9 Impacts of No Vector Control Activities

9.1 Introduction

The major alternative to the proposed Long-Term Plan is to have no vector control activity conducted by the County. It has been opined that there are no certain or serious risks (or relative risks) associated with mosquito-borne diseases for people living in Suffolk County. The potential impacts associated with vector control activities, such as use of pesticides or conducting water management, outweigh any benefits associated with mosquito control. In order to properly assess that contention, this section will examine two parts of the issue:

- quantifiable potential impacts from WNV, and qualitative assessments of potential risks from EEE and other mosquito-borne disease, in the absence of vector control activities
- the impact to the County's environment if no water management were conducted in its marshes

9.2 Impacts of Mosquito-borne Disease with No Vector Control

9.2.1 West Nile Virus

In Section 3, a description of the potential for infection for areas where there was no mosquito control was reported. The cogent data were:

- two percent infection rates (20,000 cases per million exposed)
- of the two percent infected, 1 in 150 would suffer from neurological illnesses (meningitis or encephalitis), a 0.013 percent illness rate (130 hospitalizations per million exposed)
- of those hospitalized, approximately one in 10 would die, a 0.0013 percent fatality rate (13 deaths per million exposed)

To determine the potential impacts to an area such as Suffolk County, the zip codes were mapped where the three conditions defining exposure (bird's positive for WNV, positive mosquito pools, and/or human cases) were recorded for 2000 to 2004. To simplify the work, it was assumed that no one in the County was exposed to the disease in 1999. All members of a zip code were assumed to have been exposed if it met any of the exposure criteria, and the degree of exposure for all "positive" zip codes was assumed to be the same. Population for the County as a whole for 2000 to 2004 was assumed to be constant, using the 2004 population generated by ESRI with the GIS zip code coverage (Figures 9-1 – 9-5).

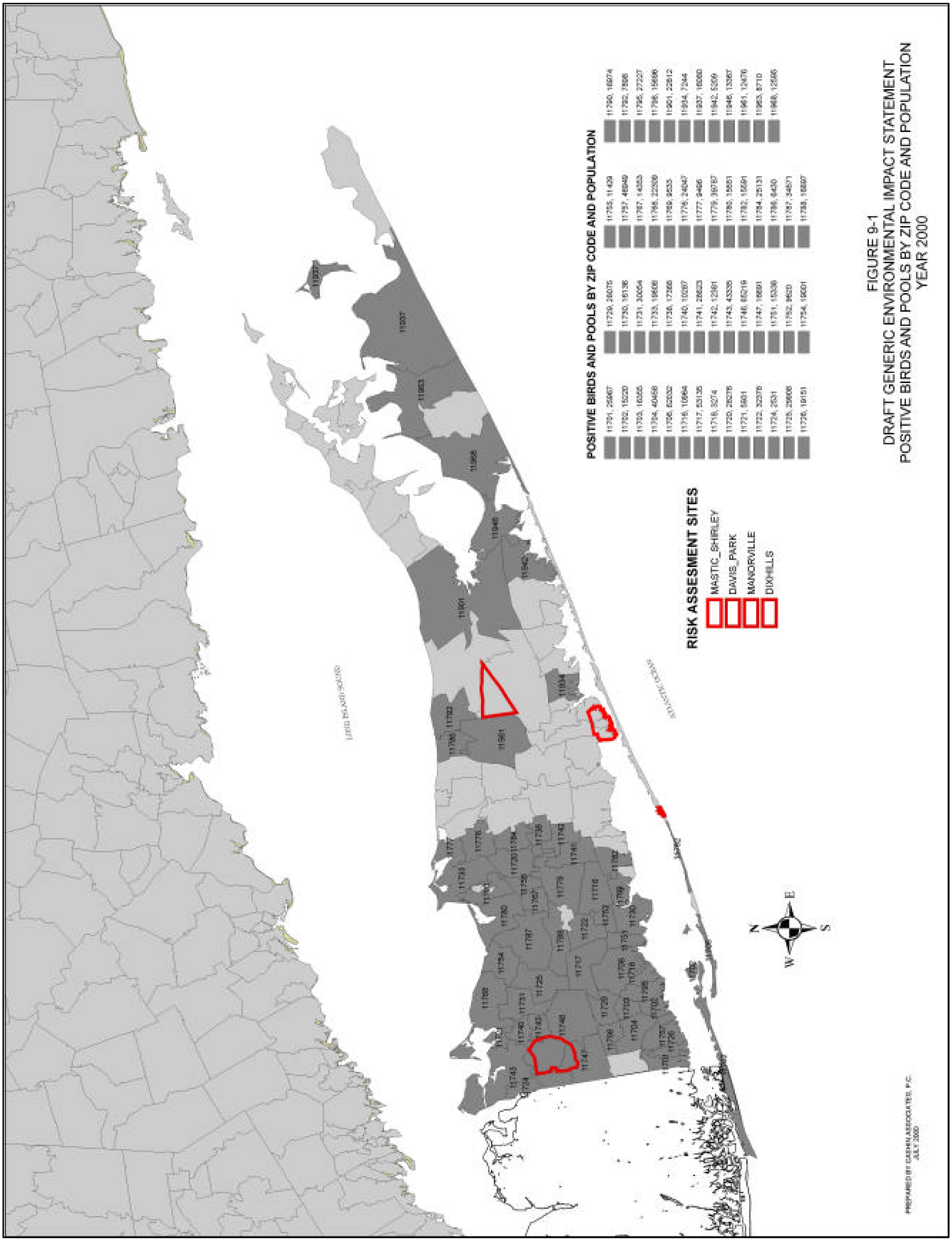


FIGURE 9-1
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
YEAR 2000

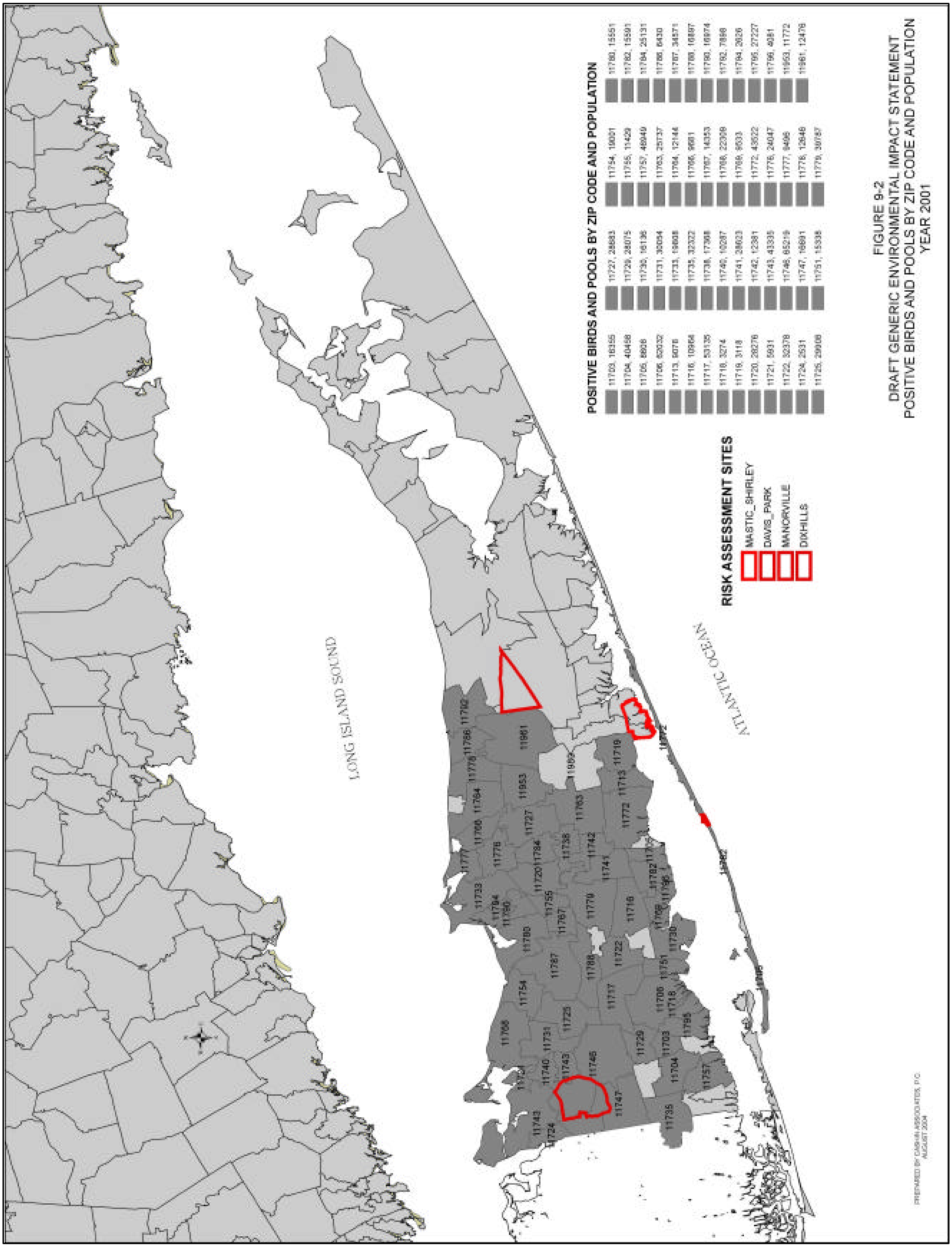
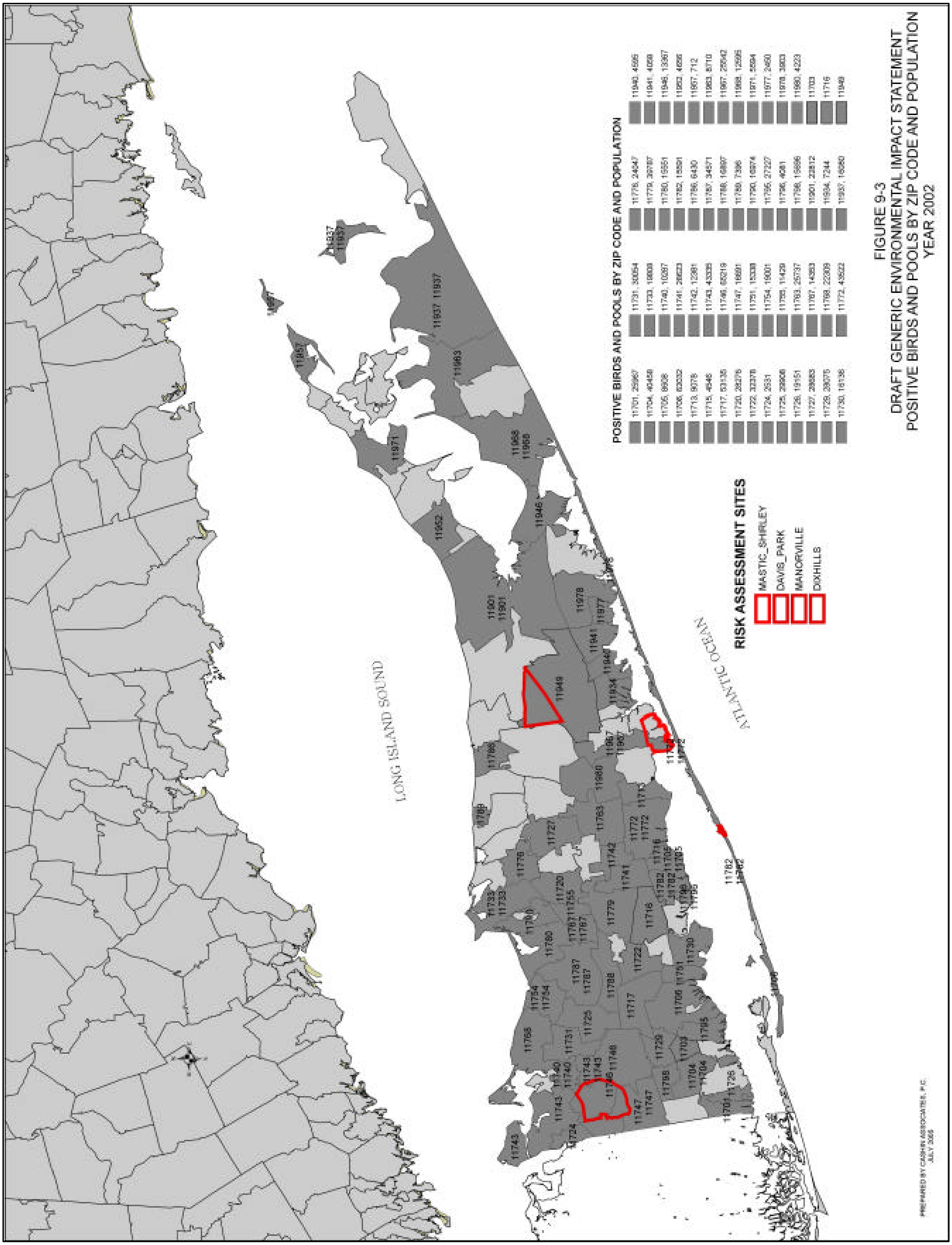


FIGURE 9-2
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
YEAR 2001


LONG ISLAND SOUND
ATLANTIC OCEAN
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
RISK ASSESSMENT SITES
MASTIC_SHIRLEY
DAVIS_PARK
MANORVILLE
DIXHILLS
FIGURE 9-3
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
YEAR 2002

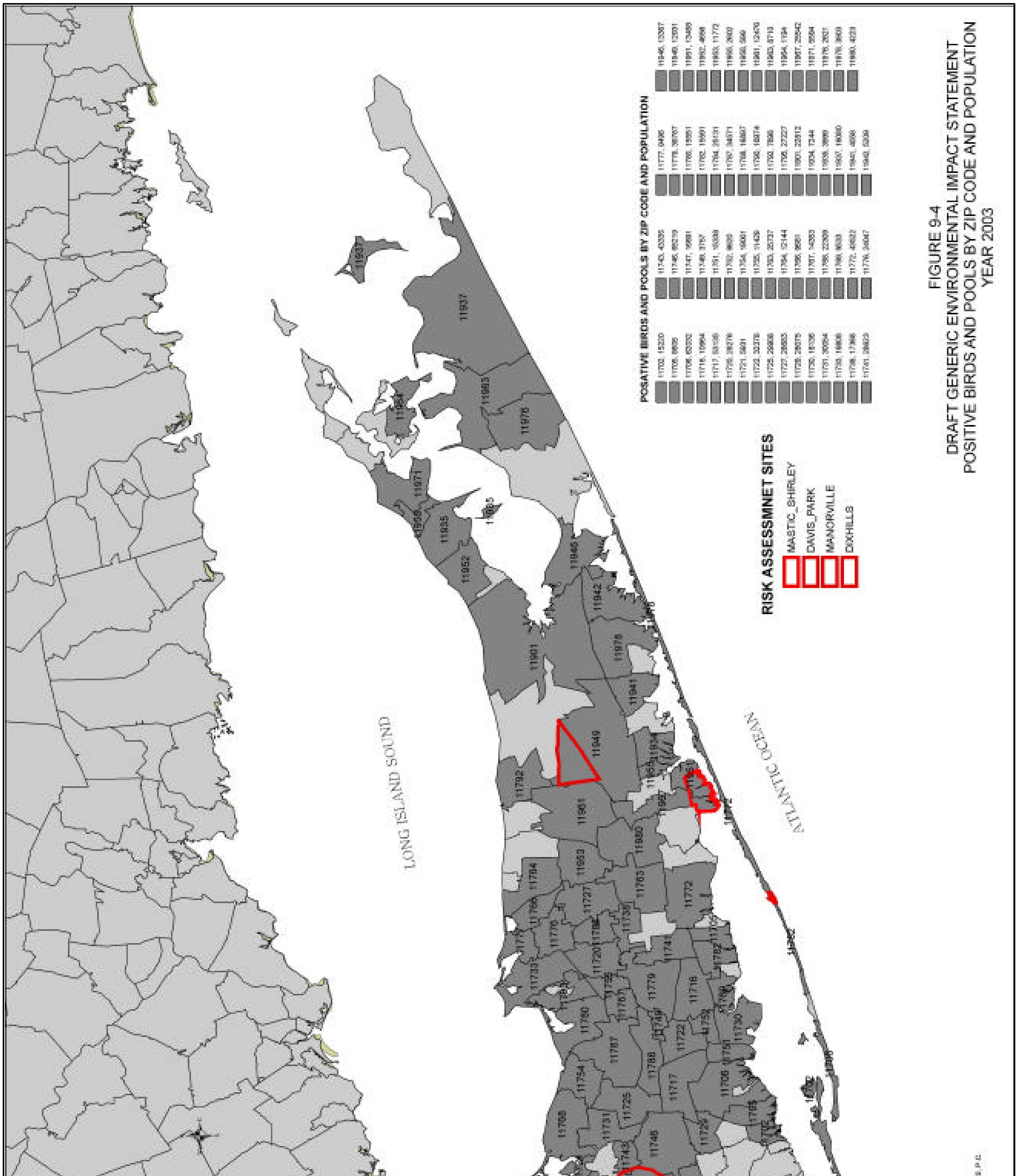


FIGURE 9-4
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
YEAR 2003

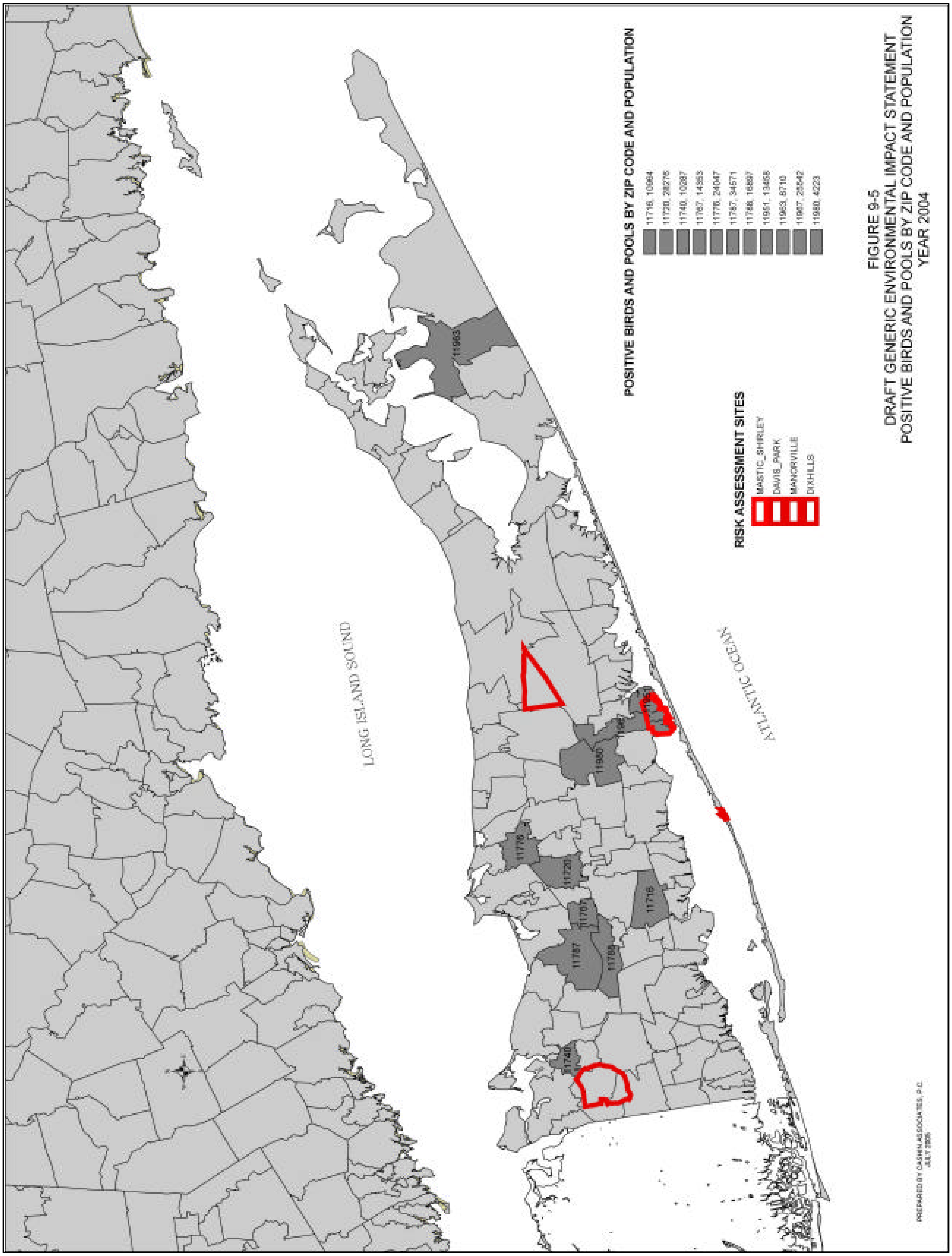


FIGURE 9-5
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
POSITIVE BIRDS AND POOLS BY ZIP CODE AND POPULATION
YEAR 2004

Similar to this evaluation, Peterson et al. (2005) evaluated health effects to people from West Nile virus. The Mostashari et al. (2001) and Loeb et al. (2005) data were used to determine infection rates, and similar assumptions regarding disease severity, drawn from CDC statistics, were cited. The overall impact on an exposed population was not quantified, but the qualitative assessment of impacts was similar to the quantitative work developed below.

The infection and disease impact model was also applied to the risk assessment areas. There, census data were used, with one exception. Davis Park was assigned an unchanging population of 2,000 (census data recorded only three people, as almost all of Davis Park is used exclusively as a summer resort). This population estimate was also used by the risk assessors, and was based on estimates that the summer population varied between 1,200 and 2,800 (J. Stoddard, Fire Island Association, personal communication, 2004).

To determine infection rates, seroconversion (and subsequent immunity from the disease) was factored in, on a County-wide basis (the percentage of the County determined to be immune from pervious years was assumed to be evenly distributed County-wide). For the outlying years, the County's population was assumed to increase at the projected LIPA population survey rate of 0.836 percent (based on 2000 to 2004 population estimates) (LIPA, 2005; LIPA, 2003). Mortality was assumed to be 831 deaths per 100,000 (the overall US mortality rate for 2003) (Hoyert et al, 2005), removing some proportion of the immune population from the County. The US mortality rate is 42 deaths per 100,000 greater than the rate of 799 deaths per 100,000 for Suffolk County reported by NYSDOH from 2000 to 2003 (LIPA, 2005), but since the data is only to be used as a rough control on increasing seroconversions, that degree of accuracy is sufficient. The mean County birth rate for 2000 to 2003 (1,393 per 100,000) was used for projected population increases post 2004, to account for additional naïve residents. The increase in population above net births over deaths (attributed to migration into the County) was assumed to have seropositive rates similar to the County as a whole.

Not all of these assumptions are strictly accurate. The degree of error is intended to be smaller than the overall magnitude of the computation, however. Table 9-1 reports the salient data from the model for the County as a whole, and Tables 9-2 to 9-5 show the results for each of the four risk assessment areas.

Table 9-1. Model of Suffolk County West Nile Virus Incidence, No Mosquito Control (based on a population of 1,482,284)

Year	Population Exposed	Hospitalizations	Deaths	Resulting Immune Percentage
2000	1,135,878	151.5	15.1	1.5
2001	1,195,260	156.9	15.7	3.1
2002	1,168,088	150.9	15.1	4.6
2003	1,227,931	156.1	15.6	6.2
2004	191,328	23.9	2.4	6.5
Totals		639	64	6.5

Table 9-2. Model of Dix Hills West Nile Virus Incidence, No Mosquito Control (based on a total population of 22,388)

Year	Population Exposed	Hospitalizations	Deaths
2000	22,388	3.0	0.3
2001	22,388	3.0	0.3
2002	22,388	2.9	0.3
2003	22,388	2.8	0.3
2004	0	0	0
Totals		12	1

Table 9-3. Model of Mastic-Shirley West Nile Virus Incidence, No Mosquito Control (based on a total population of 41,421)

Year	Population Exposed	Hospitalizations	Deaths
2000	0	0	0
2001	0	0	0
2002	25,935	3.4	0.3
2003	41,421	5.3	0.5
2004	41,421	5.2	0.5
Totals		14	1

Table 9-4. Model of Manorville West Nile Virus Incidence, No Mosquito Control (based on a total population of 2,846)

Year	Population Exposed	Hospitalizations	Deaths
2000	0	0	0
2001	0	0	0
2002	2,846	0.4	0
2003	2,846	0.4	0
2004	0	0	0
Totals		1	0

Table 9-5. Model of Davis Park West Nile Virus Incidence, No Mosquito Control (based on a total population of 2,000)

Year	Population Exposed	Hospitalizations	Deaths
2000	0	0	0
2001	2,000	0.3	0
2002	2,000	0.3	0
2003	2,000	0.3	0
2004	0	0	0
Totals		1	0

These results suggest that as many as 64 people might have died in the absence of vector control activities, assuming that mosquito transmission of WNV in the County is similar to how the disease was transmitted in Douglaston in 1999, and in Cuyahoga County and Ontario in 2002 (see Section 3). Comparisons of the levels of infection, hospitalizations, and fatalities in these areas are presented in Table 9-6 (assuming a 150 to 1 infection to hospitalization ratio for Suffolk County and Connecticut).

Table 9-6. WNV Rates (per million people exposed)

Location	Year	Infection Rate	Hospitalization Rate	Death Rate
Douglaston	1999	26,000	190	22
Connecticut	1999	0	0	0
Suffolk County	2000	1,200	0	0
Connecticut	2000	0	0.29	0
Suffolk County	2001	130*	0.84	0
Connecticut	2001	260*	1.8	0.3
Cuyahoga County	2002	19,000	100	6.4
Toronto	2002	31,000	200	0
Suffolk County	2002	1,000*	6.9	1.7
Connecticut	2002	750*	5.0	0
Suffolk County	2003	1,200*	8.1	1.6
Connecticut	2003	750*	5.0	0
Suffolk County	2004	0*	0	0
Connecticut	2004	44*	0.29	0

* = computed using a 150:1 ratio of infections to hospitalizations
all data rounded to two significant figures

The comparisons of WNV impacts in areas such as Douglaston, Cleveland (Cuyahoga County), and Toronto to areas such as Suffolk County and Connecticut show infection rates are much lower, and the more serious impacts tend also to occur at a much lower rate where organized, IPM-oriented control programs were in place.

The model for impacts in Suffolk County absent any control also shows a rising immune rate in the County. It has been suggested that perhaps long exposure to the disease, with continuing infections and resultant on-going immunity, could decrease risks to residents of the County. To test this, the model was run for the years 2005 to 2025, assuming that everyone in the County was exposed to infection each year. The model inputs and results are shown in Table 9-7. As expected, immunity rates increase with time, and the risk of death decreases. By 2025, nearly one-third of the County might be immune to the disease. However, the numbers of deaths do not change appreciably. This is due to population increases, and also the relatively small rate of increase in overall immunity. This is because the number of new naïve residents (due to births), coupled with some loss of immune people to natural mortality, and the relatively low infection rate, combine to limit the increase in immune people County-wide to approximately the increase in population each year, and result in a steady projected loss of life from the disease. That is not entirely accurate, as the number of naïve residents descreases each year somewhat, and therefore the number of infections is projected to decrease as well. But the decrease is not especially telling, and certainly does not support contentions that the County will (or has) become relatively immune to WNV. This model suggests that no mosquito control over the next 20 years could lead to 3,400 serious cases of neuro-invasive disease from WNV, with approximately 340 deaths, if all other conditions and assumptions remained constant.

Table 9-7. Long-Term WNV Effects Model Results

	Births	**Deaths**	**Migration**	**County Population**	**Immune Rate**	**Exposed**	**Naïve**	**Infected**	**Hospitalizations**	**Deaths**	**Death Rate/ 100,000**
2005	20,660	12,322	4,058	1,495,221	6.4%	1,495,221	1,400,650	28,013	186.8	18.7	1.25
2006	20,833	12,425	4,092	1,507,721	8.2%	1,507,721	1,386,304	27,726	184.8	18.5	1.23
2007	21,007	12,529	4,127	1,520,325	9.9%	1,520,325	1,372,566	27,451	183.0	18.3	1.20
2008	21,183	12,634	4,161	1,533,035	11.5%	1,533,035	1,359,422	27,188	181.3	18.1	1.18
2009	21,360	12,740	4,196	1,545,852	13.1%	1,545,852	1,346,856	26,937	179.6	18.0	1.16
2010	21,539	12,846	4,231	1,558,775	14.6%	1,558,775	1,334,854	26,697	178.0	17.8	1.14
2011	21,719	12,953	4,266	1,571,807	16.0%	1,571,807	1,323,403	26,468	176.5	17.6	1.12
2012	21,900	13,062	4,302	1,584,947	17.4%	1,584,947	1,312,488	26,250	175.0	17.5	1.10
2013	22,083	13,171	4,338	1,598,197	18.8%	1,598,197	1,302,097	26,042	173.6	17.4	1.09
2014	22,268	13,281	4,374	1,611,558	20.1%	1,611,558	1,292,216	25,844	172.3	17.2	1.07
2015	22,454	13,392	4,411	1,625,031	21.4%	1,625,031	1,282,833	25,657	171.0	17.1	1.05
2016	22,642	13,504	4,448	1,638,617	22.6%	1,638,617	1,273,937	25,479	169.9	17.0	1.04
2017	22,831	13,617	4,485	1,652,315	23.7%	1,652,315	1,265,514	25,310	168.7	16.9	1.02
2018	23,022	13,731	4,522	1,666,129	24.9%	1,666,129	1,257,555	25,151	167.7	16.8	1.01
2019	23,214	13,846	4,560	1,680,058	26.0%	1,680,058	1,250,047	25,001	166.7	16.7	0.99
2020	23,408	13,961	4,598	1,694,103	27.0%	1,694,103	1,242,981	24,860	165.7	16.6	0.98
2021	23,604	14,078	4,637	1,708,266	28.0%	1,708,266	1,236,346	24,727	164.8	16.5	0.96
2022	23,801	14,196	4,675	1,722,547	29.0%	1,722,547	1,230,131	24,603	164.0	16.4	0.95
2023	24,000	14,314	4,715	1,736,948	29.9%	1,736,948	1,224,327	24,487	163.2	16.3	0.94
2024	24,201	14,434	4,754	1,751,469	30.8%	1,751,469	1,218,924	24,378	162.5	16.3	0.93
2025	24,403	14,555	4,794	1,766,111	31.7%	1,766,111	1,213,914	24,278	161.9	16.2	0.92
2005-25					32%				3,430	343	

9.2.2 Eastern Equine Encephalitis Risks

It is not possible to determine, analytically, risks associated with EEE. It has not occurred as often as WNV, or as predictably.

However, EEE is inextricably linked with white cedar swamps and red maple swamps. This is because these areas support the amplification vector, *Cs. melanura*. As discussed in Section 7, Suffolk County does host these environments, and *Cs. melanura* is trapped at sites near or in these wetlands.

EEE has occurred commonly in New Jersey, with human cases. There it appears closely linked to the salt marsh-Atlantic white cedar swamp connection, with *Oc. sollicitans* serving as the bridge vector (Crans et al., 1986). It has occurred less commonly in Massachusetts, where it appears to be associated with inland cedar and red maple swamps, and strictly fresh water mosquitoes. It has been suggested that the frequency of disease incidence is increasing (Cashin Associates, 2005).

Suffolk County has some white cedar swamps, and more red maple swamps. It has populations of *Cs. melanura*, the amplification vector for the disease. New Jersey appears to suffer from the close association of ample *Cs. melanura* habitat in close proximity to salt marshes, home to the most efficient bridge vector of EEE, *Oc. sollicitans* (Chamberlain, 1956). Suffolk County does not have as many areas where such overlaps occur. However, there appears to be no impediment to the County having at least as many outbreaks of EEE as in Massachusetts, given similarities between red maple or white cedar swamp habitats in Massachusetts and the red maple swamps found in inland Suffolk County.

Those swamp habitats appear to allow for transmission of EEE in Massachusetts, from time to time, but not in Suffolk County. Mosquito control is certainly more widely organized in Suffolk County as compared to the fragmentary nature of municipal efforts in Massachusetts. Other ecological or geographical factors may influence the distribution of disease – but it does seem likely that the intensity of the control effort has reduced EEE incidence here, so that no human cases (and therefore, no fatalities) have ever occurred in the County.

9.2.3 Novel Disease Threats for Suffolk County

It is clear that the nature of the global economy, and changing world environment, will necessarily lead to the emergence of diseases novel to populations and ecologies (Gratz, 1999). Whether these diseases will lead to major human impacts or not is not possible to predict. It is fairly certain that a novel mosquito-borne disease will be introduced into Suffolk County in the future. For instance, on Reunion (Indian Ocean) in the austral summer 2004-2005, a novel mosquito-borne disease occurred. Over 3,000 cases of Chikungunya fever were reported. Mathematical modeling suggests that more than 200,000 people were infected, nearly one-third of the population, over the course of a single season. The widespread nature of the disease seemed to either increase its virulence, or the many infections allowed expression of more serious impacts, as this disease, which had not been thought to be fatal, apparently caused at least several deaths (WHO, 2006). Another notable aspect of this event is that the primary vector (*Ae. albopictus*, which is not yet present in Suffolk County although it has been found in Nassau County) had previously been thought to be a fairly ineffective vector of Chikungunya (Enserink, 2006). It is unlikely that any such infection rate would occur in Suffolk County, as human exposure to mosquitoes is limited by our lifestyles (primarily, air conditioning and screens) (Speilman and D'Antonio, 2001), but such a widespread outbreak over such a short period of time emphasizes the potential for infection expressed through mosquitoes (see Cashin Associates, 2005).

Candidates for novel disease introduction into Suffolk County include:

- Jamestown Canyon virus
- La Crosse virus
- Sindbis virus
- Rift Valley fever virus
- Japanese encephalitis virus
- Usutu virus

Some important characteristics of these diseases were discussed in Section 3.

WNV seems to be an important parable for the introduction of a disease in the absence of vector control. In 1999, there was near panic, as public health officials grappled with the knowledge that there was a new mosquito-borne disease affecting the city, but without good, up-to-date information on mosquito habitats and species distributions across the city. The poorly-enabled response was to adulticide wide sections of the city, without a clear understanding of whether or not risks were being reduced (or instead were possibly being increased due to pesticide exposures). In comparison, in Suffolk County, adulticide use was relatively low, and tended to be targeted to areas that appeared to have larger risks.

It has been noted by many that the expansion of WNV across the country almost always brings greater impacts for the first year an area is exposed. Some have suggested that this is due to the virus waning in strength, or in immunity achieving levels that makes infection rates lower. The modeling exercise above should make the latter explanation seem less plausible, as WNV infection rates do not seem to be high enough to cause quick "herd" immunity. In Suffolk County and Connecticut, there appears to be a more chronic level of impact, where the infection rate is more sustained (albeit, at a much lower level) (see the discussion, above). This comparison suggests that perhaps the initial high impacts from WNV in novel environments results partially because the mosquito control authorities, although forewarned, are not prepared for the magnitude of the problem. Therefore, a disastrous year one of WNV appears to be followed by a second year where it is better understood how the virus may impact the area, and what appropriate responses might be for those situations. This may lead to a rapid diminution of the problem.

These results suggest that the introduction of a novel mosquito-borne disease into an area with no mosquito control will likely result in more impacts than would be experienced in an area with an existing mosquito control program.

9.2.4 Additional Impacts from Mosquito Biting

The public welfare is directly impacted by the diseases that mosquitoes transmit, but there are a number of sub-clinical effects that result from mosquito bites, which have been discussed in

Section 3. These impacts may be decreased through a public education outreach program that emphasizes the benefits of applying personal repellants such as DEET. However, it is far from clear that compliance rates will ever be great enough to minimize these impacts for the general public. As noted earlier, the US Army has difficulty obtaining compliance rates of more than 50 percent, even when the use of repellents is expressed as a general order (Debboun and Klun, 2005). Surveys conducted in Louisiana suggested that compliance with guidance regarding mosquito risks is affected by factors other than comprehension of or awareness of scientific or technical issues. Rather, many people appeared to make decisions based on:

- inconvenience
- the "hassle factor" associated with taking precautions with resistant children
- perceptions that the problem existed elsewhere predominantly
- it is generally not a problem for themselves personally ("mosquitoes don't bite me," "I never get sick," etc.)
- racial perceptions ("it's a white disease")
- inadequate air conditioning
- outdoors as important social space ("my neighbors all sit ouut in the evening")
- confusion regarding the guidance ("Isn't repellent enough?")
- uncertainty regarding the problem ("Mosquitoes weren't this bad of a problem when I was growing up")
- any increase in risks is perceived as a failure of government control efforts, not the emergence of a new disease
- uncertainty regarding the role of personal protection is an overall mosquito management program (i.e., they are perceived of as being entirely distinct)

(Zielinski-Gutierrez, 2004)

It is unclear how many of these public perceptions apply to Suffolk County, although undoubtedly some do.

It has also been noted that infection rates for WNV could be decreased if two of three protective measures were followed by exposed populations (the three protective measures were to wear repellents, take active measures to avoid mosquitoes, and wear long sleeves and long pants) (Loeb et al., 2005).

Quality of life impacts must also be recognized. Large areas of the coastal Eastern seaboard were not well-populated prior to early efforts to control mosquitoes. This was true for the south shore of Long Island where it was noted that relief from mosquitoes due to ditching (and wetlands filling) in the 1930s directly led to suburban expansion (Glasgow, 1938). It is possible to live in areas that experience mosquito infestations. It is not an accepted part of current Suffolk County lifestyles, however.

9.3 Water Management Impacts with No Vector Control

Impacts associated with reversion – managing marshes by allowing natural processes to occur without further manipulation – were discussed in Section 7 as part of the Long-Term Plan. The County intends to use reversion as an extremely important element in its marsh management plans.

Examples where reversion would seem to be a successful management tool that were cited earlier are Crab Meadow and Hubbard Creek. In fact, a list of characteristics that seem to indicate good results from reversion were assembled:

- historical marsh health in the absence of ditch maintenance
- large tidal exchange rates, fostered by some combination of a large tidal range, a good estuarine connection, few barriers to internal water flows, and/or an extensive natural creek system
- infilling ditches from upland ends (potentially eroding at the mouths)
- relatively few people to be impacted by mosquito breeding

- killifish habitats other than ditches
- patient managers willing to allow processes to occur deliberately

However, conducting no water management means that this strategy would be employed for all marshes throughout the County. Stillman Creek was cited as an example of a marsh where reversion might not lead to good results.

A better, more appropriate example might be West Watch Hill. This marsh has not had any management since the inception of FINS in the mid-1960s. It currently is relatively degraded, with poor water quality, little wildlife or fish use of the resource, and is being invaded by *Phragmites* (see Section 5). Generally, FINS has identified degraded or degrading salt marshes as a serious management problem (Milstead et al., 2004), and appears to be considering studying other options to try and improve the quality of these habitats. Therefore, it seems likely that, for at least some County marshes, reversion is not the optimal management strategy in order to maximize environmental qualities.

Because marshes are idiosyncratic, it is difficult to universally generalize. However, it seems probable that unmanaged, natural salt marshes constitute good mosquito habitat (Chapman, 1974). Water generally collects in shallow pannes in the high marsh, and *Spartina patens* tends to grow in clumps that create a hummocky terrain (Nixon, 1982). The intent of most OMWMs is to create fish access and refuges in this general area so as to allow natural predation to control mosquito breeding (Wolfe, 1996); in natural marshes, it is far from clear that all areas of the high marsh are in close proximity to suitable, permanent fish habitat (Lathrop et al., 2000). Recent experience in Nassau County (prior to the WNVoutbreak in 1999) and historical records for Suffolk County during World War II clearly show increases in mosquito populations when marsh management is abandoned for any significant length of time. This strongly suggests that mosquito populations will increase if reversion is adopted as a County-wide management tool.

Evidence has been presented that increasing mosquito populations will lead to increased human health impacts from mosquito-borne disease. Therefore, the impact of using reversion as a means of managing the County's marshes seems to lead to increases in the risk of mosquito-borne disease, and the potential for some mixed environmental impacts, impacts that will vary widely from site to site. However, it should be noted that a policy of reversion will not lead to irreversible changes in the County's marshes; no matter what the result of no management, the changes that occur can generally be undone with more ease than almost all of the other marsh management techniques discussed in Section 7.

9.4 Summary of Impacts for the Baseline, No Vector Control Situation

The model of WNV suggests that there could be substantial human health impacts (16 deaths per year, 160 hospitalizations) if no mosquito control were conducted. No mosquito control could also mean more virulent outbreaks of EEE, due to a loss of control of presumptive bridge vectors. It is impossible to determine if other, novel diseases will have more impact in the absence of mosquito control when they are introduced into the County. However, there is evidence from analyses of WNV impacts that mosquito control, even if the control is not aimed at the specific vector of concern, may reduce disease risks (most likely through reductions in bridge vector populations). Ecological impacts of mosquito-borne disease in the County appear to be limited to a few bird species, and also appear to be waning (Section 3), and so there are not likely to be any environmental impacts from increased incidences of disease.

Experience has shown that when no water management is conducted, mosquito populations will increase. This leads to additional risks for human health and public welfare. In addition, because almost all of the County's salt marshes have been manipulated to one degree or another, it is not clear that natural processes will necessarily lead to marsh health benefits. Benign neglect for salt marshes could lead to deteriorated water quality, losses of key habitats, and expansions of invasive species such as *Phragmites* (as well as increased mosquito numbers and concurrent risks to people).

The experience of NPS in FINS is illustrative. NPS has found that the ditched marshes in the Wilderness Area are not necessarily thriving under its policy of allowing natural processes to manage them. There have been water quality problems, and general issues regarding the health of the marshes. Because of these issues, the Park Service is reevaluating its current policy, and seeking to find a means of managing the marshes that does not lead to degradation of the resource (as seems to be occurring in at least some locations).

Conducting no water management activities could lead to more detrimental effects on some marshes. Johns Neck Creek has major vector control problems, proving that the existing ditch system is not effectively reducing mosquito breeding, for example. Not implementing any water management activities will sustain mosquito breeding and further threaten the health and well-being of the surrounding residential population.

In sum, conducting no vector control activities will cause a public health risk, and could cause significant deterioration of the health of some of the County's marshes. Some marshes may thrive under this approach, however. It is clear that mosquito numbers (including species that bite people) will increase. Finally, as discussed in Section 3, impacts associated with pesticides (both to human health and to the environment) will not be eliminated if vector control activities cease.

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