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MOSQUITO MANAGEMENT PLAN

ADDENDUM

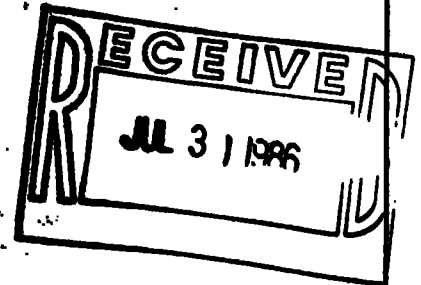
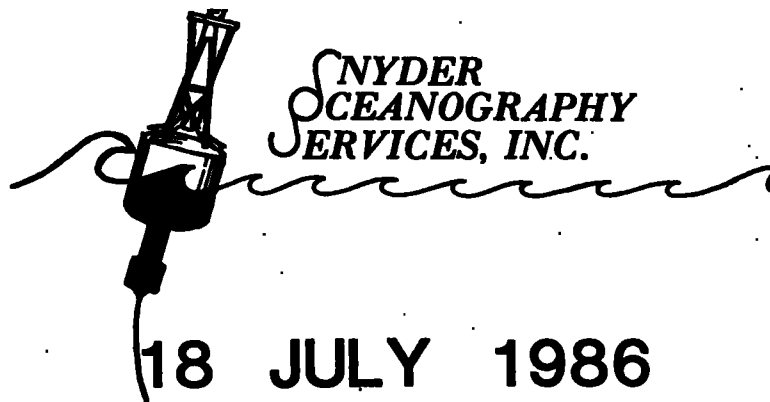
for



by



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MOSQUITO MANAGEMENT PLAN FOR GRAND HARBOR

ADDENDUM

18 July 1986

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SUMMARY

The current site conditions on the project are highly influenced by present and past agricultural and mosquito control activities. Some parcels have been altered extensively and bear no resemblance to any "natural" conditions other than the fact that certain volunteer wetland species are present although mixed with exotics. A small 6 to 7 acre parcel in the southeast corner is presently connected to the Indian River Lagoon but it too has been ditched apparently for mosquito control purposes.

There are viable, functional wetlands on site but these are restricted to the open shoreline along the southern three quarters of the Indian River shoreline, a narrow east-west ditch below the existing marina and the previously mentioned parcel to the southeast. Both low and high marsh vegetation exist in these areas. The central portion of the impoundment is less critically altered and contains broad stands of high marsh vegetation interspersed with ditches with adjacent spoil piles containing exotic vegetation and occasional shallow ponds.

Because the property will be converted from agricultural to residential resort use, there will no longer be any need for site de-watering as has taken place in the past. This presents the opportunity to rehabilitate and reconnect the currently impounded wetland areas using the presently viable parcels as a guideline the reconstruction of stable productive areas not susceptible to mosquito production.

The project design has undergone an evolution since the initial proposed land use but these changes resulted from numerous environmental and developmental concerns expressed throughout the permitting process. As currently proposed, more than 80% of the impounded high marsh will be retained adjacent to a newly created ecotonal edge returning the high marsh acreage to the Indian River Lagoon as a productive and complimentary element. Additional wetland acreage will be created from uplands and connected to the rehabilitated and existing waters. Wetland vegetation will be increased to 63 acres from 56 acres. Nearly 14 miles of productive ecotonal edge will be added to the system.

The marina expansion, wetland creation and rehabilitation work will be initiated immediately upon receipt of the required permits. System design and construction sequence are detailed in Sections I and II below. During construction, if the need arises, aerial larviciding can be employed. A mosquito monitoring program will be coordinated with the Indian River County Mosquito Control District (IRCMCD) and initiated following completion of the rehabilitation work. If breeding areas are discovered during the two year monitoring period and cannot be corrected using established techniques for OMWM development, then the option of employing RIM (Rotational Impoundment Management) will be reviewed with IRCMCD and others. Further details are given in section 2 below.

I. SYSTEM DESIGN

Organization and design of the GRAND HARBOR project began over 2 years ago. One of the first organizational functions performed was to begin to put together an experienced professional team to address the multitude of environmental concerns associated with integrated wetland rehabilitation and development.

The land use plan originally submitted to the Treasure Coast Regional Planning Council (and to DER and the Corps) has undergone considerable modification responding to the team's input relative to saltwater intrusion, flushing, nursery habitat, influence of reconnection on the Indian River Lagoon, agricultural pesticides, wildlife values and mosquito control. Responding independently to separate concerns does not often lead to completely compatible results. Although all issues were considered in the original planning, numerous changes have been made in response to various agency inputs. These include:

- o Minimum modification to the only presently connected wetland in the southeast corner of the property.

- o Removal of the two southern small boat marinas and the originally conceived Harbor Center.

- o Extension of the marginal freshwater system to further offset present tendencies for saltwater intrusion and provide additional freshwater recharge.

- o Removal of the condition for public boating access to the major wetland to be rehabilitated.

- o Reduction of dredging of the main entrance channel to maintenance only and placement of markers to decrease manatee endangerment.

- o Redesign of the rehabilitated major wetland section to handle mosquito control and to give the reconnected marsh the optimum opportunity to equilibrate the new connection while maintaining as much high marsh as is feasible and while providing circulation, ecotone and stability.

The basic concept of land development in this project has been to recognize the important wetland values and functions as elucidated in the Treasure Coast Regional Planning Council's "Wetland and Deepwater Habitat Policy", "Classification of Wetlands and Deepwater Habitats of the United States", Office of Biological Fish and Wildlife Service, 1979, and "Preliminary Guide to Wetlands of Peninsular Florida" Environmental Effects Laboratory, U.S.A.E.W.E.S., 1978, and to integrate these values and function into the project as an aesthetic amenity as well as contributing to the public benefit.

In the restoration opportunity available, a wide variety of wetland habitats can be created. Neither engineering design nor construction method are limitations. High marsh, low marsh, lagoon, channel, flats, impoundment, or any mix of these can be restored to optimum value or created. It is only a matter of determining through expert consultation which form of enhancement/mitigation is best. The following review the general situation in the Indian River and outlines designs achievable through state-of-the-art environmental engineering.

The referenced documents, including the TCRPC, "Wetland and Deepwater Habitat Policy", are useful to evaluate options for wetlands restoration.

1. Meet a demonstrated public need. Since the subject is restoration, the question is what wetland mix best meets the public need. Clearly, the public interest will be served by restoring the wetlands which are now in a very dysfunctional state. The marsh was historically a combination of high and low salt marsh, both of which need hydrological connection the Indian River to provide ecological function. The public interests to be benefited will be in improved habitat for birds and aquatic life, restored ecological function and for amenities. The most appreciated values may be for detrital export to the River and for nursery grounds for marine and estuarine species.

what was the hydrology?

2. Provide benefits more valuable than those already provided by the unaltered habitat. Benefit to the Indian River aquatic/estuarine ecosystem are very low in the highly impacted, isolated remnants on the site today. Restoration to a functioning mix of low and high salt marsh and deepwater habitat by hydrologic connection and by grading and planting and elimination of exotics will make the value of the marsh system available to the Indian River ecosystem.

Studies in the Indian River ecosystem (Gilmore, Harrington, and others) show that it is high salinity system (average 27 ppt salinity) with inlets which allow marine as well as estuarine fishes to utilize it as nursery areas as well as a permanent living-feeding-breeding area. The estuary is shown to be extremely important for sanctuary and feeding for the juvenile state of sea fish; e.g., snook. The snook is a good example because of its recreational importance and its critical need for marsh habitats. Gilmore shows that snook spawn along the open coast but their young arrive in marsh (and freshwater) habitats when they are about one month old. They remain there for several months before migrating to sea grass beds for their next stage nursery area.

3. Represent the best method of satisfying the identified need. Clearly, fish like snook (perhaps 25-40 other species as well) need both access to the marsh systems and good quality habitat within the system. Therefore, it seems advisable to open the marsh and restore its function. Many marshes in the Indian River area have been impounded to prevent mosquito breeding which seriously limits the interchange and functional interplay between the marsh and the Indian River system. Other possibilities exist for insect control which do not decrease benefits to the estuarine

ecosystem. If a restored and expanded functional salt marsh system can be designed to minimize mosquito problems without impoundment, we believe it is the best approach.

In the project area, impoundments are generally closed and flooded during May - September, which would: 1) deny access to them for this period by larvae and young stages of fish (e.g., snook have one peak of recruitment in late spring and early summer), and 2) seriously alter the ecosystem of the areas from the typically beneficial salt marsh system.

The developer directed his concept team to enlist qualified experts in evaluating present values and functions in relation to public need and design, wetland integration, enhancement and creation into the project to optimize these values to the benefit of the public and the project. Restoring hydrologic connection and designing and constructing an optimal mix of channels, flats, marsh vegetation, and surface grades is considered to be the optimal approach. As conceived, the final plan will contain more area of wetland, allow greater functional value than those presently on the site.

As mentioned above, essentially none of the existing wetlands are presently functioning anywhere near their potential. This is because of various past activities related to agricultural practices and waterway maintenance. The large central high marsh area will require the least physical effort to restore it to pre-impact conditions. This area will be reconnected to the Indian River restoring, as closely as possible, the pre-existing interchange. Exotics will be carefully removed and interior circulation will be enhanced.

Much of the northern abandoned agricultural area will be restored to its more natural condition consistent with providing circulation.

Historical information indicates that the fringe marsh originally extended as much as 2500 feet inland from the Indian River shoreline. To aid in flushing, increase wetland area and add diversity to the wetland system, it is planned to create a 100-foot to 250-foot wide freshwater marsh area along the mid portion of the project with multiple weired connections to the renovated estuarine marsh area. This western marsh will be integrated into the project drainage system to take advantage of the wetland's purification values.

Because of the importance of these areas, considerable additional site studies were undertaken to determine how best to preserve the wetlands in a natural condition with a minimum of disturbance. The project team conducted numerous discussions with state and federal agency personnel and liaison has been maintained throughout the detailed design and permitting processes. Areas that will be preserved with a minimum of construction activity obviously did not need as detailed a review as those areas which interface with project activities such as golf course roughs and fairways and building pods. Those areas which involve wetland/development integration will be very closely monitored and modifications will be proposed when determined to be beneficial to long term productivity and stability.

It is the consensus of the professionals involved that this project offers a unique and far reaching opportunity for the cooperation of regulatory agencies with a developer who desires to take advantage of wetland values, not the least of which is the recognized enhancement and support of the quality of life in the region. To accomplish this end requires that the wetlands to be created, enhanced and maintained, not only contain the intrinsic values needed to support wildlife, but also display the beauty long associated with wilderness areas. In this case the developer is willing to expend the energy and funds necessary to accomplish these goals. By integrating wetland areas into a project as part of the visual and vital amenities, there will be continuing incentive to maintain and manage these resources in perpetuity. It is unlikely that such opportunities will exist in the future if this property is developed without wetland integration. On the other hand, this project could be held up as an example of what can be accomplished through cooperative public and private efforts based upon a mutual appreciation of the full range of wetland values.

Because the Grand Harbor project is representative of many of the estimated 37,000 impounded acres between Titusville and the Jupiter Inlet (the geological definition of the Indian River Lagoon), it has been thought of as a possible model for future privately financed rehabilitation and stabilization of impacted wetlands. In summary, we can say that a major consideration in the wetland system design has been our response to what is considered to be the legislative intent to the recently passed Henderson Wetlands Act which states in the preamble that wetlands "...are a major component of the essential characteristics that make this state an attractive place to live. They perform economic and recreational functions that would be costly to replace should their vital character be lost...". In the case of Grand Harbor, this "vital character" had been heavily and negatively impacted by both government and private activities prior to the current owner's involvement. With full knowledge of the cost of replacing the economic and recreational functions for the public good, the present owners agreed to extensive rehabilitation, mitigation and creation of wetland acreage at no cost to the public. In further recognition of the fact that the buying public is becoming ever more aware of not only the importance of our wetlands but of their aesthetic appeal if they are in functional condition, the owners agreed that sensitive golf course placement as recreational amenities within and complimentary to the rehabilitated wetlands would be responsive to the legislative intent. There is probably no better example of private sector response to the will of the public, especially when one considers the incentive of eventual project resident to maintain the "vital character" of their property while also maintaining their property's long term contribution to the estuary. Wildlife utilization of the golf course areas can be expected to be high and special design details are being incorporated to prevent wetland degradation from over fertilization or excessive storm water runoff.

III. OPEN MARSH WATER MANAGEMENT

A. CONCEPT

The success of water management for mosquito control in wetland areas relies upon three basic concepts. These water management principles are:

- 1) increasing the amount of water, thereby increasing the presence of mosquito predators (e.g., fish) and decreasing the frequency of periodic dry down and reflooding;
- 2) increasing the movement of water, thereby eliminating the larval habitat.
- 3) decreasing the amount of standing water, thereby eliminating the larval habitat.

The application of the open marsh water management (OMWM) technique will result in the control of mosquitoes in coastal wetlands without disruption of the natural wetland-estuarine exchange. The use of OMWM in coastal wetland ecosystems is based upon an understanding of both mosquito biology and environmental factors associated with wetland habitat. OMWM derives its name from controlling mosquito populations while retaining the open character of the salt marsh. This is accomplished through construction of tidal ditches, ponds, and pond radials, habitats which typically do not breed mosquitoes.

B. OBJECTIVES

The objectives of OMWM technique are: (1) the control of mosquito populations, (2) elimination of insecticide applications to wetlands, and (3) the enhancement of the wetland/estuarine ecosystem. The technique has been shown to be effective in meeting all of the objectives in various independent research projects in the Northeast and California in the last twenty years. To assure the proper application of the technique and to meet its objectives, individual State standards have been developed and published in various agencies and implements in three northeastern States [Delaware, Maryland and New Jersey (see Appendix I)]. These standards have met favorably with the U.S. Army Corps of Engineers in various northeast districts.

C. GENERAL APPLICATION OF OMWM

The application of any method of mosquito control has to be based upon the need for control. In the United States the primary reason for control of mosquito populations is to reduce nuisance. Prevention of disease is normally of secondary concern. Before being subjected to OMWM there has to be documentation that an individual site is a mosquito problem area. Documentation is accomplished by larval surveys performed on the marsh surface to identify individual mosquito larval habitats. The distribution of the mosquito habitats defines the type of physical alteration for that site. For example, if the mosquito habitat is adjacent to a tidal ditch, a continuation of the tidal circulation into the depression will eliminate the mosquito breeding capabilities. If there is a concentration of mosquito habitats, a pond would be the alteration of choice. Only the mosquito producing areas of

a site are altered, while the remainder of the wetland is left in its natural condition. Alterations are accomplished with the rotary ditcher for spoil management purposes, that is, to keep elevational changes to a minimum so that wetland vegetational associations are not affected.

Mosquito control commissions in New Jersey have extensive experience with OMWM in a variety of habitats under various environmental conditions. In the last two decades, over 25,000 acres of coastal wetlands have been managed with OMWM in tide ranges of less than 6 inches to over 6 feet. The Barnegat Bay area in New Jersey, for example, has a smaller mean and spring tide range than the Grand Harbor site (see Table I).

Table 1. Comparison of the tide ranges (feet) in various areas of the Barnegat Bay, New Jersey with the Grand Harbor site in Vero Beach, Florida (from the Tide Table 1985, High and Low water predictions, East Coast of North and South America, U.S. Department of Commerce, NOAA).

<u>Location</u>	<u>Tide Range (ft)</u>	
	<u>Mean</u>	<u>Spring</u>
Barnegat Bay, NJ		
Mantoloking	0.5	0.6
Coastes Point	0.5	0.6
Tom's River	0.6	0.7
Waretown	0.6	0.7
Indian River Lagoon, FL		
Vero Beach	0.8	1.0

D. APPLICATION OF OMWM IN FLORIDA

OMWM has had limited application in Florida wetlands because of the long term use of impoundments and the "negative" experience of the parallel ditching technique of the past. During the inspection of the water management projects along the Florida coast in the late 1970's by Dr. Shisler, several past projects in Hillsborough and Lee Counties were identified as being somewhat similar to the OMWM technique.

The Hillsborough County project is located in a marsh in the southwest section of the county. The high marsh habitat contains a series of dragline-constructed ditches that were not connected to the estuarine system.

These ditches created a type of pond habitat that is common in the high marshes of Florida. These ditches created a type of pond habitat that is common in the high marshes of Florida. These pond habitats do not breed mosquitoes since they do not dry down during the summer months or periods of drought and they contain fish. The major problem with the site was that the spoil was not graded and thus, provided habitat for upland and exotic species. According to Mr. D. Gorman, Director of the Hillsborough County Mosquito and Aquatic Weed Control District, the area has not been a mosquito producer since the ditches were construction in the 1960 s.

The Lee County site was designed by Mr. Fred Lesser who was employed by the County Mosquito Control Commission during the 1960's, and who later became the Director of the Ocean County Mosquito Extermination Commission in New Jersey. This system consisted of a pond constructed in the high marsh area. It was noted during the inspection that the site was not a mosquito producer.

More recently, Ms. C. Murdock reported on the experimental "open marsh water management" project in a high marsh habitat in the northern section of Hillsborough County at the recent Wetland Restoration and Creation Meeting in Tampa, Florida. The project consisted of the construction of a pond and pond radials. The pond radials were constructed with a rotary ditcher with the spreading the spoil onto the marsh surface. The pond was constructed with a dragline and the spoil was removed from the marsh. The reported results showed favorable impacts in both the control of mosquito populations and the increase in fish diversity and populations without changing the vegetational associations in the first year of the project.

Owing to the similarities in low tide ranges, the application of the OMWM technique in Florida should have results similar to the work mentioned above and also the work in the Barnegat Bay region of New Jersey (Table 1). The high marsh habitat is the major portion of the salt marsh in wetlands subjected to low tide ranges. Therefore, the construction of a series of tidal ditches through the marsh will not control the mosquito problem. The use of ponds and pond radial (ditches connecting mosquito habitats and ponds) has been effective in controlling the mosquito populations without any reported negative effects on vegetational associations. Ponds constructed on the high marsh are similar to natural ponds in many functions and undergo exchange anytime the marsh is flooded by a storm tide. Ponds are constructed into the marsh water table (which is usually only several inches below the surface) in order to keep them filled with water.

E. MOSQUITO CONTROL ON THE GRAND HARBOR SITE

The development of a mosquito control plan on the Grand Harbor site will include an interdisciplinary approach between Grand Harbor consultants and the Indian River Mosquito Control District (IRMCD). The plan will be implemented over a period of years during the development of Grand Harbor. Therefore, the mosquito control plan is separated into a series of steps that will be implemented during the construction phases.

1) Tidal access to the areas for the restoration and creation of the wetland systems will be limited. During this time period, mosquito control problems originating from the impounded areas should be at a minimum due to the construction and continual altering of the drainage patterns.

2) The restored and created wetland habitats will be opened to allow normal tidal inundation into individual sections as they are completed. A period of time will be required to allow these systems to adjust to the tidal circulation and established vegetation.

During the first two steps, IRMCD personnel will continue with normal mosquito control operations of monitoring and aerial spraying when required. A mosquito light trap may be set up on the site for adult mosquito population monitoring by the IRMCD, if they wish.

As the wetland habitats are stabilizing, they will be routinely inspected by IRMCD personnel and Grand Harbor's consultant to identify potential mosquito problem areas and make recommendations for their elimination by minor alterations in the wetland restoration. The application of additional open marsh water management techniques would be implemented at this time after the additional permits are obtained.

3) The Grand Harbor Development will employ and train personnel as part of their normal operational program to monitor and treat larval mosquito populations (at Grand Harbor's expense) under the direction of the IRMCD. Larval mosquito populations will be controlled via biological control methods and the use of Bacillus thuringiensis, Serotype H-14 (Bti) (or similar material) where feasible.

4) If, after the systems have had two years to equilibrate, control of larval mosquito populations remains problematic, Grand Harbor will consult with IRMCD to implement, at Grand Harbor expense, alternative methods of control, including, if necessary, rotational impoundment management.

III. CONSTRUCTION SEQUENCE

Since the marina expansion, wetland rehabilitation and wetland creation work is designated as early Phase I activity, it is appropriate to address the general construction sequence both for construction planning and permit consistency.

There will be four separate construction areas as shown on figure 1. Activities in the four areas will be coordinated but will be separately specified and possibly separately contracted. The degrees of difficulty of construction without serious environmental impact will be different for each area and will dictate the degree of construction oversight required.

The work designated in AREA I is confined to the current uplands and will

be the least critical with respect to meeting construction specifications. This work includes all lakes, fresh water swales and those wetland areas to be connected to the estuary on a predetermined schedule. The AREA I work will be conducted in the dry and de-watered into AREA II with appropriate controls. All areas will be subdivided for staging purposes and overall earth work coordination.

AREA II involves the marina expansion and reconstruction of the abandoned agricultural areas. The marina basin will be isolated with silt screens during expansion and shallowing work. It will also be isolated from the abandoned agricultural areas with de-watering controls between sections. Viable fresh water vegetation in the abandoned agricultural areas will be stockpiled for use in the fresh water wetlands where practical.

The AREA III work is the most critical in that it involves strict attention to high marsh preservation, open marsh water management (OMWM) specifications, removal of exotics and selective removal of pesticide laden sediments. Following determination of the horizontal and vertical distribution of the pesticide concentrations and areas to be removed, the subject material will be vacuum dredged, pumped to special diked spoil areas, and flocculated for concentrated removal for layering in the upland golf course fairways. No material to be removed from the rehabilitated high marsh areas will be connected in any way to either fresh or estuarine waters. Once the sediments have been taken off the rehabilitation site, this site will be de-watered and the remaining channel excavation and exotic removal will be conducted in the dry. Upon completion of this work the area will be carefully flooded with estuarine water for creation of the low marsh ecotonal edge. After establishment of the new vegetation, the area will be allowed to equilibrate prior to opening to the Indian River Lagoon. This connection will be made in coordination with progress in AREAS I and II to insure maintenance of water quality and turbidity control.

AREA IV involves shoreline rehabilitation including exotic removal and the planting of red mangroves and smooth cordgrass. It will also include, with appropriate coordination, the stabilization of the internal marina shore in AREA II prior to the removal of silt screens and reconnection of the reconstructed abandoned agricultural areas. AREA IV also includes maintenance dredging of the permitted navigation channel.

There are more or less standard construction specifications that can be applied to the work in AREAS I, II, and IV. Even though this is specialty work, the consultants associated with the Grand Harbor project have had extensive experience in directing similar environmental earth work. AREA III, however, requires a "hands on" input from both the environmental planner and the OMWM expert. The criteria of the two specialties are compatible and consistent with the added factor of detailed attention to potential mosquito breeding areas. This work is to be conducted in accordance with dredge and fill permits to be issued but will be field directed using experienced contractors using general, rather than specific, contract specifications. Following satisfactory completion under close supervision, as built surveys and cross

sections will be produced and will form the basis of the detailed vegetation, water quality and mosquito monitoring program.

IV. MONITORING

There are three major areas of scientific interest in a project of this nature. Not all of them are related to water quality or jurisdictional questions and therefore cannot be considered a fair burden to the developer as a condition of the permitted work. Project team members, however, are associated with various institutions and are in contact with others that have interest both in marsh rehabilitation in general and the Indian River Lagoon in particular. The developer is willing to cooperate with these institutions in conducting joint studies with outside support and to take responsibility for data collection directly related to project work. The following paragraphs outline the general areas of interest that will be addressed. The actual project monitoring program will be coordinated with the Department of Environmental Regulation.

The three areas of interest are 1) the data base of current, pre-activity conditions, 2) environmental conditions during the construction period, and 3) post construction response of the rehabilitated and created systems.

A. DATA BASE

The data base includes both on site and off site conditions. The off site conditions will serve as background for project evaluation. These will include pesticide concentrations offshore and away from the site in bottom sediments. Sea grass surveys have already been conducted and the results are included on the enclosed large scale drawing. Pesticide residues have also been determined for both floral and faunal communities in the river. For the purpose of strengthening the data base, benthic samples will be taken and preserved and made available for detailed study by others. Existing data from other sources will also serve to fill out the data base.

The on site data base is generally established and shown on the drawing of existing conditions. This information is shown on Figure 2. In addition a more detailed survey of pesticide concentrations will be made in the areas to be rehabilitated for purposes of determining the areal and vertical extent of the material of concern for comparison with off site concentrations. It is proposed that this work be conducted by phases. The first phase will be a series of transects covering all areas to be disturbed by project construction. Based on the results of these data, the second phase will concentrate on the areas of greatest impact and highest concentration. A third phase may be necessary depending on the results of phase two. As with the off site data base work, benthic samples will be taken and preserved for later study by others. The current vegetation distribution and condition will also be updated and refined to serve for comparison with post construction monitoring. The specific details of these baseline studies will be presented to DER for inclusion in the dredge and fill permit as permit conditions.

B. CONSTRUCTION MONITORING

Construction monitoring will concentrate on compliance with state water quality standards and on mosquito breeding conditions within the project. This work will be coordinated with the IRCMCD personnel. A pesticide monitoring program will also be instituted for the inventorying of the fate of materials to be excavated and isolated on the project. This program will be coordinated with DER.

C. POST CONSTRUCTION MONITORING

Post construction monitoring will involve water quality on the project and in the adjacent receiving waters, mosquito activities in the rehabilitated and created waters and wetlands and environmental response of the modified system. Once the marina is placed in use, the water quality monitoring will be increased to include appropriate source parameters.

Another important aspect of post construction monitoring is the ecological response to tidal restoration of the rehabilitated system and the stability of the resulting wetlands and channels. The details of this aspect of the program will be worked out with DER and other interested parties.

APPENDIX

STATE STANDARDS FOR OPEN MARSH WATER MANAGEMENT

Bruder, K. 1980. The establishment of unified open marsh water management standards in New Jersey. Proceedings of the New Jersey Mosquito Control Association 66:72-76.

Lesser, C.R. 1984. Standards for Maryland open marsh water management (MOMWM). Proceedings of the New Jersey Mosquito Control Association 70:29-34.

STATE STANDARDS FOR OPEN MARSH WATER MANAGEMENT

Bruder, K., 1980. The establishment of unified open marsh water management standards in New Jersey. Proceedings of the New Jersey Mosquito Control Association 66:72-76.

NEW JERSEY MOSQUITO CONTROL ASSOCIATION, INC. THE ESTABLISHMENT OF UNIFIED OPEN MARSH WATER MANAGEMENT STANDARDS IN NEW JERSEY

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As most of you are aware, mosquito control agencies here in New Jersey, as in other States, are required to obtain Army Corps of Engineer permits before commencing any water management work on our salt marshes. A major problem that often confronted the counties in the past, however, was the lengthy delays in the issuance of such permits due to the review process of the federal agencies involved.

This problem may have been eliminated, or at least reduced, here in New Jersey. For through the cooperative efforts of county, state and federal personnel over the past few months, a set of Open Marsh Water Management Standards has been compiled which is acceptable to all concerned agencies.

These standards have been so well accepted, in fact, that the Army Corps of Engineer's Permit Section has already indicated that they will be incorporated in all future permits for marsh management work on New Jersey's open tidal areas. The acceptance, and inclusion of the Open Marsh Water Management Standards in all future permits, will hopefully eliminate any concern the Corps has had in the past regarding inappropriate mosquito control practices on open tidal marsh areas and should help in expediting the issuance of permits to the counties.

It has taken over twenty years to develop the standards that are being discussed today. Ferrigno et al, (1975) listed some nine general standards for Open Marsh Water Management. Of special note is the fact that in the article the authors briefly mention the U.S. Fish and Wildlife Service's interest in having coastal states establish standards for water management for mosquito control so that such standards could be used by the federal government in screening permit applications. This was back in 1975. To my knowledge, New Jersey is the first and the only state thus far to adopt such a set of standards dealing with mosquito control on open tidal marshes.

The need to adopt a set of standards covering Open Marsh Water Management became apparent this past fall. In November, I was informed by the superintendents of the Cape May and Cumberland County Mosquito Commissions of the fact that the Corps was withholding county permits for Open Marsh Water Management work due to problems that it was having in determining what management techniques were being included under the term Open Marsh Water Management, as it appeared on county application forms.

In response, I scheduled a meeting with representatives from

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the coastal counties and the state to have them air their views on what should, or should not, be considered as acceptable techniques under Open Marsh Water Management, and to establish a set of standards which would be acceptable to all concerned. In attendance were Judy Hansen, Superintendent of the Cape May County Mosquito Commission; Pat Slavin, Director of the Cumberland County Mosquito Commission; Brian Gooley, the Superintendent from Burlington County; Fred Lesser, and Tom Candeletti from Ocean County; Harry Tillett and Dave Rizzley representing the Atlantic County Mosquito Control Agency; Mr. Fred Ferrigno, Senior Biologist from the New Jersey Division of Fish, Game and Shellfisheries; and Dr. Joseph Shisler, Marsh Management Specialist from the New Jersey Agricultural Experiment Station. As a result of the meeting, a first draft of Open Marsh Water Management Standards was drawn up.

A second meeting was then held on December 14, with the same individuals in attendance, plus Jeff Steen and Frank Cianfrani from the Permit Section of the Army Corps of Engineers in Philadelphia. The standards were further reviewed and additional amendments made. At that meeting, Mr. Steen requested that the revised standards be submitted to the Corps' Office in Philadelphia as quickly as possible, for final approval. This was done in early January. Since then, my office has received several letters from representatives of the Corps of Engineers and the U.S. Fish and Wildlife Service indicating their acceptance of the standards.

I strongly believe that the Open Marsh Water Management Standards, although established primarily for work on New Jersey's open tidal marshes, can be utilized and adopted in other states as well.

At this time, I would like to briefly run through our Standards with you.

STANDARDS FOR OPEN MARSH WATER MANAGEMENT (OMWM)

County mosquito commissions, Rutgers University and the New Jersey Division of Fish, Game and Shellfisheries have been perfecting one technique, Open Marsh Water Management (OMWM) for the control of all genera of salt marsh mosquitoes on open tidal marshes for over two decades. Perfection is achieved by continued improvement and evaluation. In order to ensure the finest quality and identify this management technique, certain standards are a necessity. These standards should be included in any riparian or other permit. Improper adherence to these standards would be a violation of the permit and infringement of the quality of the management technique. The following standards shall be utilized and strictly adhered to in any OMWM project:

I. NEED. OMWM will be based entirely on need and utilized on breeding marshes only.

- A. OMWM will be confined to the Spartina patens or mixed S. patens, short S. alterniflora or types of similar vegetation that are irregularly flooded by rains, spring or storm tides. It will not be employed on marshes that are regularly inundated or affected by daily tides such as tall saltmarsh cordgrass (Spartina

alterniflora), wildrice (Zizania aquatica), cattail (Typha spp.), arrow arum (Peltandra virginica), three-square (Scirpus olneyi) and other types of similar vegetation.

- B. All alterations must directly affect mosquito breeding depressions.
- C. The direction and type of alteration used will depend on the distribution of the mosquito breeding depressions and their proximity to natural ponds and tidal ditches.
- D. An experienced wildlife biologist, mosquito control worker, or both, shall stake out all breeding depressions ahead of the equipment. Depression marking shall be utilized to determine the least amount of alteration needed to eliminate mosquito breeding.
- E. All mosquito or other ditches encountered that are not contributing to breeding mosquitoes will not be cleaned.
- F. When possible, ponds previously altered by mosquito ditches will be restored.

II. ALTERATIONS. Three types of alterations (tidal ditches, ponds and pond radials) will be used.

A. Tidal Ditches

1. All tidal ditches will be dug with suitable equipment, preferably with a rotary ditcher.
2. When mosquito breeding depressions are located adjacent to a tidal, mosquito or other ditch, a tidal ditch alteration will be utilized.
3. When a tidal ditch is dug near a pond, the spoil should be deposited on the pond side.
4. Attempts should be made to dig tidal ditches to a depth of approximately three feet. Meandering or straight ditches are acceptable.
5. Main tidal ditches are used to provide tidal circulation through large areas. They should be connected to a tidal source on both ends where possible. Their location is determined by the distribution of breeding depressions.
6. Lateral tidal ditches connect breeding depressions to mains, natural tidal ditches or other laterals. Such laterals often dead-end in a breeding depression.
7. All mosquito or other ditches that are breeding will be cleaned.
8. Spoil shall be used whenever possible to fill adjacent mosquito breeding depressions or spread evenly over the marsh to encourage growth of existing vegetation.

B. Pond Radials

1. All mosquito breeding depressions located near a natural or other permanent pond shall be connected to this pond by pond radials. These radials will provide access for fish to devour mosquito larvae in the depressions.
2. All pond radials shall be constructed with suitable equipment, preferably with a rotary ditcher.
3. To prevent drainage of a pond by muskrats or snow

geese, all pond radials shall terminate at a sufficient distance from a tidal ditch.

C. Ponds

1. Where large numbers of mosquito breeding depressions are concentrated in a limited area, a pond alteration will be utilized.
2. Pond construction is accomplished by the use of the rotary ditcher, amphibious crane or other suitable equipment.
3. Ponds should be shallow, less than one foot in depth, to promote the best waterfowl, wading and shore bird use.
4. To prevent mosquito breeding during droughts, a reservoir three feet in depth shall be installed within the pond.

5. These reservoirs should provide proper pond areas by humans. When large numbers of radials are used, reservoirs are unnecessary.
6. Reservoirs for fish can be ensured in natural ponds that dry out during droughts by construction of three foot ditches with a rotary ditcher or other suitable equipment. These reservoirs will connect all the lowest areas within the pond.
7. Pond spoil should be squashed and leveled without causing depressions. It should be reduced to the lowest possible level to ensure reestablishment of existing vegetation. Spoil shall approximate the level of the existing marsh.
8. Ponds may take the shape of the breeding area or may be squared off to facilitate construction. The shape of a pond or ditch does not appreciably affect wildlife use. Depth, food potential and availability are the main factors that determine wildlife utilization.

III. OBJECTIVES

- A. To adequately serve the three major objectives (control mosquitoes, eliminate insecticides and enhance the tidal food web) all three alteration types (tidal ditches, ponds and pond radials) shall be utilized on each section of marsh whenever possible. Diversity provides a better marsh environment, prevents marsh surface breeding by all genera of mosquitoes and enhances both major branches of the tidal food web.
- B. Insecticide use is gradually phased out as OMWM progresses to eliminate breeding acreage. When the project is completed, all insecticide use should terminate.

IV. OTHER TECHNIQUES

Impoundments, stop ditches and other types of management techniques are not OMWM.

V. EVALUATION

Mosquito larval dippings, vegetational plots, invertebrate sampling and wildlife censuses are to be conducted on the area treated with OMWM and compared with a control of similar composition.

I would like to express my appreciation to the superintendents of the county mosquito control commissions, and to Dr. Joseph Shisler and Mr. Fred Ferrigno for their cooperation and input in setting up the standards. I would also like to thank Jeff Steen and Frank Cianfrani from the U.S. Army Corps of Engineers and Mr. Tom Huph from the U.S. Fish and Wildlife Service for their interest and assistance in putting together an acceptable set of standards for Open Marsh Water Management in New Jersey.

REFERENCE CITED:

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STANDARDS FOR MARYLAND
OPEN MARSH WATER MANAGEMENT (MOMWM)

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The need and demand for improved control of salt marsh mosquitoes, primarily *Aedes sollicitans*, exists in many parts of Maryland, particularly the southern Eastern Shore region. It is accepted that the fundamental requisite for the control of *Ae. sollicitans* is the control of the larvae by either chemical means (larviciding) or physical means (water management). Whereas chemical control poses several problems, including environmental contamination, high cost, temporary results, and eventual resistance by the mosquitoes, it is concluded that control by water management is the preferred control technique.

The basic principle of water management mosquito control techniques is to facilitate access of larvivoracious fish to the mosquito breeding areas and/or cause removal of water from the breeding areas before the mosquito larvae can complete their development.

The Maryland Mosquito Control Advisory Committee has investigated various strategies of water management for use in the State since 1976. In order to identify the management technique(s) most suited for use in Maryland, certain standards are necessary. These standards were developed through practical experience and comprehensive ecological studies (Lesser, 1982; Lesser and Saveikis, 1979) and shall be used as a guide in future water management projects and be incorporated in all permits issued for mosquito control marsh management projects. These standards will be periodically reviewed and revised if necessary.

I. Objective

- A. The primary objective is to provide a management technique that will control the larval production of all species of salt marsh breeding mosquitoes: *Aedes sollicitans*, *Aedes taeniorhynchus*, *Aedes cantator*, *Anopheles bradleyi* and *Culex salinarius*.
- B. Reduction in the use of insecticides - After the completion of a water management project, mosquito control will be achieved, therefore the use of larvicides on that area will be eliminated.
- C. The application of MOMWM shall, to the extent possible, minimize the negative impact on floral and faunal composition of the salt marsh/estuarine ecosystem.

- D. The technique must be cost effective - Inasmuch as public funds will pay for this management it is essential that these funds be used to provide the intended results at a reasonable cost.

- II. Need: The use of MOMWM will be based entirely on the need for mosquito control as determined by larval inspections.

III. Implementation

- A. Because the ecological requirements necessary for the breeding of all genera of salt mosquitoes are reflected in the vegetational character of the marsh, this character can be used to determine potential breeding marshes. In Maryland, the plant species associated with high marsh, i.e. infrequently flooded by rains, spring or storm tides; therefore indicative of mosquito breeding habitat are: *Distichlis*

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spicata; *Spartina patens*; short form *Spartina alterniflora*; small areas of *Juncus roemerianus*, *Scirpus olneyi* and *Typha* spp. in association with the previous three species; *Phragmites communis*, *Scirpus robustus*, and (in some instances) *Panicum* spp. Water management will not be employed on marshes subject to regular floodings (greater than 8 days per month) or daily tides. Non-breeding marshes are vegetationally characterized by tall form *Spartina alterniflora*; *Zizania aquatica*; extensive stands of either *Typha* spp., *Scirpus olneyi* or *Juncus roemerianus*; and similar species of vegetation. Permanent ponds on the salt marsh do not provide breeding sites for mosquitoes and will not be drained.

- B. All alterations must directly affect mosquito breeding sites.
- C. An experienced mosquito control entomologist, wetland biologist, or both shall stake out all of the alterations to be constructed. The amount of construction done will be the minimum required to satisfy the objectives of MOMWM.

- IV. Alterations: Four types of alterations (tidal ditches, semi-tidal ditches, ponds and pond radials) will be used. To a degree, the type of alteration used will be dependent on the type of marsh being managed. Darmody and Foss (1978) define three types of marsh in Maryland: Coastal, Submerged Upland and Estuarine.

Coastal type marshes have a higher salt content in the soil than the other marsh types and are characterized by vast swards of *S. alterniflora* and *S. patens*. Coastal marshes occur along the margins of Chincoteague and Assawoman Bays in Worcester County. It is the dominant marsh type in Worcester County and constitutes all of that county's mosquito breeding salt marsh.

Submerged upland type marshes have developed over areas which were formerly uplands and are being submerged by the slowly rising sea level. These marshes are characterized by relatively thin organic soils overlaying older mineral soils developed from wind-blown silts or sands. The dominant vegetation consists of *J. roemerianus*, *S. patens*, *D. spicata*, *S. alterniflora*, *S. olneyi* and *P. communis*. It is the dominant marsh type in Maryland, and is found primarily in Dorchester and Somerset Counties where it is the predominant mosquito breeding marsh type.

The estuarine type marsh occurs in all counties along Chesapeake Bay and the Atlantic Coast. This marsh type is found primarily along streams and rivers which drain into Chesapeake Bay. The marshes develop from the silting in of streams, estuaries or bays. They may also develop from the accumulation of sediments in tidal streams as estuarine meanders. The dominant vegetation in the brackish and saline areas of this marsh type is *S. alterniflora*, *S. patens*, *D. spicata*, *Spartina*

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cynosuroides, *S. olneyi* and *J. roemerianus*. This is the dominant marsh type for salt marsh mosquito breeding in the Western Shore region and is also common along Pocomoke Sound in Somerset County and Fishing Bay in Dorchester County.

A. Tidal Ditches

1. Tidal ditches are the most effective alteration to eliminate mosquito breeding and are the preferred type of ditch to be used on coastal marshes and on some estuarine marshes. On submerged upland marshes the use of tidal ditches will be restricted to the upland edge as a "band ditch" and when existing upland drainage ditches outlet to the marsh that part of the ditch traversing the marsh to a tidal drain may be cleaned so as to assure tidal flow.
2. All tidal ditches will be dug with suitable equipment, preferably with a rotary ditcher. When a rotary ditcher is not available or cannot be used other equipment types, such as amphibious cranes or backhoes, are acceptable provided that spoil taken from the ditches is graded to as near marsh level as possible. Spoil dug with a crane or backhoe should be placed on opposite sides of the ditch so as not to form a continuous line of spoil which would impede water movement across the marsh surface.
3. Tidal ditches should be dug to a depth of two to three feet, with the deeper ditches being preferred.

2. Semi-tidal ditches will be constructed according to the specifications given for tidal ditches except that the outlet of main ditches will contain a sill which will not allow complete drainage. This sill will be approximately 100 feet long and 6 to 10 inches below the marsh surface.
3. The semi-tidal ditches will allow drainage of excess surface water, thus eliminating sheet water breeding sites, and flood frequently enough by spring or storm tides to maintain a water quality sufficient for fish survival. If these results are not achieved, the depth of the sill shall be lowered.

C. Ponds

1. Where numerous mosquito breeding depressions are concentrated in a limited area, a pond alteration will be utilized.
2. Pond construction is accomplished by a rotary ditcher, amphibious crane, backhoe or other suitable equipment.
3. Ponds should be 18 inches or 24 inches in depth to promote waterfowl and wading bird use and the growth of submerged aquatic vegetation.
4. To ensure fish survival in the ponds during droughts a reservoir ditch of at least three feet depth shall be constructed along at least two sides of the pond edge.
5. Pond shape may be either linear or take the shape of the breeding area.
6. Islands shall be left in the pond when possible to provide additional edge cover within the pond.
7. Pond spoil should be graded as low as possible without undue disturbance to the nearby non-breeding marsh surface. Pond spoil shall be used to fill mosquito breeding depressions when possible.

D. Pond Radial Ditches

1. Mosquito breeding sites located near a permanent natural or constructed pond shall be connected to the pond by pond radial ditches. These radial ditches will provide access for fish to devour mosquito larvae at the breeding sites.
2. All pond radials shall be constructed with the type of equipment previously mentioned for tidal and semi-tidal ditches.
3. Spoil from the radial ditches shall be disposed of in a similar manner as described for tidal and semi-tidal ditches.
4. To prevent drainage of a natural permanent or constructed pond by muskrats or other natural factors, all pond radials shall end no closer than 50 feet from a tidal ditch or creek.

- V. Other Techniques: Impoundments, closed ditch systems and other types of management not described here are not MOMWM.

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RODERIC SCHMIDT: What type of a hook-up do you have for your Dondi ditcher? Is it a PTO or hydraulic?

CYRUS LESSER: It is a three point hook up with a power take off coming from the tractor.

RODERIC SCHMIDT: Does that mean that in your heavy soil marshes you have to take several passes to cut a ditch?

CYRUS LESSER: Yes. We do need to make several passes. Even with the Quality Marsh machine. We use a 30 inch cutting head as opposed to the 36 inch used in New Jersey because of the heavy soil and possibility of hitting a buried stump. It takes at least three cuts with ditches to get sufficient depth.