A Technique for the Assessment of the Visual Impact of Nearshore Confined Dredged Materials and Other Built Islands[1]

Roy Mann[2/]

Abstract: Drilling rigs, confined dredged material disposal sites power and sewage treatment facilities, and other built objects on or near shorelines have often created appreciable impacts on the aesthetic perceptions of residents and recreational users. Techniques for assessing such impacts that are reviewed in this paper include viewscape analysis for large-scale shore facilities, as employed in the Long Island Sound Regional Study and the visual impact analysis used in the Hart-Miller Islands Environmental Assessment for review of alternative spoil island location. Guidelines and design solutions reviewed include those developed for offshore rigs at Long Beach, California; for a free horizon arc offshore of Santa Rosa Island, Florida; and for landscape concepts for dredged material sites prepared for the U.S. Army Corps of Engineers.

INTRODUCTION

The confinement of dredged navigation channel sediments in diked disposal facilities is an important function of harbor and waterway development and maintenance, particularly where open water disposal and undiked mounding of dredged materials are prohibited or impractical.

Assessment of the visual impact of proposed disposal facilities is often a necessary step in facility planning, since facility appearance is typically intrusive and contrastive to natural shore landscapes, particularly where these are scenic or recreational, and may be incompatible aesthetically with urban civic or residential areas.[3/]

In 1969 the Maryland General Assembly appropriated funds for the construction of a diked disposal area in upper Chesapeake Bay in the vicinity of Baltimore Harbor for the purpose of confining sediments dredged in the maintenance of existing Harbor channels and for the development of new channels or additional channel depth.

A site for the facility was selected by the Maryland Department of Natural Resources at Hart and Miller Islands, two small marshy islands situated approximately 1-2 miles offshore of the western Bay mainland. Design development of the diked facility, planned to contain 52.8 million cubic yards of dredged spoil was initiated in 1970. An environmental impact study was prepared by the U.S. Army Corps of Engineers in 1974. The Maryland Department of Natural Resources subsequently contracted with Roy Mann Associates in 1975 to conduct a peer review of outstanding environmental impact questions.

[1/]Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[2/] Roy Mann, President, Roy Mann Associates, Inc. Cambridge, Massachusetts.

[3/]Harrison, Joan and Laurie C. Chisholm. Identification of Objectionable Environmental Conditions and Issues Associated with Confined Disposal Areas. Arthur D. Little, Inc., prepared for Environmental Effects Laboratory, U.S. Army Corps of Engineers. Sept. 1974.

In the execution of the Peer Review[4], RMA identified and analyzed various potential environmental impacts, including visual impacts at the Hart-Miller Islands site and at nine alternative sites in upper Chesapeake Bay or Baltimore Harbor.

The following discussion summarizes the methodology developed by RMA for evaluation and comparison of the visual impact of the alternative sites vis-a-vis the proposed spoil facility.[5]

Project Description

The Hart-Miller Islands disposal facility planned for a 52.8 million cubic yard capacity within an area above mean sea level of 1012 acres. A perimeter dike, the element most readily visible to observers at or near sea level, would crest at 18 feet above sea level and would be armored with rip-rap on its exposed Bay sides. The new island would measure 2 miles by somewhat less than 1 mile at its Hart-Miller Islands location, but would take other configurations at the alternative sites, reflecting benthographic, navigational, and other conditions unique to each of these locations.

Assumptions

The probable visual impact of a dredged materials disposal facility may be estimated through delineation of viewing zones, identification of the size of presumably sensitive viewing populations, description of visual characteristics of the proposed facility, identification and analysis of adverse characteristics of the facility, and evaluation of facility visual impact on foreground and background landscape. Weighting factors may include the degree of contrast between the proposed facility and the existing site environment and the degree to which impact mitigation measures offer assurance that negative impact can be minimized and positive impact made possible.

Earth Curvature

For observers in boats or others at or close to sea level, the earth's curvature and light refraction by haze covering Bay waters may combine to obscure the lower portion of the dike. A boater with eye level at 6 feet above the water line would be able to see the uppermost 9 feet of a facility dike at a distance of three miles. Any elevation less than 9 feet (half the dike height) would seem to lack visual significance. However, since some sport fishermen, cruising boaters, and excursion boaters may be at an eye level 8 to 12 feet above water level, five miles was judged to be maximum distance from the facility dike site within which visual impact would have significance for boaters and other observers across the open Bay.

Distraction Zone

Other factors, such as the obscuring of view by vegetation, waves, haze and smoke, and structures in the field of view may diminish the significance of the nominally visible portion of the facility or even the facility as a whole. The existence of minor elements, including vegetation, which filters but does not eliminate views of the facility, can constitute a distraction zone, that is, a stratum of the field of view in which interference renders neutral an otherwise visually significant object. The height of the zone (see fig. 1) can be subtracted from the bottom of the Bay image beyond to locate the minimum significant sight line correctly. This corrected field of view will allow the investigator to plot the true elevation below which views of the facility cannot be obtained. Where sufficient field knowledge of intermediate crest conditions was unobtainable, a 30-foot height was assumed for the distraction zone in vegetated areas, under Step 2, Visual Zone Delineation (see below).

Significant Viewable Surface

A diked disposal facility presents a great deal of perspective foreshortening to the observer where the incident angle of view is

---

[4] Roy Mann Associates, Inc., Peer Review of the Evaluation of Hart and Miller Islands and Alternatives for Dredged Materials Disposal. Prepared for the State of Maryland Department of Natural Resources. July, 1975. See chapter 6: Visual Impact.

[5] Since the actual impact ratings of the alternative sites are not directly germane to the discussion of methodology presented here, they have been omitted from this paper. Interested readers may request a copy of either Chapter 6 or the full Peer Review from the Department of Natural Resources, Annapolis, Maryland.

FIGURE 1: VISIBILITY FACTORS, OPEN WATER

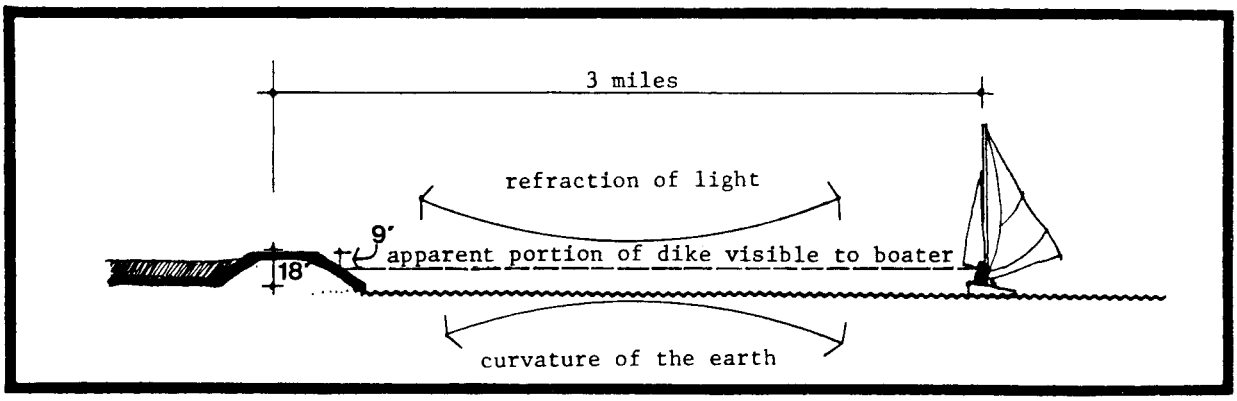
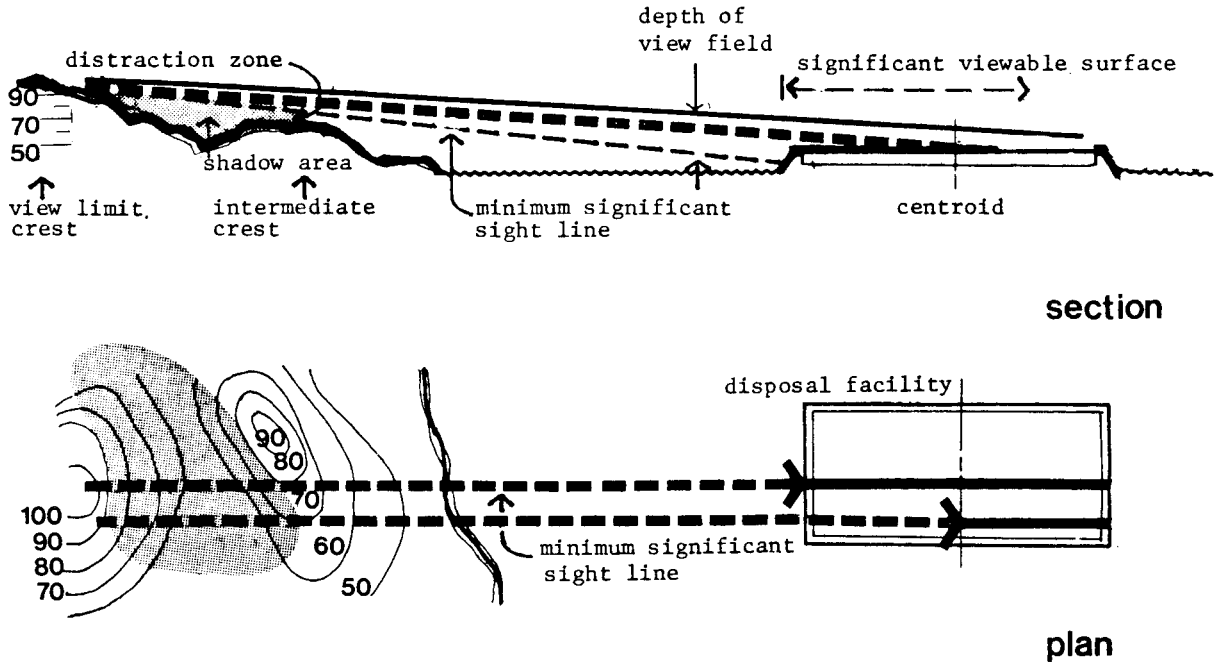


FIGURE 2: DISTANT OBJECT VISIBILITY



low. The dike itself may represent a major portion of the island's silhouette. The significant viewable surface can be considered the entire surface extending from the lowest significant sight line (see Figure 2) to the distant edge of the facility. However, where only the far edge of the facility (beyond its centroid) was visible to inland observer positions over the crest of intermediate hills, impact was considered insignificant and the observer positions were excluded from the impact zone.

Distance

Distances of 6 miles over land areas and 5 miles over water were taken as the far boundaries of viewing zones within which visual impact would be potentially significant. Although in some instances views of alternative sites could be obtained from the probable merging of facility silhouette with island and harbor forms in the Baltimore Harbor area over greater distances, the 6 mile limit was considered realistic.

METHODOLOGY

Step 1: Determination of the Impacting Aspect of the Facility Image

For the purpose of defining a single standard of evaluation against which each of the ten alternative sites and their physical configurations could be assessed, the significant viewable surface (see above and Figure 2) was taken as equivalent to the visually impacting aspect of the facility. The differentiation among sites would be left to the distinctions in viewing populations within the viewing zones.

Step 2: Delineation of Viewing Zones

Next, delineation of the viewing zone projectable from each alternative disposal site was undertaken. A viewing zone consisted of the water and terrestrial surface over which the 18-foot high dike structure (9-foot high bulkhead in inner harvor sites) and the disposal area to the rear would be visible.

The limit of the terrestrial viewing zone for each candidate facility was delineated through analysis of topographic maps and aerial photos, as follows:

- Sight lines were projected from the centroid of each alternative facility site to surrounding topography up to the highest point within a six mile radius. Shadow areas between crests or ridges, i.e., areas from which views of the facility could not be acquired, were eliminated from the viewing zone.
- The viewing zones were also reduced to reflect the distraction zones identifiable above intermediate crests. The height of the distraction zones were presumed to be 30 feet where tree masses existed and 10 feet where open fields predominated.
- The projection of sight lines was repeated at 30° intervals over 360 degrees.
- The viewing zones were further corrected to reflect restriction of view of the facility by intervening factories, bridges, viaducts, and other built structures.

Step 3: Determination of the Size of the Affected Viewing Population

The potentially sensitive viewing population within each delineated viewing zone was identified, in total numbers. Included were:

- residential population
- daily visitors to selected major activity centers related to park, recreational, educational, and civic-cultural use
- numbers of motorists using bridges from which a candidate facility could be viewed
- numbers of boaters estimated to use boats registered in the homeport of which the viewing zone is part

Weighting Factors: Since resident and institutional viewers are likely to experience most frequent visual contact with the numbers of users of the proposed facilities, greater weight was assigned to potential impact on this viewer group.

Method: 1970 U.S. Census tract data were analyzed in conjunction with land use maps and U.S.G.S. topoquads to determine the percentage of the population within each tract residing within the viewing zones and who therefore could be expected to come in visual contact with the proposed structure. Counts of potential viewers employed in industrial areas within the viewing zones were excluded from the analysis since many employees may also be residents within the same viewing zones and because construction of a disposal facility within an

industrial visual setting was presumed not to modify existing visual quality substantially, either adversely or beneficially.

No attempt was made to estimate the percentage time viewing populations might actually view the facility, because a reliable method for such estimations has not yet been established by research in the field and because population size alone is an acceptable parameter for comparing impact among alternative sites. However, factors which would tend to increase likelihood of view, such as topography, openness of housing patterns, and orientation of residential city streets towards the facility sites, were employed as weighting considerations.

The results of the Step 3 analysis are shown in Table 1.

Step 4: Visual Quality Evaluations

The final step of the visual analysis involved evaluating the compatibility of the candidate facilities on the existing foreground and background visual environments of each site. Photographs taken from selected viewing orientations were utilized together with drafted constructions of the presumed facility overlaid on the photographic prints. Compatibility effects on visual quality were evaluated for four criteria:

- Obstruction of view: The degree to which construction of a proposed facility will obstruct open bay or cross water views.
- Compatibility with foreground: The degree to which the disposal facility will be

Table 1--AFFECTED VIEWING POPULATION*

	TOTAL RESIDENTIAL VIEWING POPULATION	SELECTED MAJOR ACTIVITY CENTERS	AVERAGE DAILY TRAFFIC[2/]	RECREATIONAL BOATERS[6/]
Hart-Miller	3,662	3,000[1/]		19,825
Black Marsh	4,192	--		19,825
Hawthorn Cove	4,779	--		16,779
Man O'War Shoals	5,511	--		10,183
Patapsco River Mouth	13,167	--	2,181,000[3/]	10,183
6-7-9 Foot Knolls	3,899	--	29,890[4/]	21,607
Belvidere Shoals	4,638	--	29,890[4/]	21,607
Sollers Point	3,425	--	2,181,000[3/]	10,183
Colgate Creek	1,725	--	2,181,000[3/]	10,183
Middle Branch	3,841	--	31,620[5/]	10,183

[1/]Maximum daily visitors; Rocky Point Park Source: RMA telephone communication with Rocky Point County Park manager.

[2/]Computed at 1.5 persons/vehicle

[3/]One lane traffic; new Outer Harbor Crossing Source: Table 21 Outer Harbor Bridge Estimated Traffic and Revenue 1976-1985; Maryland Dept. of Transportation.

[4/]One lane traffic; Lane Memorial Bridge Source: State of Maryland "Traffic Volume Map," 1974. RMA telephone communications with Bureau of Traffic Engineering, Md. Dept. of Transportation (June 1975).

[5/]One lane traffic; Hanover Street Bridge Source: same as above

[6/]Average no. of persons per boat = 2.82; includes water stored craft only Source: Recreational Boating in the Continental U.S. in 1973; Coast Guard, October 1974, pg.51.

* Source: Peer Review of the Evaluation of the Hart and Miller Islands and Alternatives

compatible with the form, color, texture, and scale of the foreground visual setting.

- Significance of view of the facility interior: The degree to which the interior of a facility is exposed to view from elevated observer positions.

For each of these criteria, a rating scale of -5 to +5 was used. A negative assessment for each criterion implies, respectively: greater obstruction of views, lower compatibility with the existing visual setting, whether foreground or background, and greater exposure to view of the interior of the facility. Weighting factors included the presence of distracting elements in the visual setting of each site, which would tend to mask negative aspects of the facility, and the operating life of each facility during which construction and disposal activities and machinery would accentuate negative effects.

The results of the Step 4 visual quality analysis are displayed in Table 1. Obstruction of view and compatibility of the structure with existing foreground and background visual setting are considered the most important criteria in assessing visual impacts. Therefore, evaluations of these factors are summed in the fourth column total, to provide a first order indication of the relative expected visual impact for each candidate site. The other three factors: significance of view, presence of distracting elements, and facility operating life are utilized as weighting factors in conjunction with the magnitude of the affected viewing populations to derive a final assessment of overall visual impact.

FINDINGS

- As indicated in Tables 1 and 2, which are excerpted from the Hart-Miller Review findings, the visual zones of the alternative facility sites were characterizable in terms of viewing population sensitivity, and probable visual effect of the facility on foreground and background of the site.

- The differentiation among site impacts was distinct, reflecting primarily a variation in sizes of sensitive populations.

- Distraction zones and their influences on visual impact of distant large scale shore facilities are not easily defined and deserve further investigation.

- Earth curvature, sea surface characteristics, and atmospheric conditions may reduce the visual impact of low offshore and nearshore disposal facilities to observers on the water or at the water's edge, at distances great enough to create an apparent diminution of silhouette. These factors, however, also deserve further investigation with respect to their mitigating effect on visual impact.

- Providing design modifications in the alignment and topographic character of perimeter dikes, combined with selective tree planting, may achieve mitigation of visual impact, where feasible. These mitigative measures were not provided for in the scope of the Hart-Miller Review, but are recommended for consideration in future impact analyses.