environmental Endowment, EPA Targeted Watershed Grant, VA Dept of Forestry, Fish America, Small Watershed Grants Program
- Consider establishing tidal wetland mitigation bank at Money Point

Milestones

- Initiate first wetland project 2007-2008
- Implement 20 acres of wetland restoration by 2016
- Restore 5 acres of shellfish by 2016

Oysters show new growth on riprap at Elizabeth River Terminals shoreline. More oysters to be added at Money Point.



Sanda Iliescu and Phoebe Crisman, UVA Professors of Art and Architecture, wanted to commemorate the positive power of the plan with a gigantic public art installation on the concrete silos at Lafarge Cement. Here, students craft elements of the 150 foot high piece, unveiled with the plan on October 19, 2006.

Back cover: Drawing by Sanda Iliescu for the public art project, Sixteen Silos, Sixteen Shades of Yellow.

Project Team

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We welcome your support!

Money Point Revitalization Task Force

Special thanks to the stakeholders who developed this plan:

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Marlene Mansfield, *South Norfolk Women's Club*
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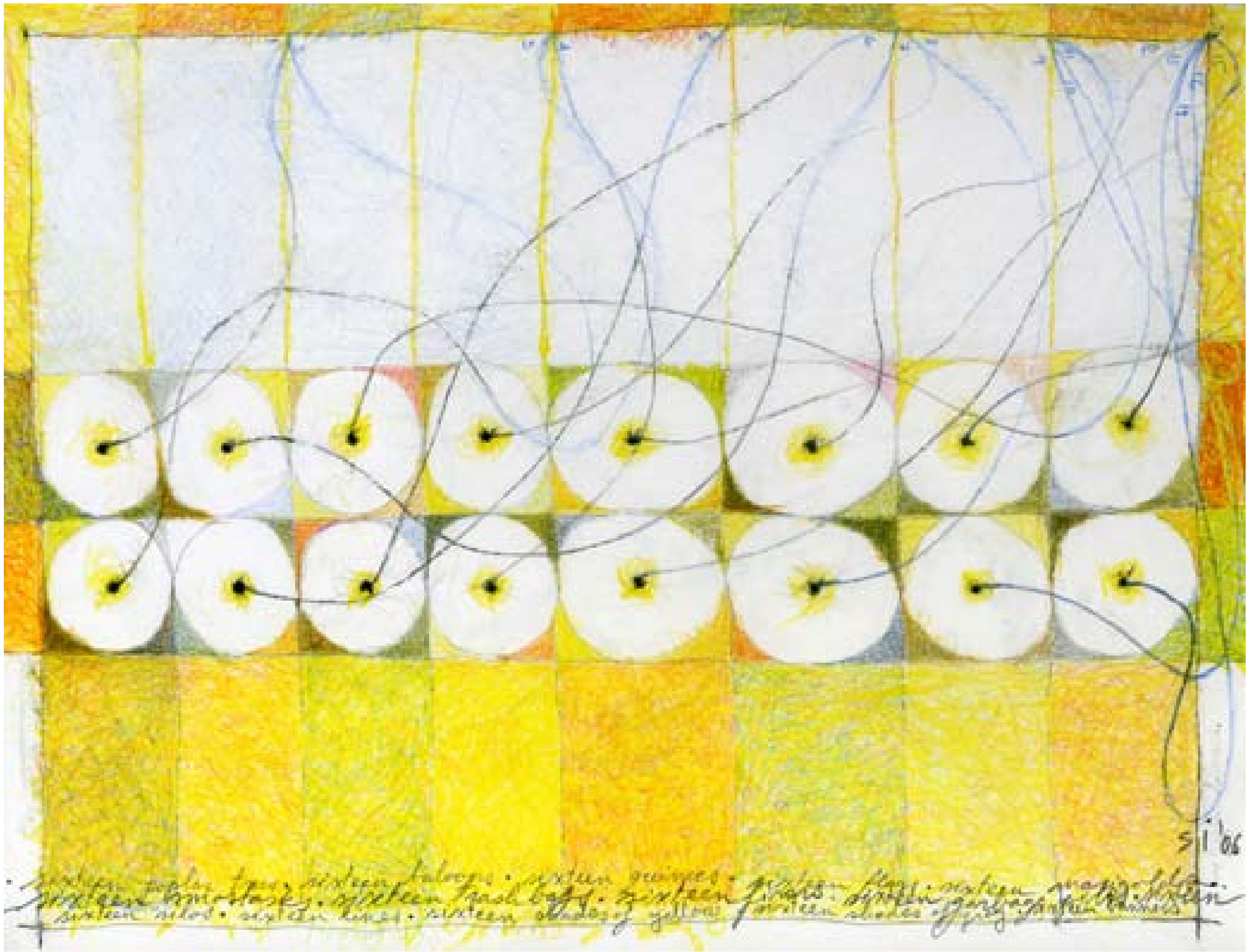
Nancy Welch, *Chesapeake Health Dept.*
Ben White, *Chesapeake Economic Development Authority*
Van White, *NOVA Chemicals, Inc.*
Bernard Wilson, *First Baptist Church Money Point*
Stan Wilson, *First Baptist Church Money Point*
Bob Wolfe, *Amerada Hess*
Pastor Kenneth Woodley, *First Baptist Church Money Point*
Jay Woodward, *VA Marine Resources Commission*


Money Point Task Force members meet at Portlock Galleries.

Art inspired by cement silos and wetland restoration at Money Point. *Sixteen Silos, Sixteen Shades of Yellow,* celebrates the power of this plan: industrial and ecological regeneration occurring together.



Appendix D – Glossary of Terms

Glossary of terms

Benthos - refers to organisms that dwell on or within the bottom. Includes both hard substratum habitats (e.g. oyster reefs) and sedimentary habitats (sand and mud bottoms).

B-IBI - the benthic index of biotic integrity of Weisberg et al. (1997). The is a multi-metric index that compares the condition of a benthic community to reference conditions.

Fixed Point Stations - stations for long-term trend analysis whose location is unchanged over time.

Habitat - a local environment that has a benthic community distinct for other such habitat types. For the B-IBI of Chesapeake Bay seven habitat types were defined as combinations of salinity and sedimentary types - tidal freshwater, oligohaline, low mesohaline, high mesohaline sand, high mesohaline mud, polyhaline sand and polyhaline mud.

Macrobenthos - a size category of benthic organisms that are retained on a mesh of 0.5 mm.

Metric - a parameter or measurement of benthic community structure (e.g., abundance, biomass, species diversity).

Probability based sampling - all locations within a stratum have an equal chance of being sampled. Allows estimation of the percent of the stratum meeting or failing the benthic restoration goals.

Random Station - a station selected randomly within a stratum. In every succeeding sampling event new random locations are selected.

Reference condition - the structure of benthic communities at reference sites.

Reference sites - sites determined to be minimally impacted by anthropogenic stress. Conditions at theses sites are considered to represent goals for restoration of impacted benthic communities. Reference sites were selected by Weisberg et al. (1997) as those outside highly developed watersheds, distant from any point-source discharge, with no sediment contaminant effect, with no low dissolved oxygen effect and with a low level of organic matter in the sediment.

Restoration Goal- refers to obtaining an average B-IBI value of 3.0 for a benthic community indicating that values for metrics approximate the reference condition.

Stratum - a geographic region of unique ecological condition or managerial interest. In the1999 study the primary strata were the Mainstem of the river, the Lafayette River, the Eastern Branch, Western Branch and Southern Branch. In succeeding years the entire Elizabeth River watershed was sampled as a single stratum.

Threshold - a value of a metric that determines the B-IBI scoring. For all metrics except abundance and biomass, two thresholds are used - the lower 5^{th} percentile and the 50^{th} percentile (median) of the distribution of values at reference sites. Samples with metric values less than the lower 5^{th} percentile are scored as a 1. Samples with values between the 5^{th} and 50^{th} metrics are scored as 3 and values greater than the 50^{th} percentile are scored as 5. For abundance and biomass, values below the 5^{th} and above the 95^{th} percentile are scored as 1, values between the 5^{th} and 25^{th} and the 75^{th} and 95^{th} percentiles are scored as 3 and values between the 25^{th} and 75^{th} percentiles are scored as 5.