OA Systems Corporation

MOSQUITO CONTROL REVIEW FOR CRANEY ISLAND DREDGED MATERIAL MANAGEMENT AREA (CIDMMA)

A Plan of Action

July 12, 2004

Prepared Under:

CONTRACT NUMBER DACW65-03-D-0057
Task Order 0003

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Norfolk District
U.S. Army Corps of Engineers

PREFACE

The Norfolk District procured consulting services through an existing contract (OAS Contract DACW65-03-D-0057) with OA Systems Corporation to provide a "Mosquito Control Review for Craney Island Dredged Material Management Area" and develop a Plan of Action (POA). The notice to proceed was received from Norfolk District on February 22, 2004. The period of performance for this study was from February22 to July 12, 2004.

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Patricia A. Spaine prepared this report with contributions by Norman R. Francingues, and Charles R. Lee.

The authors wish to thank the many mosquito control professionals from the Corps of Engineer Districts, EPA, State and County agencies who contributed their time and knowledge regarding mosquito practices in place on the Middle Atlantic Coastal Region. They are too numerous to list here but are included in Personal Communication Reference List.

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1.0 INTRODUCTION

1.1 Background

The mosquito control program at Craney Island Dredged Material Management Area (CIDMMA) has undergone a review as a result of a number of converging events: a large mosquito bloom in 2002, the emergence of West Nile virus and Equine Encephalitis as major health concerns in the United States, and raising the dikes at the CIDMMA drawing attention to the area. Therefore, the Norfolk District decided to undertake a study to determine if changes were needed and the potential impacts of changes to the CIDMMA mosquito control program.

Since much of the report information was obtained from numerous mosquito control specialists in various agencies, a Personal Communication Index was compiled presenting a list of persons contacted for this study, organized geographically by Corps of Engineers' District. Referenced conversations are identified as "P.C. 00" with the numeric value referring to the position on the list.

1.2 Local Mosquito Surveys

For the Portsmouth area, information was obtained from the Portsmouth Mosquito Control Task Force Powerpoint™ presentation entitled "Mosquito Program Annual Report, July16-October 31, 2003", a version received from Corps of Engineers March 2004 (Portsmouth, 2004). Figure 1 indicates 19 birds and 14 mosquito pools were found in Portsmouth in calendar year 2003. Eight of the birds and four of the mosquito pools were mapped in areas north of the Western Branch of the Elizabeth River.

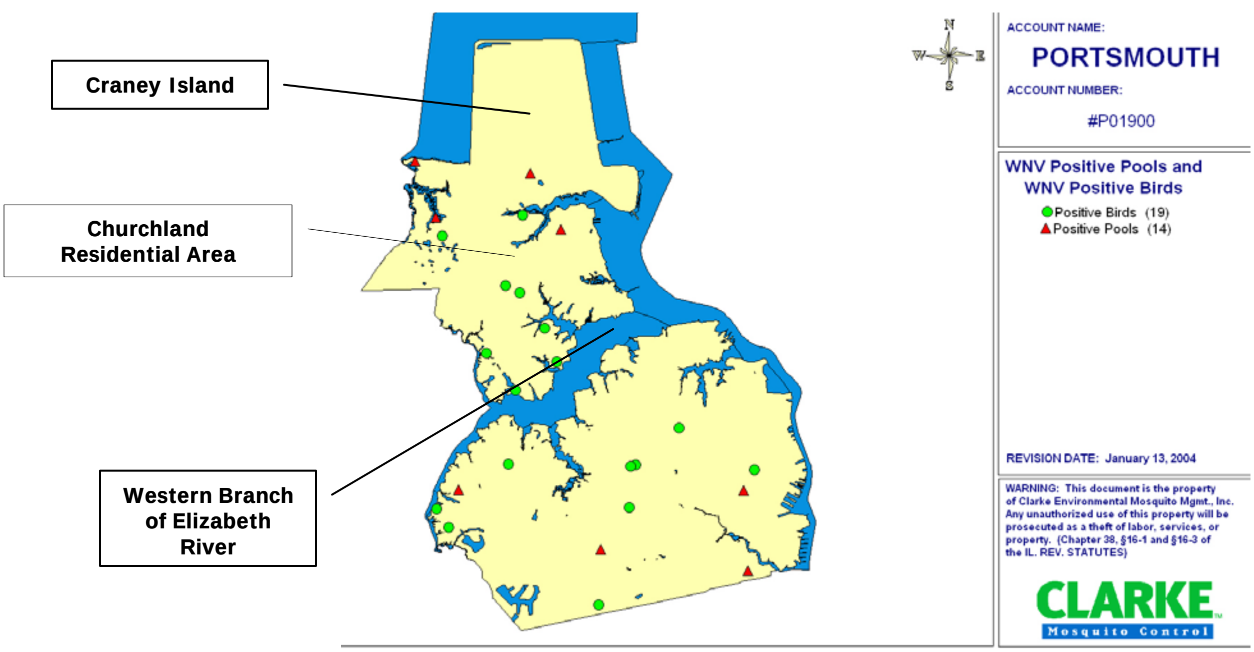


Figure 1 : Portsmouth West Nile Positives for 2003 (Portsmouth, 2004)

Mosquitoes at CIDMMA and other nearby federal facilities are of most concern due to their proximity to residential areas, considering the public health concerns of West Nile (WN) Virus and Equine Encephalitis.

Rindfleisch (1995) in the “1995 Craney Island Mosquito Survey” described the prime breeders at CIDMMA as the Greater Salt Marsh Mosquito *(Ochlerotatus sollicitans)* contributing 80% according to trapping surveys, the Lesser Salt Marsh Mosquito *(Ochlerotatus taeniorhynchus)*, and to a much lesser degree the *Culex salinarius*, a freshwater mosquito. According to discussions with the author of the report (PC, 16), those percentages appear to still hold for CIDMMA-bred mosquitoes. The Culex mosquito cannot tolerate the saltwater conditions in the dredged material cells at CIDMMA, and only breed in incidental freshwater outside the cells.

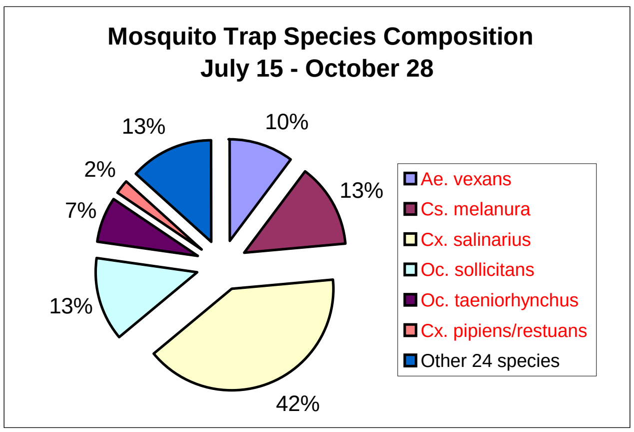
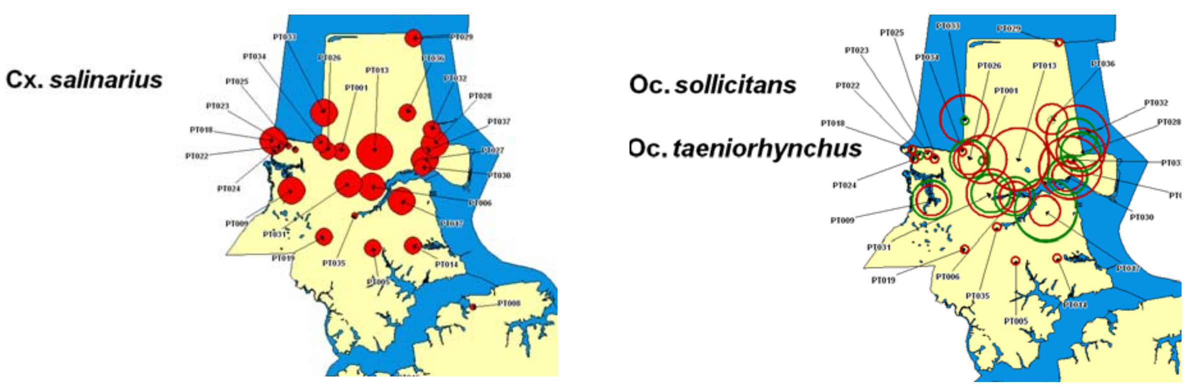


Figure 2 a: Mosquito Species in Portsmouth

The Portsmouth data from the 2003 season (Portsmouth, 2004) Figures 2. a, b, c show these same species as the dominant ones in the Churchland vicinity. While all of these species are suspected WN vectors, the salt marsh varieties (the most prevalent breeders at CIDMMA) are moderate to low competence vectors and a bridge vector from birds to mammals. The *Culex salinarius* is the third most frequently found WN species in both the U.S. and Virginia and is highly competent as both a Primary and Bridge vector. Although over 80% of the mosquitoes emerging from the area are lesser vectors of WN and regardless of the statistics, if there are mosquitoes biting in the proximity, then there is a public health risk and elevated concern. This potential for elevating the risk/concern is the driving force for review of the mosquito control program at CIDMMA. An overview from the Center for Disease Control (CDC) and Virginia Department of Health (VDH) describing WNV and WN Mosquito species is contained in Appendix A.



Figures 2 b & c: Location of Trapped Mosquito Species in Portsmouth North of Western Branch

1.3 Purpose

The purpose of the study was to conduct a technical review of existing "Best Management Practices (BMP)" of the application of EPA approved larvicide and pesticide products for the purpose of mosquito and *Phragmites* control at the Army Corps of Engineers, Craney Island Dredged Material Management Area in Portsmouth, VA. The result of the review is a recommended Plan of Action (POA) to implement BMP's for the CIDMMA.

1.4 Scope and Report Organization

The report is organized and presented according to the following scope of work items:

- Identification of existing BMP's that are directly addressing the threat of the West Nile virus being spread by mosquitoes;
- review of existing mosquito control practices used at the CIDMMA ;
- focused review of BMP's used by the Middle Atlantic Coast Corps of Engineer Districts;
- preparation of a matrix detailing the regiment of the biological and chemical controls and application methods used under routine operations, response to significant mosquito infestations, and response to public health crisis as related to mosquito transmitted illnesses such as West Nile virus;
- consideration of impacts to endangered species as a result of implementation of specific BMP and determination of whether or not an environmental assessment (EA) would be required to implement specific BMP's at CIDMMA;
- impact of *Phragmites* on mosquito breeding and control; and
- preparation of a POA that identifies and describes the full range of biological and chemical control products and application methods approved for application under existing BMP control strategies.

2.0 WEST NILE VIRUES MOSQUITO CONTROL STRATEGIES

The emergence of West Nile Virus (WNV) and Equine Encephalitis (EE) throughout the United States has driven the Environmental Protection Agency (EPA) and Center for Disease Control (CDC) into developing uniform methods for Mosquito Control. An overview of the WNV, known mosquitoes that are primary vectors, and information regarding prevalent WN mosquito species in the U.S., Virginia, and Portsmouth are contained in Appendix A. The mosquito control community within the United States commonly uses the term Integrated Pest Management Programs (IPM) rather than Best Management Practices (BMP) when referring to rigorous mosquito control programs. All of the programs reviewed for this report incorporate many components of IPM, but few programs were formal written programs or BMPs. Most were either State Programs, general mosquito control district practices, or defined by varying degrees by Corps of Engineers contract scopes. To define what "Best Management Practice" infers within the mosquito control community today, the CDC and EPA IPM Program Components must be identified and delineated.

The CDC and EPA recommend incorporating IPM principles for prevention and control of arboviral diseases. The CDC defines IPM programs (CDC, 2003) based on an understanding of the underlying biology of the transmission system, and utilizing regular monitoring to determine if and when interventions are needed to keep pest numbers below levels at which intolerable levels of damage, annoyance, or disease occur. IPM-based systems use a variety of physical, mechanical, cultural, biological and educational measures, singly or in appropriate combination, to attain the desired pest population control. As directed by the Virginia West Nile Virus Plan (VA, 2003) " The basic theory behind IPM is to base control decisions such as target area, time of application, and control method on surveillance findings, and knowledge of the pest, and to apply the best and most appropriate control method(s) or pesticide(s) for each situation. By using different control methods and pesticides, technicians can deal with various species of mosquitoes during all stages of their life cycle. IPM methodologies also decrease the development of pesticide resistance by minimizing usage of any one type of pesticide/mode of action, and by minimizing frequency and volume of application through appropriate targeting. *The way each IPM component is utilized should be tailored to best meet the particular public health needs of each affected locality. The application of pesticides for mosquito control should be a local decision based on local surveillance data and knowledge of local conditions. To be effective, control activities must be directed towards the specific target mosquito species. Therefore, surveillance programs need to identify local mosquito populations and the specific biology and habits of the target mosquitoes need to be well understood."(Emphasis added.)*

The following discussion (Sections 2.1 through 2.6) is extracted and condensed from the CDC "Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control" (CDC, 2003) which presents the recommended IPM components of Mosquito Control Programs:

2.1 Surveillance

Effective mosquito control begins with a sustained, consistent surveillance program that targets pest and vector species, identifies and maps their immature habitats by season, and documents the need for control. The following surveillance methodologies are used by mosquito control agencies.

2.1.1 Larval Mosquito Surveillance

Larval surveillance involves sampling a wide range of aquatic habitats for the presence of pest and vector species during their developmental stages. Responsible control programs target vector and nuisance populations for control and avoid managing habitats that support benign species.

2.1.2 Adult Mosquito Surveillance

Adult mosquito surveillance is used to monitor species presence and relative abundance of adult mosquitoes in an area. Information derived from adult mosquito surveillance programs using standardized and consistent surveillance efforts provide information essential to monitoring potential vector activity, setting action thresholds, and evaluating control efforts.

2.1.3 Virus Surveillance

The prevalence of WNV in the mosquito population is determined by virus surveillance as a component of the vector management program.

2.2 Source Reduction

Source reduction is the alteration or elimination of mosquito larval habitat breeding. Reduction of breeding remains the most effective and economical method of providing long-term mosquito control in many habitats. Source reduction activities can be separated into the following two general categories:

2.2.1 Sanitation

The by-products of human's activities have been a major contributor to the creation of mosquito breeding habitats. An item as small as a bottle cap or as large as the foundation of a demolished building can serve as a mosquito breeding area. Educational information about the importance of sanitation in the form of videos, slide shows**,** and fact sheets distributed at press briefings, fairs, schools and other public areas are effective source reduction tools.

2.2.2 Water Management

Water management for mosquito control is a form of source reduction that is conducted in fresh and saltwater breeding habitats. Water management programs can be for vector control in impounded areas or open marshwaters. Although impoundments usually achieve adequate control of salt-marsh mosquitoes, there are situations in which impoundments can collect stormwater or rainwater and create freshwater mosquito problems that must be addressed using other techniques discussed below (*This is a generic consideration made in the CDC report, but is not applicable to the high salinity dredged material cells at CIDMMA*). Ditching as a source-reduction mosquito control technique has been used for many years. Mosquito broods can be controlled to some degree without pesticides by allowing larvivorous fish access to mosquitoproducing pools. Or conversely, the draining of these depressions can occur before adult mosquitoes can emerge.

Source reduction and water management practices may also be applied to stormwater retention structures designed to hold runoff before it is discharged into groundwater or surface water. Mosquito control should be considered in the design, construction, and maintenance of these structures, as appropriate.

2.3 Chemical Controls

Pesticides can be directed against either the immature or adult stage of the mosquito life cycle when source reduction and water management are not feasible or have failed because of unavoidable or unanticipated problems, or when surveillance indicates the presence of infected adult mosquitoes that pose a health risk. Pesticides used by mosquito control agencies must comply with state and federal requirements. Public health pesticide applicators and operators in most states are required to be licensed or certified by the appropriate state agencies. Application rates and methods must follow label directions.

2.3.1 Larviciding

Larviciding, the application of pesticides to kill mosquito larvae or pupae by ground or aerial treatments, is typically more effective and target-specific than adulticiding, but less permanent than source reduction. The objective of larviciding is to control the immature stages at the breeding habitat before adult populations have had a chance to disperse and to maintain populations at levels at which the risk of arbovirus transmission is minimal. Applications of larvicides often encompass fewer acres than adulticides because treatments are made to relatively small areas where larvae are concentrated, as opposed to larger regions where adults have dispersed. When applying larvicides, it is important that the material be specific for mosquitoes, minimize impacts on non-target organisms, and, where appropriate, be capable of penetrating dense vegetation canopies. Larvicide formulations (i.e., liquid, granular, solid (briquets & sands)) must be appropriate to the habitat being treated, accurately applied, and based on surveillance data. Accuracy of application is important because missing even a relatively small area can cause the emergence of a large mosquito brood resulting in the need for broad-scale adulticiding.

2.3.2 Adulticiding

Adulticiding is the application of pesticides to kill adult mosquitoes. The ability to control adult mosquitoes is an important component of any integrated mosquito management program, and like the other components of the program, its use should be based on surveillance data. Mosquito adulticiding may be the only practical control technique available in situations where surveillance data indicate that is necessary to reduce the density of adult mosquito populations quickly to lower the risk of WNV transmission to humans. Mosquito adulticiding differs fundamentally from techniques used to control many other adult insects. For adult mosquito control, pesticide must drift through the habitat in which mosquitoes are flying in order to provide optimal control benefits. The EPA has determined that the pesticides labeled nationally for this type of application do not pose unreasonable health risks to humans, wildlife, or the environment when used according to the label. Application of adulticides should be timed to coincide with the activity period of the target mosquito species. Many *Culex* species are nocturnal and are active in the tree canopy level. Control of adult day-active species poses additional problems because ULV adulticide effectiveness is greatly reduced during daylight hours. Early-morning use of adulticides, applied before temperatures rise, may provide a measure of control for these species.

2.3.3 Resistance Management

In order to delay or prevent the development of pesticide resistance in vector populations, integrated vector management programs should include a resistance management component. Ideally, this should include annual monitoring of the status of resistance in the target populations to provide baseline data for program planning and pesticide selection before the start of control operations, detect resistance at an early stage so that timely management can be implemented and continuously monitor the effect of control strategies on resistance.

2.3.3.1 Management by Moderation – using dosages no lower than the lowest label rate, use of pesticides of short environmental persistence, avoidance of slow-release formulations, avoidance of the same class of pesticide to control both adults and immature stages, local application, establishment of high pest mosquito densities or action thresholds prior to pesticide application, and alternation of biorational larvicides and insect growth regulators annually or at longer intervals.

2.3.3.2 Management by continued suppression – a strategy used in areas of high-value (e.g., heavily touristed areas) or where arthropod vectors of disease must be kept at very low densities. This is achieved by the application of dosages within label rates but sufficiently high to be lethal to susceptible as well as to heterozygous-resistant individuals.

2.3.3.3 Management by multiple attack - achieving control through the action of several different and independent pressures such that selection for any one of them would be below that required for the development of resistance. This strategy involves the use of pesticides with different modes of action in mixtures or in rotations.

2.4 Biological Control

Biological control is the use of biological organisms, or their by-products, to control pests. Biocontrol is popular in theory, because of its potential to be host-specific and virtually without non-target effects. Overall, larvivorous fish are the most extensively used biocontrol agent for mosquitoes. Predaceous fish, typically *Gambusia* or other species which occur naturally in many aquatic habitats, can be placed in permanent or semi-permanent water bodies where mosquito larvae occur, providing some measure of control. Other biocontrol agents that have been tested for mosquito control, but that to date generally are not widely used, include the predaceous mosquito *Toxorhynchites*, predacious copepods, the parasitic nematode *Romanomermis*, and the fungus *Lagenidium giganteum*.

2.5 Continuing Education of Mosquito Control Workers

Continuing education is directed toward operations personnel to instill or refresh knowledge related to practical mosquito control. Training is primarily in safety, applied technology, and requirements for the regulated certification program mandated by most states.

2.6 Vector Management in Public Health Emergencies

A surveillance program adequate to monitor WNV activity levels associated with human risk must be in place. Early-season detection of enzootic or epizootic WNV activity appears to be correlated with increased risk of human cases later in the season. Control activity should be intensified in response to evidence of virus transmission, as deemed necessary by the local health departments. Such programs should consist of public education emphasizing personal protection and residential source reduction; municipal larval control to prevent repopulation of the area with competent vectors; adult mosquito control to decrease the density of infected, adult mosquitoes in the area; and continued surveillance to monitor virus activity and efficacy of control measures.

3.0 LIMITED SURVEY OF CORPS OF ENGINEERS MOSQUITO CONTROL PRACTICES

Lengthy telephone reviews were conducted with five Middle Atlantic Coast Corps of Engineers Districts and their mosquito control contractors (PC 1 through 29). A site visit was also made to Norfolk District to visit CIDMMA and interview key people responsible for mosquito control (PC, 9-17). There were no written Best Management Practices available for Mosquito Control for large Corps dredged material management facilities. Outside Norfolk District, local mosquito control authorities under contract to the various Corps districts handle all mosquito control program components. These contractors are State agencies, County agencies or Mosquito Districts. For the most part, the only written documents available were either generic State programs or scopes of work from contract documents. An overview of each Corps of Engineers District program is provided as summary sheets in Appendix B. The summaries list IPM components currently in practice; pesticides used, and where available, cost.

Based on interviews and reviews of program documents; the programs in place for the Corps of Engineers Atlantic Coast Districts adhere to the principles of IPM and incorporate a variety of the components based on site specific considerations (Table 1).

Table 1 - IPM Components utilized by Corps Districts for Large Dredged Material Management Areas

	Philadelphia	Baltimore	Norfolk	Wilmington	Charleston	Savannah
Larvae Surveillance			✓	✓	✓	✓
Adult Surveillance			✓	✓	✓	✓
Water Management		✓	✓	✓	✓	✓
Biological Controls				✓		
Larvicides			✓	✓	✓	✓
Adulticides	✓	✓	✓		✓	✓
Public Communication		✓		✓		
Interagency Communication	✓	✓	✓	✓	✓	✓

3.1 Philadelphia District

The Philadelphia District relies on contracts with the State of New Jersey for mosquito control services for the Delaware Main Channel to the Sea. A scope of work delineating a mosquito control program written in 1986 by Dr. Al Cofrancesco at WES was provided by the Philadelphia District (Mr. Tom Groff). However, it is unclear if the present contractor strictly follows the procedures recommended by WES. The Philadelphia District provided a brief contractor scope for New Jersey. Multiple phone calls over several weeks to New Jersey Department of Environmental Protection were not returned. The District supplied Invoicing and

Application Reports for the Mosquito Season 2002 from the State of New Jersey. The billings indicated reliance on aerial application of the adulticide Abate on 2,817 acres of dredged material management area. These documents are provided in Appendix B along with a summary sheet.

3.2 Baltimore District

The Baltimore District contracts with the State of Maryland for Mosquito Control at the jointly owned Poplar Island dredged material placement site. Maryland also provides mosquito controls at two large State-owned dredged material management facilities, Cox Creek and Hart Miller Island. Discussions with Mr. Cyrus Lesser, Maryland Department of Agriculture, Mosquito Control, and Ms. Jennifer Harlan, Maryland Environmental Services (MES), Poplar and Hart Miller Operators, indicate that the State relies predominantly on aerial application of the adulticide Trumpet EC (Naled) at Poplar and Hart Miller Islands, after mosquitoes are observed on the wing and complaints by the MES operations staff. Water management is conducted at Hart Miller and Poplar Islands as a part of dredged material management, and the mosquito program may benefit tangentially from those activities. There is no written protocol for the mosquito control programs at these sites, only the documented State Program on the website http://www.mda.state.md.us/mosquito. A summary sheet and relevant documents are provided in Appendix B.

3.3 Wilmington District

The Wilmington District is serviced by contracts with four local county mosquito control agencies (PC,21). The mosquito control staffs at these counties, along with Wilmington District staff, and others gather quarterly during mosquito season for brief, targeted meetings to report trends and lessons learned. Brunswick and New Hanover are the two counties that service the Wilmington Harbor dredged material management site, Eagle Island. According to Mr. Jeff Brown, Mosquito Control, Brunswick County (PC, 23), they rely on very aggressive surveillance, water management, biological controls, and application of larvicides. The counties aggressively monitor the larvae development and know well their mosquito species' breeding cycles and locations of trouble areas. They inspect after each rainfall event and, at a minimum, monthly. Water management includes maintaining water level to 2 feet during active filling stages to reduce crack-forming potential, to allow mosquito-eating minnow and fish to freely circulate and to inhibit *Phragmites* growth; dropping the water level in the containment areas to dewater and consolidate the dredged material; and extensive ditching to drain cracks and isolated areas and allow mosquito-eating minnows and fish access to pools. Larvicides are either hand applied or helicopter applied granules. Adulticides are rarely used. There was no written protocol available, but there is a technical summary provided and several technical papers. A summary sheet and relevant documents on the Eagle Island site are provided in Appendix B.

3.4 Charleston District

The Charleston District uses Charleston County and Georgetown Mosquito Control Divisions to control mosquitoes at the Charleston Harbor and Intra-Coastal Waterways dredged material sites. Charleston County provides mosquito control at the Charleston Harbor 1600-acre dredged material site. According to Mr. Martin Hyatt (PC, 26), Charleston County Mosquito Control Divisions, the Division inspects the sites after every rainfall, taking dipper counts and observing larvae-ball formations by helicopter. Primary control is larvicide application, methoprene on sand from fixed-wing aircraft or combination of methoprene and *B.t.i.* applied by helicopter. If the larvicide applications are unsuccessful for control of mosquito breeding (generally due to weather preventing aerial applications) they will apply adulticides (either Naled or Malathion). The Charleston District conducts ditching and water management for dredged material management purposes only, according to Mr. Norman Moebs (PC, 24). A summary sheet and some contract documents for the Charleston District sites are provided in Appendix B.

3.5 Savannah District

The District contracts with Chatham and Glynn Counties for mosquito control. There are no large dredged material management facilities in the District. Chatham County (PC, 28) performs surveillance once a week from helicopters to check for larvae. They apply the larvicide liquid methoprene on sand from fixed-wing aircraft. Experience with oils and biological controls have not proven effective. Glynn County applies the adulticide Naled in liquid form from helicopters (PC, 29). A contract document for Andrews Island Disposal Area was provided by Mr. Walt Lanier of the Savannah District (PC,27). A summary sheet and some contract documents for Savannah District sites are provided in Appendix B.

4.0 PESTICIDES FOR MOSQUITO CONTROL

4.1 Approved Pesticides

The Norfolk District wants to examine the possibility of adding pesticides to their IPM Program. There are only a limited number of classes of pesticides that have been approved by EPA for Mosquito Control. Within those classifications are numerous formulation and products. The formulations have restrictions on use, habitats, concentrations, applications rates, etc. Table 2 presents the EPA classes of pesticides, general restrictions when applied based on label directions, and Virginia restrictions. The restrictions and cautions by EPA and Virginia are comparable, however, some risks are rated higher on one than the other, as seen in Table 2. Appendix C contains the Virginia West Nile Virus Plan 2003, with Attachment 4.C “Pesticides Registered in Virginia Commonly Used to Control Mosquitoes”. Appendix D (provided electronically) contains a full electronic file of all pesticide formulations (with trade names) registered in Virginia for Mosquito Control.

4.2 Pesticides Used at Corps Sites

Many of the EPA-approved pesticides are currently used in other Corps Districts or by mosquito control authorities contracted by them. Some may be restricted at CIDMMA due to the aquatic environment and potential threat to invertebrates, fish, or bird populations. Table 3 presents a summary of pesticides by Mosquito Control Authority servicing the mid-Atlantic Corps Districts. Three examples of pesticides used elsewhere that would likely be either prohibited at CIDMMA or create significant regulatory reviews for approval are:

- Abate - used in New Jersey, is too toxic to many aquatic life forms to attempt to adopt for use at CIDMMA.
- Malathion - used in Charleston County, while safe, the public relations around this pesticide makes approval difficult.
- Biomist - used by Portsmouth in their fogging trucks, would be risky to fish and aquatic invertebrates.

Suggestions for additional pesticides that show potential for use at CIDMMA are discussed in Section 6.1.

Table 2 - EPA Approved Pesticides for Mosquito Control

Pesticide Classes	Active Ingredients	Some Popular Product Names	EPA Considerations for Coastal Environments[1]	Registered for is in VA Aquatic Environments[2]
LARVICIDES				
Organophosphates	Temephos	Abate	Low risk to birds and terrestrial species; higher risk to non-target species and toxic to aquatic invertebrates	Highly toxic to some birds, fish, freshwater insects and aquatic invertebrates
Bacteriological	*B.T.I. - Bacillus thuringiensis israelensis*	Aquabac, Teknar, Vectobac, LarvX	Does not pose risk to wildlife, non-target species or the environment	Not toxic to birds, mammals or fish; practically non-toxic to amphibians
	B.s. - Bacillus sphaericus	VectoLex CG, VectoLex WDG	Does not pose risk to wildlife, non-target species or the environment	Not toxic mammals or other animal groups; toxicity to other arthropods is unavailable
Methoprene	Methoprene	Altosid	Toxicity to fish and birds is low, non-toxic to bees; breaks down quickly in water and soil; won't leach into groundwater, minimal acute and chronic risk to freshwater fish, invertebrates and estuarine species	Slight to moderate toxicity to birds, fish, and crustaceans; will not harm aquatic amphibians and some aquatic insects
Oils	Petroleum & Mineral	Golden Bear & Bonide	Potentially toxic to fish, amphibians, and other aquatic organisms	May affect non-target aquatic organisms; use on water in sensitive environments should be avoided
Surface Films	Monomolecular Films	Anique MMF, Arosurf MSF	Somewhat restricted to avoid un-targeted species	Ineffective in areas of high winds & heavy aquatic vegetation; can harm small aquatic arthropods
Diflubenzuron	Dimilin		<u>Severely restricted</u>	<u>Not Registered</u>
ADULTICIDES				
Organophosphates	Malathion		Low toxicity to birds and mammals; degrades rapidly in the environment	Moderately toxic to birds; wide range of toxicities to different fish species; highly toxic to amphibians and aquatic invertebrates
	Naled (Dibrom)	Trumpet EC	Low toxicity to fish and birds; potential for chronic risks to freshwater invertebrates; breaks down rapidly in soil and water	Moderately toxic to humans & other mammals, moderately to highly toxic to birds, fish and aquatic invertebrates
Pyrethroids	Permethrin	Biomist	Toxic to fish and aquatic invertebrates; breaks down rapidly in the environment	Highly toxic to fish and aquatic invertebrates; practically non-toxic to birds; low mammalian toxicity; <u>some restrictions of use to near open water</u>
	Resmethrin	Scourge	<u>"Restricted Use Pesticide"</u> Very toxic to fish and aquatic invertebrates	Very toxic to fish and aquatic invertebrates; practically non-toxic to birds; low mammalian toxicity. <u>Should not be applied where surface water is present</u>
	Sumithrin	Anvil 10+10	Toxic to fish and aquatic invertebrates; breaks down rapidly in the environment	Very highly toxic to fish; moderately toxic to aquatic invertebrates. <u>Should not be applied where surface water is present</u>

1 – EPA http://www.epa.gov
2 – Virginia West Nile Virus Plan, Attachment A.3

Table 3 - Pesticides Currently Listed in Mosquito Control Programs for Government Owned Dredged Material Disposal Areas in the Mid-Atlantic Coastal Region

State of New Jersey			State of Maryland			Brunswick County NC			Charleston County SC			Chatham County GA			Glynn County GA		
Pesticide	**Form**	**Method**	**Pesticide**	**Form**	**Method**	**Pesticide**	**Form**	**Method**	**Pesticide**	**Form**	**Method**	**Pesticide**	**Form**	**Method**	**Pesticide**	**Form**	**Method**
LARVICIDES																	
Abate 4E			*None on HMI & Poplar*			*B.t.i.*	*Granular*	*Ground or Helicopter*	*Methoprene*	*Liquid on Sand*	*Fixed-wing*	*Methoprene*	*Liquid on Sand*	*Fixed-wing*			
Abate 2G	Flowable conc. or granules	Aerial	Methoprene	Liquid	Fixed-wing	Altosid			*Combo - B.t.i. & Methoprene*	*Liquid on Sand*	*Helicopter*	Oils					
Abate 5G			Methoprene XRG	Granular	Helicopter												
Altosid SR10																	
B.T.I.																	
Actual Use 2002, *Abate 2BG, Temephos 2%*		*Fixed-wing*															
ADULTICIDES																	
Soybean Oil			*Trumpet EC*	*Liquid*	*Fixed-wing*	None			*Malathion*	*Liquid*	*Fixed-wing*				*Naled*	*Liquid*	*Helicopter*
Resmethrin / PBO									*Naled / Trumpet*	*Liquid*	*Fixed-wing*						
Malathion ULV																	
Malathion LV																	

Italicized indicates dominant pesticide used

5.0 CIDMMA and Local Programs

CIDMMA is in Portsmouth, Virginia at the north end of the peninsula above the Western Branch of the Elizabeth River. Also, in that immediate area are a Naval Fuel Terminal, Coast Guard Station, City of Portsmouth Landfill, Residential Community, and High School. Figure 3 shows these general areas. The mosquito program at CIDMMA cannot be examined without also reviewing the management strategies used by surrounding areas.

Figure 3 CIDMMA and Surrounding Areas

5.1 CIDMMA Mosquito Control Program

In Virginia, mosquito control activities are the responsibility of the jurisdiction in which they are required. Section 32.1-187 of the Code of Virginia (1950), as amended, provides that counties, cities, and towns may create mosquito control districts. Within the Norfolk District geographic boundaries, the mosquito control programs are more fragmented than within any other Corps district studied. In all other Corps Districts, the local agencies take very strong roles and are willing to contract with the Corps to perform all aspects of mosquito control at dredged material placement sites. These services run the full gamut from surveillance, to ditching for water management, to pesticide applications and interagency and public communication, and education. Based on discussions with numerous mosquito managers inside and outside the Norfolk District (PC, 9,10,11,16,17), these types of integrated services have not been and are not available to the Norfolk District with either governmental agencies or private contractors. Consequently, the Norfolk District has undertaken a variety of components of IPM over the years with differing degrees of mosquito control. At present there is a somewhat disjointed program in place. Table 4 presents the activities and the parties currently responsible for the mosquito control activities.

Table 4 - Current Mosquito Program at CIDMMA

Activities	Corps Personnel	Portsmouth City	Corps Contractor (York Co.)	Corps Private Contractor	Air Force
Public Communication	✓	✓			
Interagency Communication	✓	✓	✓		✓
Larvae Surveillance	✓		✓		
Adult Surveillance		✓			
Water Management	✓				
Larvicides (hand applied: *B.t.i.* dunks)	✓				
Larvicides (Fixed-wing: *B.t.i.* Granules)				✓	
Adulticides (Fixed-wing: Naled)					✓
Adulticides (Truck Fogging: Biomist (Permethrin/Piperonyl Butoxide) and Anvil (Sumithrin/Piperonyl Butoxide)). **** Just offsite on Southern Perimeter*****)**		✓			

To put in context the IPM components in use, the dynamic of the dredged material management must be described. Often overshadowed during mosquito events, the purpose of the disposal area is to contain, consolidate and recover dredged material. An integral part of the operations is the dewatering of the dredged material (a slurry of mud, silts, clays, sand, and water). Dewatering is accomplished by allowing the heavier constituents to settle out and returning the water fraction to the James River. The system is designed for dredged material to be placed in one of three cells to settle and dry for a few years while the coarse material is recovered for reuse.

During the drying period, the dredged material transforms from a thick soupy mud state where there is a distinct mud water interface. The cells are managed to drain the water from the cells over spillway weirs to accelerate the dewatering. As the material dries and the free water is drained, cracks form in the muds and deepen as the drying and draining progresses. Additionally, ditching is used to advance the dewatering and to drain isolated pools (PC,14). The District purchased a track-hoe and ditcher in 2003 to more aggressively dewater the cells of both dredge water and rainwater. It is estimated that the District will be able to make longitudinal ditches throughout the crack-forming cells multiple times during the mosquito season. This will enhance drainage during rainfall events and possibly lessen the potential for blooms during multiple rain events in a single week.

Again, the mosquito breeding and behavior must be understood to determine the IPM components needed at CIDMMA. This breeding cycle description is condensed and abstracted from the Craney Island report (Rindfleisch, 1995). Based on discussion with the report author and the operations staff at CIDMMA (PC, 14,16,17), the mechanisms described herein are representative of current conditions at CIDMMA. For more detailed information, that report should be reviewed. When it rains, stormwater accumulates in the cracks and ditches at CIDMMA. The Greater and Lesser Saltwater mosquitoes *(Ochlerotatus sollicitans and Ochlerotatus taeniorhynchus, formerly named Aedes sollicitans and taeniorhynchus)* readily breed in the cracks. If water remains in the cracks for a period of 10 days adult mosquitoes emerge. Dye studies in at CIDMMA indicate that the water moves at a rate of approximately one foot per second, providing sufficient flow to drain rainfall from cells within seven days. However, water can be trapped in isolated low pockets resulting in saltwater mosquito development inside the cells. After mating, the female mosquitoes search for a blood meal, usually from birds. The mosquitoes may drift on evening winds into neighboring residential areas. The intention of the CIDMMA Program is to control the mosquito breeding primarily with water management and larviciding.

5.1.1 Public Communication

The Norfolk District Public Affairs Office issues News Releases on an as needed basis. The City of Portsmouth releases weekly information on their website “The Buzz” regarding mosquito status and control activities within Portsmouth to include their activities at CIDMMA (http://www.portsmouth.va.us/publicworks/thebuzz/).

5.1.2 Interagency Communication

There are monthly meetings of the "Portsmouth Mosquito Control Task Force" consisting of a Portsmouth City Councilman, Portsmouth Director of Mosquito Control, Portsmouth Director of Public Works, a Navy representative, a Norfolk District representative, a Coast Guard representative, and a citizen group representative. This is an informal working group, operating without a memorandum of understanding or formal funding commitments. There is periodic coordination with the Air Force with regard to the aerial adulticide spraying.

5.1.3 Larvae Surveillance

Currently Norfolk District site operators at CIDMMA inspect and periodically sample for larvae and dip samples from disposal cell areas and intermittent storm water pools outside the cells (PC, 14).

5.1.4 Adult Surveillance

Currently the adult surveillance is being conducted by the City of Portsmouth. Portsmouth reports the results to the Norfolk District and the public (PC, 18).

5.1.5 Water Management

The District operators are currently aggressively managing the free water to ensure a positive flow within the placement cells and over the weirs (PC, 14). Past dye studies indicate a water flow rate of approximately 1 foot per second is maintained. New equipment (tracked and amphibious vehicles) will provide for ditching and drainage to connect isolated stagnant pools and improve dewatering rates. While there are large open water areas within active cells, as long as the water is flowing, larva development can be minimized. Operators re-grade areas outside the cells to eliminate transitory stormwater pools. Present and past sites operators and the York County officials believe that the level of aggressiveness in the current water management within the cells is adequate for this mosquito control component. (PC, 14, 16, 17). Furthermore, they believe coupling improved larva surveillance, water management, and targeted hand application of *B.t.i.* by Norfolk District site operators can provide effective mosquito control.

5.1.6 Biological Controls

Currently, Purple Martins are the only introduced biological control at CIDMMA (PC10, 11).

5.1.7 Larvicides

The District site operators apply *B.t.i.* dunks by hand when larvae is encountered within the cells, in known problem areas, and outside the cells in transitory storm water pools. This is the only pesticide that can be applied without a license (PC, 14). A yet unused contract for fixed-wing application of *B.t.i.* Granules provides a means for impromptu large aerial application of larvicide in the event of a bloom in a cell (PC, 9).

5.1.8 Adulticides

The Air Force applies the adulticide Naled in liquid form by fixed-wing aircraft (PC, 16,17). The flights are pre-scheduled three times a mosquito season based on tidal charts and mosquito breeding habits. The flights are made on an “as available” basis. While the Tidewater area has one of the highest priorities for mosquito flights, the aircraft has been diverted to other DOD priorities in the past few years with flights made once in 2003 and twice in 2002. The Norfolk District pays only for the purchase of the pesticides. This activity provides an additional tool with manageable risks at reasonable cost to the Norfolk District.

5.2 City of Portsmouth Program

The City of Portsmouth provides mosquito control in the City areas south of CIDMMA (the community of Churchland and the city landfill). In the proximity of the landfill are ditches and creeks leading into the residential areas to the south. These areas are breeding grounds for a variety of mosquitoes. There are also numerous ditches, creeks and storm water control features within the residential areas that are prone to mosquito breeding. The City program was described on the website and by Mr. George Wojcik, Mosquito Control Program, City of Portsmouth (PC, 18) according to the IPM components, as follows:

5.2.1 Public Communication

The City of Portsmouth provides a web-based weekly status report "The Buzz" at http://www.portsmouth.va.us/publicworks/thebuzz/. The weekly reports give a ranking of 1 to 10, but the basis for that ranking is not clearly defined on the website. The site reports mosquito counts, mosquito activity areas based on adult traps, and the number of community calls / complaints. The site forecasts pesticide applications by the City fogging truck and Air Force spray plane.

5.2.2 Interagency Communication

The City of Portsmouth participates in the monthly Task Force meetings.
Source Control: Source reduction efforts include property inspections to eliminate containers breeding mosquitoes in citizens' yards.

5.2.3 Water Management

Water management efforts are limited to maintaining existing ditches and storm water structures.

5.2.4 Surveillance

There are adult traps placed in the peninsula both on public and federal lands. (The WN positives were reported to the CDC and are shown in Figure 1). It s not clear if the City performs larvicide surveillance.

5.4.5 Biological Controls

There are no active biological controls in place at this time, any areas that could support fish were stocked many year ago.

5.2.6 Larvicide Application

Altosid, *B.t.i., B.s.,* and surface oils are applied adjacent Craney Island in ditches, low areas, and storm drain systems at label rates as conditions dictate.

5.2.7 Adulticide Application

Fog truck application many times each year within the City landfill area and residential communities. The primary pesticides used are Biomist (Permethrin/Piperonyl Butoxide) and Anvil (Sumithrin/Piperonyl Butoxide) applied at a rate of 0.5 oz/acre to 1 oz/acre as conditions dictate. The city does not currently apply any pesticides directly to Federal Lands.

5.3 Naval Fuel Terminal Program

The Naval Fuel Terminal is on the southeast edge of CIDMMA. It has heavy vegetation, marsh lands, and pollution control features that hold stormwater. *Ochlerotatus sollicitans, Ochlerotatus taeniorhynchus, Aedes vexans and Culex salinarius* breed heavily and persistently in this area according to the recent City of Portsmouth surveys (Portsmouth, 2004) and the 1995 Rindfleisch report (Rindfleisch, 1995). After rainfall events the breeding becomes explosive. Currently, there is no known formal mosquito control program for the Navy Fuel Terminal, according to Norfolk District (PC, 9, 10) and York County (PC, 16) personnel. This has not been confirmed with the Navy.

5.4 Coast Guard Station

Farther to the southeast of the Coast Guard Station there is an impounded wetland marsh, near a protected historic resource. This marsh produces large numbers of Saltwater Marsh mosquitoes *(Ochlerotatus sollicitans and Ochlerotatus taeniorhynchus)* (Portsmouth, 2004 and Rindfleisch, 1995). Currently, there is no known formal mosquito control program at the Coast Guard Station (PC,10,16). This has not been confirmed with the Coast Guard.

6.0 CONSIDERATIONS FOR PESTICIDES, HABITATS & ENDANGERED SPECIES, AND PHRAGMITES AT CIDMMA

6.1 Potential for adding Pesticides to the CIDMMA IPM Program

Although, the water management, hand larvicide application, fixed-wing larvicide contract, and Air Force adulticiding at CIDMMA can provide a complete and balanced approach to mosquito control, there are two pesticides the Norfolk District may consider adding to their pesticide program. The only pesticides that are routinely acceptable in aquatic environment that the District should consider adding to the CIDMMA arsenal of pesticides are the larvicides *Bacillus sphaericus (B.s.)* and Methoprene (Altosid).

6.1.1 *Bacillus sphaericus* (*B.s.*)

B.s. compliments the bacteriological agent *B.t.i.,* currently used at CIDMMA. *B.t.i.* is not very effective on the *Culex* species (the primary WN vector), whereas, *B.s.* is highly effective against species in the *Culex* genus, but is not effective against Asian tiger mosquitoes and several other species of *Aedes* mosquitoes. *B.s.* works very well in polluted water, where it may be self-perpetuating (VA, 2003).

6.1.2 Methoprene

Biopesticide larvicides contain an insect growth regulator called methoprene and are sold under the trade name Altosid. Methoprene is an insect hormone mimic that prevents immature mosquitoes from developing into adults. Altosid products are labeled for use in a wide variety of natural and artificial aquatic habitats and are effective for use in salt marshes. Altosid is relatively target specific and will not harm many aquatic species such as amphibians or aquatic insects having incomplete metamorphosis (e.g., water bugs, damselflies, and dragonflies). However, it may be slightly to moderately toxic to some fish species and is toxic to crustaceans such as shrimp or crab species or aquatic insects with complete metamorphosis (e.g., flies, beetles). Altosid may be somewhat toxic to birds that consume granules that land on dry ground (VA, 2003).

6.1.3 Chemical Safety

Both larvicides are considered to be safe in coastal environments by EPA and Virginia if label directions are followed. Appendix E contains a link to the Maryland website contain Material Safety Data Sheets for all popular Mosquito Control Chemicals. It also contains MSDA sheets for VectoLex (product name for *B.s.*)and Altosid (product name for Methoprene).

Both pesticides will require distribution by a licensed applicator. *B.s.* could be applied by fixed-wing or helicopter at CIDMMA, similar to *B.t.i.* Methoprene can be applied by fixed-wing or helicopter depending on the formulation (sand, granular or liquid). The sand option may provide better control compared to the liquid in keeping the product within the cells. The sand option may also eliminate the concern for bird consuming granules on dry land.

Both pesticides are very expensive, making cost-effective application difficult. The mosquitoes breed in cracks which make up less than 10% of the land space within the dredged cell. Aerial application will naturally distribute 90% to ineffective locations.

The Norfolk District will have to determine the environmental risks and cost effectiveness of adding these pesticides.

6.2 Protected Habitats and Endangered and Listed Species

Dredged material management areas are man-made environments, often found near sensitive or protected natural environments. As such, all activities within their boundaries and local vicinities are suspect when considering the potential for environmental impacts. Mosquito control activities at CIDMMA are no exception. Prior to participating in mosquito control efforts at CIDMMA, the Air Force required that the Norfolk District file an Environmental Assessment (Rindfleisch, Jim, undated) for mosquito control operations on CIDMMA and the nearby federal lands (Navy Fuel Terminal and Coast Guard Station). To our knowledge, it is the only Corps controlled dredged material management site on the mid-Atlantic coast to have a formal EA on file. It has been reported by the Brunswick County representative (PC, 23) that the Military Ocean Terminal, Sunny Point, North Carolina has an EA. Attempts to acquire a copy of that document from Wilmington District and Sunny Point have been unsuccessful.

The CIDMMA EA reviewed the habitats and threatened and endangered species in the Federal project near CIDMMA with respect to mosquito control activities. The assessment covered physical, mechanical, biological, and chemical methods proposed for mosquito control. The assessment incorporates many of the EPA/CDC Integrated Pest Management (IPM) components. It defines a comprehensive and integrated program that is flexible to changes. The EA presents responses to many of the Reviewing Agencies' concerns regarding T&E species, other habitat concerns, and health and safety issues.

According to the Norfolk District and the EA on file, the endangered and threatened species of concern at CIDMMA are: the piping plover (*Charadrius melodus*), the Least Tern (*Sterna antillarum*), and several other known species in the lower James River watershed. In the EA, the reviewing agency for the most part expressed concerns about prey base of the endangered species rather than direct affect on the species or habitat by the mosquito controls. The agencies concluded that "the proposed treatment of Naled and *B.t.i.* should not significantly impact wildlife and non-target organisms due to these material's target specificity, mode of action, low persistence, rapid biodegradability, and limited numbers of applications."

To consider adding pesticides for use at CIDMMA, EPA and Commonwealth of Virginia agencies were queried to determine if there were "approved lists" for pesticides for coastal areas. The answer was that there was no specific guidance regarding pesticides in coastal areas. However, EPA presents discussions on their website (http://www.epa.gov) about general pesticide classes and restrictions that were summarized in Table 2, Section 4. The VA Department of Health (VA, 2003) also presents a discussion and guidance of approved pesticides in the same classes. These chemicals are also summarized in Table 2. The representatives at the Virginia Department of Game and Inland Fisheries stated that they perform reviews of chemical application programs on a case-by-case basis (PC, 30).

There are two chemicals that may be considered for addition to the CIDMMA Mosquito Control Program: *Bacillus sphaericus* and methoprene. Methoprene is a mainstay among the pesticides used in mosquito control districts queried along the Middle Atlantic Coast (Table 3). Methoprene ise the pesticides most popular among Corps District contractors for mosquito control at large dredged material management areas. *Bacillus sphaericus* is a newer biological larvacide similar to *B.t.i.* and is emerging as a likely alternative in some situations. We anticipate that the state and Federal regulatory agencies will have little opposition to adding *Bacillus sphaericus* and methoprene to the CIDMMA mosquito control program (PC, 16).

In the years since the filing of the EA, the mosquito control community (operators, applicators, and regulatory agencies) has further studied Naled, *B.t.i.*, *B.s.*, and methoprene. They remain among the most frequently used mosquito control chemicals in the United States. No new chemicals have emerged to replace them. Meanwhile, the public health concerns regarding West Nile Virus and Equine Encephalitis has increased the need for more effective and species targeted mosquito control programs. Expanding the CIDMMA program to add *Bacillus sphaericus* and methoprene would potentially improve resistance management by being able to rotate larvicides being applied.

Based upon our review, and due to the comprehensiveness and flexibility of the original EA, a major re-write should not be required. Updating the EA would require submission of a letter to the original reviewing agencies requesting the addition of *Bacillus sphaericus* and methoprene to the CIDMMA program. A consequence of adding the two would be to open the entire EA for public review and comment, but in view of the popularity of the suggested larvicides in coastal programs, significant controversy is not anticipated. A mosquito control professional should prepare the initial draft letter of submittal to the regulatory and review agencies for the District's consideration.

6.3 Phragmites Control

Vegetation control at dredged material management areas presents a challenge, especially at sites like CIDMMA where the material is being recovered and used beneficially. Certain stages of dredged material management create optimum habitats for the nuisance species *Phragmites* to grow and to foster mosquito-breeding opportunities. Conversely, the absence of vegetation assists in mosquito control by increasing water temperature, increasing wave action, and increasing water turbidity.

There are a few benefits described by operators. *Phragmites* actually enhances the filtering of the dredged material slurry during the active filling stage of a cell by holding the fine-grained material (PC, 5, 22, 23). Also, during the ditching and draining stage, *Phragmites* tends to grow and dewater the dredged material. The dewatering benefits can quickly be offset in terms of mosquito control by causing quiescent water, providing shelter to mosquito larvae habitats, and providing resting areas for adult mosquitoes. *Phragmites* is in an optimum growth spurt at the time when mosquitoes are breeding. Vegetation control during this period is difficult due to the size of the dredged material cells and the trafficability within the cells.

Some of the common control methods used for *Phragmites* control include:

- Water Level Management

- Scraping
- Mowing
- Burning
- Herbicide Application
- Composting of scraped/mowed *Phragmites*

A survey of activities at Corps of Engineers Districts for *Phragmites* control reveal a wide diversity regarding the perception of the problem and the actions taken (Table 5) (PC, 21 through 29). These actions range from no problem, to a problem and no action, to very aggressive alternate actions.

Table 5 - Phragmites in Mosquito Control Efforts at Corps Districts

Location/ Organization	Status	Controls
PHILADELPHIA		
District **New Jersey**	Some Infestation	The 1986 Scope of Work recommends mechanical removal and pesticide application to vegetation both prior to dredge material additions and after material deposition. It is unclear whether NJ follows the 1986 scope, invoices don't indicate vegetation control being implemented.
BALTIMORE		
Maryland Env. Svc.	<u>Hart Miller Island</u>: Infested <u>Poplar Island:</u> Not yet a problem.	<u>Hart Miller:</u> 1.) Spray with Rodeo™ in the fall when all other vegetation is dormant, 2.) burn the following early spring to reduce mat, and 3.) revegetate with a wetland seed mix to provide alternate cover. <u>Poplar:</u> *Phragmites* not yet established. Spray as observed in order for it not to go to seed.
WILMINGTON		
Brunswick Co.	Eagle Island: Some infestation	1.) Keep 2 feet of water in active cells during filling; this impedes the growth of *Phragmites.* 2.) Trafficable dry cells are scraped and the *Phragmites* is burned or composted
CHARLESTON		
District		No mention of vegetation control in Mosquito Control Contract Scopes.
Charleston Co.	Not a problem yet.	No Action
SAVANNAH		
District		No mention of vegetation control in Glynn Co. Mosquito Control Contract Scope.
Chatham Co.	*Phragmites* chokes some areas, making it impossible to perform larvae surveillance & prohibits helicopter landings associated with mosquito control	No controls at present – this results in poor larvicide application & performance and increases the areas required for adulticide application.

CIDMMA is most similar to Hart Miller Island and Eagle Island facilities. *Phragmites* is a recognized problem for these facilities and active controls are necessary. Two actions used on inactive cells at Eagle Island and Hart Miller Island that could be applied to CIDMMA are: 1.)

application of herbicides at appropriate times in the growth cycle and 2.) mowing, burning, and scraping to reduce seed spread. There are emerging methods for applying herbicides that can reduce the amount of chemicals required and reduce the air spray carryover into sensitive environments (Lee, 2000). These include the use of specialized equipment for wiping with herbicides. Appendix F contains the Engineer Research and Development Center (ERDC) Technical Note C-20 “Implementation Guidance for the Control of Undesirable Vegetation on Dredged Material,” describing the wiping technique. Other techniques for control such as water management by flooding and reseeding to provide cover material are incompatible with the material reuse goals at CIDMMA.

7.0 RECOMMENDED PLAN OF ACTION

A recommended Plan of Action (POA) has been developed based on evaluation of the IPM components at CIDMMA and specific recommendations for revising or adding to those activities. The following POA is organized according to the principles of IPM. For each IPM component the status at CIDMMA is stated, any problems related to that component are delineated, and specific recommendations are made.

7.1 Interagency Communication

Status: The CIDMMA is a high profile site that presents an obvious potential source when mosquito events happen. It appears that the District's relationship with the City of Portsmouth may be characterized as contentious. The City of Portsmouth Mosquito Control web Page "The Buzz" often refers to the mosquito traps, counts and mosquito activity at the "South End of Craney Island". The exact location is not defined. Adult mosquito traps can identify species ranges, but don't necessarily identify breeding areas. Linking CIDMMA by name creates a significant problem to the Corps regardless of whether the mosquitoes originate from CIDMMA or adjacent City or other federally controlled land. Based on discussions with Norfolk District Managers, former District site managers, and local agency personnel (PC, 9,10,11,16,17) there are two types of routine interagency meetings; the Mosquito Task Force and the Tidewater Mosquito and Vector Control Council. The Task Force is the meeting of the landholders in the Portsmouth area. This is the primary formal public coordination point between the Corps and Portsmouth. The Task Force has had uneven success in integrating mosquito control programs. The Council is a monthly meeting of mosquito control commissions from the cities throughout Hampton Roads. Most Council meetings are composed of lectures on technology and products by vendors. Neither meeting forum has overcome difficulties in terms of interagency and integrated mosquito control in the region.

Problem: The boundary zone between the CIDMMA cells and the residential area appears to be a very active mosquito breeding area. The lack of a cohesive interagency plan makes mosquito control difficult and probably reduces the regional effectiveness of the programs currently in place.

Recommendation: The Norfolk District should continue to explore ways to foster better relationships and to identify mutually beneficial activities with the City of Portsmouth for active control of mosquitoes within the boundary zone.

7.2 Public Communication

Status: Public perception drives mosquito programs. If mosquitoes are biting, it doesn't really matter to the citizens whether the bite was from a Craney-bred or Churchland-bred mosquito. The public doesn't know if it is a low risk WN vector or a *Culex* species that just bit them. Reports in newspapers and on television are the dominant communication means with the public. The weekly reporting in "The Buzz" on the Portsmouth website is likely a source for the news agencies, as well as, the internet-connected public.

Problem: At present the City of Portsmouth has complete control of the news reported and updates about mosquitoes in the CIDMMA vicinity.

Recommendation: The Norfolk District should explore ways to report mosquito control activities at CIDMMA to the neighboring residential areas. This may be a weekly status of activities that the District posts on their website and directly linked with "The Buzz". If this is done it must be *updated weekly without fail*. Inconsistency is worse than no information. Another suggestion is to involve the District's Public Affairs Office (PAO) in the Task Force activities (members include the District, City of Portsmouth, Navy, Coast Guard, public representatives and any other stakeholders) in hopes of exerting more balanced views of the District's efforts and successes. Again, regularity and consistency is important with any Public Outreach. The PAO can likely develop other viable options to communicate the District's viewpoint to the public.

7.3 Larvae Surveillance

Status: Currently Corps operators at CIDMMA inspect and periodically sample placement cell areas and transitional storm water ponds outside the cells.

Problem: To optimize larvicide applications, a structured larvicide surveillance program needs to be implemented. Various entities have performed this function in the past in a somewhat inconsistent fashion with varying degrees of success. To introduce a third party (such as private contractor or university students) to conduct these activities would further fragment the program and may be less time and cost effective.

Recommendation: Since the Norfolk District's site operations staff is currently handling the larvicide surveillance function, the most efficient means would be to expand that program to be more effective with the larvaciding activities. Consistent monitoring and recording of larvae formation will optimize the locations where pesticide is applied and amounts used. Based on discussion with York County officials (PC, 16) and Bill Rawls (former Corps Manager at CIDMMA) (PC, 17), it is estimated that it would take less than 2 hours per week for the staff to perform the surveillance and hand application of *B.t.i.* dunks.

The District should have a site-specific larvicide surveillance and application program be developed by a mosquito control professional. The CIDMMA site operators should undergo re-training for evaluating surveillance results to determine effective application timing, rates, and locations. This training update would provide the operators with skills to develop a cohesive program integrating the surveillance function with the larvicide applications, water management, and public reporting. A program for documenting these findings should also be a part of the surveillance function. The information collected would feed the activities defined in the "Public Communication" component above (Section 7.2).

Status: Currently, the Navy Fuel Terminal has no Mosquito Control Program in place.

Problem: The area serves as an active mosquito-breeding habitat.

Recommendation: The District should consider additional outreach to the Navy. This outreach could include allowing Navy personnel to attend training sessions for larva surveillance and application of *B.t.i.* dunks; thereby presenting a cohesive federal program in the area.

7.4 Adult Surveillance

Status: Currently, adult surveillance is being conducted by the City of Portsmouth who reports its results to the Norfolk District and the public. The Norfolk District is focused on larvae control and has built its water management and pesticide arsenal on this basis.

Problem: While it is important to know if adult mosquitoes are leaving the CIDMMA, the District does not have a contingency plan for impromptu adulticiding during high infestation periods. The land-based and aquatic life on CIDMMA and openwater nearby make selection of an apparent safe pesticide for this situation difficult.

Recommendation: Continue the practice of periodic oversight of the City of Portsmouth adult surveillance activities and reporting. There is no apparent advantage to the Norfolk District to undertake this task at this time. The District should also review of the appropriateness of the placement and types of traps utilized within the boundaries of CIDMMA. The Virginia WNV Plan 2003 (VA, 2003) provides some guidance as to the appropriate traps based on the species present.

7.5 Water Management

Status: The CIDMMA site operators are currently aggressively managing the free water to ensure a positive flow within the cells and over the weirs. Past dye studies indicate water flow rate of approximately 1 foot per second is maintained for rainwater in inactive cells. New equipment acquired in the last year will provide for ditching and drainage to connect isolated stagnant pools and improve dewatering rates. While there are large open water areas within active cells, as long as the water is flowing and stagnant areas are opened up, larva development can be minimized. Currently, site operators re-grade areas outside the cells to eliminate transitory storm induced freshwater pools. Present and past site operators and the York County officials believe that the level of aggressiveness in the current water management within the cells is adequate for this mosquito control component. Furthermore, they believe coupling improved larva surveillance, water management and targeted hand application of *B.t.i.* by District site staff can provide effective mosquito control (PC,16, 17).

Problem: Each dredging season provides different material deposition within the placement cells. Until the mosquito season gets underway and a comprehensive surveillance program is undertaken the problem breeding areas at CIDMMA will not be delineated.

Recommendation: Implement the proposed aggressive ditching activities with the new equipment. Utilized improved larvicide surveillance activities to identify the problem areas within the cells. The site operators should target ditching activities to improve drainage/flow in problem areas.

7.6 Biological Controls

Status: Currently, Purple Martins are the only introduced biological controls at CIDMMA. Larvae-eating fish and minnows coupled with ditching efforts have proven to be very effective components of IPM at other Corps Districts.

Problem: The bird predation on mosquito provides limited effective mosquito control on a site this size.

Recommendation: The Norfolk District should explore the possibility of introducing fish, such as mosquito fish (*Gambusia affinis*) into mosquito breeding habitats to control mosquitoes. Additional biological controls may be advantageous at CIDMMA and would provide a more diversified approach to mosquito control. With the new active ditching effort, minnows and fish may become more effective than in the past. Authorization must be obtained from the Virginia Department of Game and Inland Fisheries (VDGIF) to collect and/or stock mosquito fish (Contact: Becky Wajda, Assistant Director, VDGIF Division of Wildlife Diversity; 804-367-8351) and jurisdictions having permits to use mosquito fish can obtain these fish for stocking from a hatchery operated by the York County, VA, Mosquito Control Program (contact James Rindfleisch at 757-890-3790) (VA, 2003).

7.7 Larvicides

Status: The site operators apply *B.t.i.* dunks by hand when larvae is encountered within the cells, in known problem areas, and outside the cells in transitory storm water pools. This is the only chemical that can be applied without a pesticide applicator's license.

Problem: Without a rigorous larvae surveillance program, effective application of the expensive *B.t.i*. larvicide cannot be accomplished.

Recommendation: The application of larvicides can be optimized and pesticide costs possibly reduced by implementing improved larva surveillance by the operators, as discussed previously.

Status: The Norfolk District has a contract for fixed-wing application of *B.t.i.* granules to provide for impromptu large area aerial application of larvicide in the event of a bloom in a cell.

Problem: The effectiveness of helicopter application of *B.t.i.* has not been evaluated at CIDMMA because the District has not yet used this contract.

Recommendation: This District should continue to contract for this service. It will provide a back-up means to control larvae blooms. The larvae surveillance activities (Section 7.2) can be used to evaluate the effectiveness of this component.

Status: There are two commonly used larvicides, *B.s.* and methoprene, that may complement the pesticides currently used at CIDMMA. These compounds would improve "resistance management" in the CIDMMA IPM Program, by adding different pesticides into the rotation of application. Methoprene does increase risk to some aquatic species and bird populations. Both are expensive to purchase and apply. Both products are commonly used in similar habitats in Corps Middle Atlantic Districts.

Problem: Addition of new larvicides will require amending the Environmental Assessment.

Recommendation: The Corps should evaluate the potential for adding *B.s.* and methoprene to the CIDMMA Program. The advantages, risks and costs should be assessed. The amendment to the EA would require a short submittal recommending addition of the pesticides and circulated to the original EA reviewers for approval.

7.8 Adulticides

Status: The Air Force applies the adulticide Naled, in liquid form by fixed-wing aircraft to CIDMMA and vicinity. The flights are pre-scheduled to fly three times during the mosquito season based on tidal charts and mosquito breeding habits. The flights are made on an "as available" basis. The Norfolk District and other program participants pay only for the purchase of the pesticides. This activity provides an additional tool with manageable risks at little cost to the District. This is the only adulticide activity that is covered by the EA and currently available to the District at CIDMMA.

Problem: While the Tidewater area has one of the highest priorities for mosquito flights, the Air Force aircraft is subject to diversion to other higher priority DOD missions. Consequently, flights have been reduced to once in 2003 and twice in 2002.

Recommendation: The Norfolk District should continue to provide pesticides to the Air Force for aerial application at CIDMMA up to three times a year. The adulticide component of the IPM is a proven, low cost option, even if the number of applications are reduced and not always at optimum times.

Status: Currently, the Navy Fuel Terminal (NFT) is eligible to use the Air Force flights, but the Navy does not participate in this program. The NFT has no known active mosquito control program. While they are eligible for the Air Force Program, they contribute no funding. They are incuded in the spraying effort by other participants contributing pesticides to apply to the NFT lands.

Problem: The Navy Fuel Terminal is an active mosquito breeding area. The mosquitoes emerging from this area often rest in the vegetation in the boundary areas and are caught in traps in "South Craney Island Area" and thereby are associated with the CIDMMA.

Recommendation: The Norfolk District should contact the Navy to encourage them to participate in the Air Force Spraying Program. If those attempts fail, then the Norfolk District continue to purchase additional pesticides so that the Naval Fuel Terminal can be flown as a partnering effort.

The Norfolk District has all the components of a successful Integrated Pest Management Program. These components are documented in the Environmental Assessment (Rindfleisch, undated). The components that could most improve execution of the program include:

- public and interagency communication;
- more rigorous larvae surveillance and documentation;
- consideration of additional biological controls,
- consider amending the EA to add alternate pesticides to the list at CIDMMA, and
- provide assistance to the Navy in mosquito control efforts at the fuel depot.

Most of these efforts require only minor changes and little increase in time requirements to the way the Norfolk District is currently executing the mosquito control program at CIDMMA. These small changes will yield rewards; a better documented understanding of the mosquito breeding on CIDMMA and improved mosquito control at CIDMMA.

TECHNICAL REFERENCES

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VA, 2003, "Virginia West Nile Virus Surveillance and Response Plan", http://www.vdh.state.va.us/epi/wnvsrplan/PDF%27s/Mosquito%20Control,%202003.pdf

PERSONAL COMMUNICATION REFERENCE LIST

	Person	Agency	Method: Phone	Method: Interview	Method: e-mail	Phone	Topic
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	BALTIMORE						
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	NORFOLK						
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13	Tom Szeleste	Corps of Engineers		×	×	757-441-7700	Contract Management
14	Carlos Quinones	Corps of Engineers		×		757-484-1021	Craney Island Operations
15	Denny Copperthite	Corps of Engineers	×			757-484-1021	Craney Island Operations
16	Jim Rindfleisch	York Co. Mosquito Control	×	×	×		Craney Project History
17	Bill Rawls	Retired Corps Employee		×		757-838-2127	Craney Island Operations
18	George Wojcik	City of Portsmouth	×		×		Mosquito Programs
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30	Kathy Graham	VA Dept of Game & Inland Fisheries	×			804-367-9717	Approved Pesticides
31	Marvin Lawson	VA Pesticide Office	×			804-371-6558	Approved Pesticides
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