4 Risk Assessment Background Information

4.1 Evaluation Management Plan Approach

4.1.1 Purpose

An evaluation management plan was crafted to allow for the preparation of a quantitative risk assessment. This would make it possible for Suffolk County to alter certain elements of the Long-Term Plan on completion of the risk assessment of the evaluation management plan, where risks were identified as being too large, or to include elements that may have been determined to have a lower risk than was anticipated.

The evaluation management plan called for IPM, based on a hierarchical approach of public education, source reduction, potential use of biocontrols, larval control, and only as a last resort, adult control. Scientific surveillance was to be the basis of information needed to make control decisions.

4.1.2. Scope

Pesticide use is the key element in terms of the impact assessment. Primarily, this is because the risks associated with pesticide use can be quantified more completely than the other two major elements of the impact analysis, mosquito-borne disease impacts, and water management impacts.

For the pesticide impact section, many of the evaluation management plan details were drawn from past and current practices. This was because maximal or past practices were generally thought to be representative bounds on future actions; the goal of the Long-Term Plan planning project was to reduce potential human and environmental impacts partly by reducing pesticide applications, and so past practices therefore appeared to represent maximal potential application scenarios. Aerial application methodologies were modified, however, as work associated with the Long-Term Plan planning project found that off-target drift could be reduced through some simple modifications in flight procedures.

The evaluation management plan was organized around the four risk assessment areas, but the general program of pesticide use was as follows:

- Larviciding: conducted to reduce adult populations of mosquitoes, by a variety of means (hand or aerial applications, including applications to catch basins as well as wetlands). The frequency of applications was determined by statistical analysis of past application rates in the study areas over the 2000 to 2003 time period.
- Non-health emergency (vector control) adulticide applications: conducted to reduce impacts to public welfare (and for a degree of disease risk reduction). The frequency of applications was assumed to be 14 times per year in Davis Park, at one week intervals using hand applications, and eight truck applications a year in Mastic-Shirley (based on maximal frequencies over the study areas).
- Health Emergency applications: conducted to reduce risk of human disease, following guidelines issued by CDC and NYSDOH. The frequency of the applications was assumed to be twice in Manorville and Mastic-Shirley, at two week intervals, and once in Dix Hills. All of these were assumed to have been applied by air.
- Garlic oil was to be evaluated, applied by sprayer in a park setting within each study area.

The application means were assumed to be those currently in use, with one exception. The Long-Term Plan process had identified modifications to aerial applications that could be implemented with little to no difficulty, and that would reduce off-target drift[1]. Therefore, because there was no chance that past practices would continue under the Long-Term Plan, the modifications were incorporated into the modeling approach.

The evaluation management plan contained other modifications from the present practices of Suffolk County. These included improved public outreach, better data management, more emphasis on tire management, more extensive monitoring (with an improved laboratory), efficacy testing for larvicide and adulticide applications, more quantitative information use in adulticide decision-making, and, perhaps most importantly, incorporation of progressive water management into the program. All of these improvements are expected to have measurable impacts on human health, public welfare, and environmental impacts associated with the Long-

[1] The explicit modification that was included in the modeling assumptions was that the helicopter would travel at a lower rate of speed (35 mph in place of 70 mph) using swath widths that were twice as wide as had been made with the faster speed. This modification turned out not to be implementable, due to pilot concerns regarding recovery from engine difficulties at that speed. However, use of a coupled weather system-pesticide application computer model (the Adapco Wingman system) has enabled the County to optimize the delivery of pesticides, and verified that past practices would not be adhered to.

Term Plan. However, to be conservative, no benefits from any of these changes were assumed when computing risks under the quantitative risk assessment and impacts from mosquito-borne disease analyses.

4.1.3. Evaluated Management Options

This environmental assessment generally considered management options in four different ways:

- No active vector management: this constitutes risks associated with background pesticide use in the absence of all vector control applications (which could not be quantified), and potential disease impacts from vector-borne disease in the absence of any vector control (which could only be partially quantified). This option was not evaluated under the quantitative risk assessment, as it included no pesticide applications.
- The "most likely program," also identified as the evaluation management plan. This included application of resmethrin, permethrin, sumithrin (all with and without PBO), and malathion according to Table 4-1, all of which had quantified human health and ecological risk assessments. A comparative assessment of the impacts from adoption of the Long-Term Plan on mosquito-borne disease was made (comparative to recent, actual health impacts).
- Water management options. Four main alternatives were qualitatively assessed. The impacts of adopting a progressive water management program, using 15 Best Management Practices and four Interim Actions-On-going Maintenance Options, were assessed; these were compared to impacts associated with no active water management, continuing the current ditch maintenance program, and maintaining all ditches in the County.
- Additional management options were also considered. These consist of six alternatives to the most likely pesticide program:
    - use Mosquito Magnets in place of adulticides at Davis Park (this assumed no mosquito-borne disease changes)
    - eliminate the use of all larvicides in fresh water environments and the use of methoprene in salt water settings

- adulticide only in cases of declared human health emergencies (eliminates all adulticide applications except for the aerial applications)
- adulticide only after human illness (this option was, for the quantitative risk assessment, indistinguishable from adulticiding only in cases of declared human health emergencies)
- eliminate all adulticiding
- conduct a limited calculation of the impact of continuing to use the 2004 aerial application methodologies.

In addition, semi-quantitative, or qualitative comparisons of risks associated with the following additional chemicals (Table 4-2) were derived. Where the comparisons were quantitative, the same methodologies (or parallel methods) were used as had been for the evaluation management plan pesticide use analysis.

Table 4-1. Vector Control Management Plan Characteristics for Each Study Area

Plan Characteristics	Study Area			
	Davis Park - Adulticides	**Davis Park - Larvicides**	**Mastic-Shirley- Adulticides**	**Mastic-Shirley - Larvicides**
Agent	All	All	All	All
Delivery Method	Handheld - backpack sprayer	Hand Application, Backpack	ULV - truck mounted or Aerial	Aerial, Backpack Blower, Hand Apply,
		Blower		Ground, Truck Sprayer
Spraying Season	late June - early October	early May – mid September	mid June - mid September	mid April - mid September
Time of Day for Applications	4-6 pm	Daytime	dusk + 3 hrs	daytime
Number of Applications	2000 & 2004 – 8	2002 - 100, 2003 – 73	2000 - 8, 2001, 2003, & 2004 - 5	1999 - 643, 2000 - 744, 2001 - 617
During Spraying Season*	2001 & 2003 - 12, 2002 - 14	2004 – 30	2002 - 4	2002 - 468, 2003 - 449, 2004 - 372
Number of Days	Mostly once a week	1x to 2x a month - mostly	A minimum of one week intervals	1x - 4x per week on average
Between Applications	2000 - ranged from 6, 7, 9 ,14	2001 - 5, 9, 14, 26, 30	2000 - 0, 1, 2, 5, 6, 7, 12, 13	1999-2004 - 0, 1, 2, 3, 4, 5, 6, 7
	2001 & 2002 - 7	2002 - 0, 25, 27, 35, 37	2001 - 5, 7, 58 2002 - 0, 10, 33, 41	1999 - 8, 9, 13 2000 - 8, 10, 11
	2003 - 7 except once 14	2003 - 0, 10, 13, 14, 15, 16	2003 - 0, 6, 9, 23, 26	2001 - 8, 12 2002 - 8, 12, 14
	2004 - 7 except once 28	2004 - 1, 18, 21	2004 - 1, 6, 7, 21, 27	2003 - 8, 14 2004 - 9, 11, 12, 13, 19
Number of areas treated**	---------	33	---------	118
Miscellaneous locations	---------	14 locations larvicided only in 2001 received an average of 1.43 applications per location for 2001	---------	348 locations larvicided between 2001-2004 received an average of 1.26 applications per location for those years
Mean # of treatments per season	10.8 (for all of Davis Park)	2.05 (for each treatment location)	6.8 (for all of Mastic Beach/Shirley)	3.99 (for each treatment location)
Maximum # of treatments at one area	14 (for all of Davis Park)	8 (for each treatment location)	13 (for all of Mastic Beach/Shirley)	26 (for each treatment location)
95% confidence interval	---------	0 - 4.1	---------	0 - 11.81

*Number of Applications During Spraying Season = the number of times a particular location received pesticides. If there were multiple applications in one day for an area, the application was only counted once. The number shown does not include miscellaneous location applications.

**Number of Areas treated = Number of SCVC ID locations. Does not include miscellaneous locations.

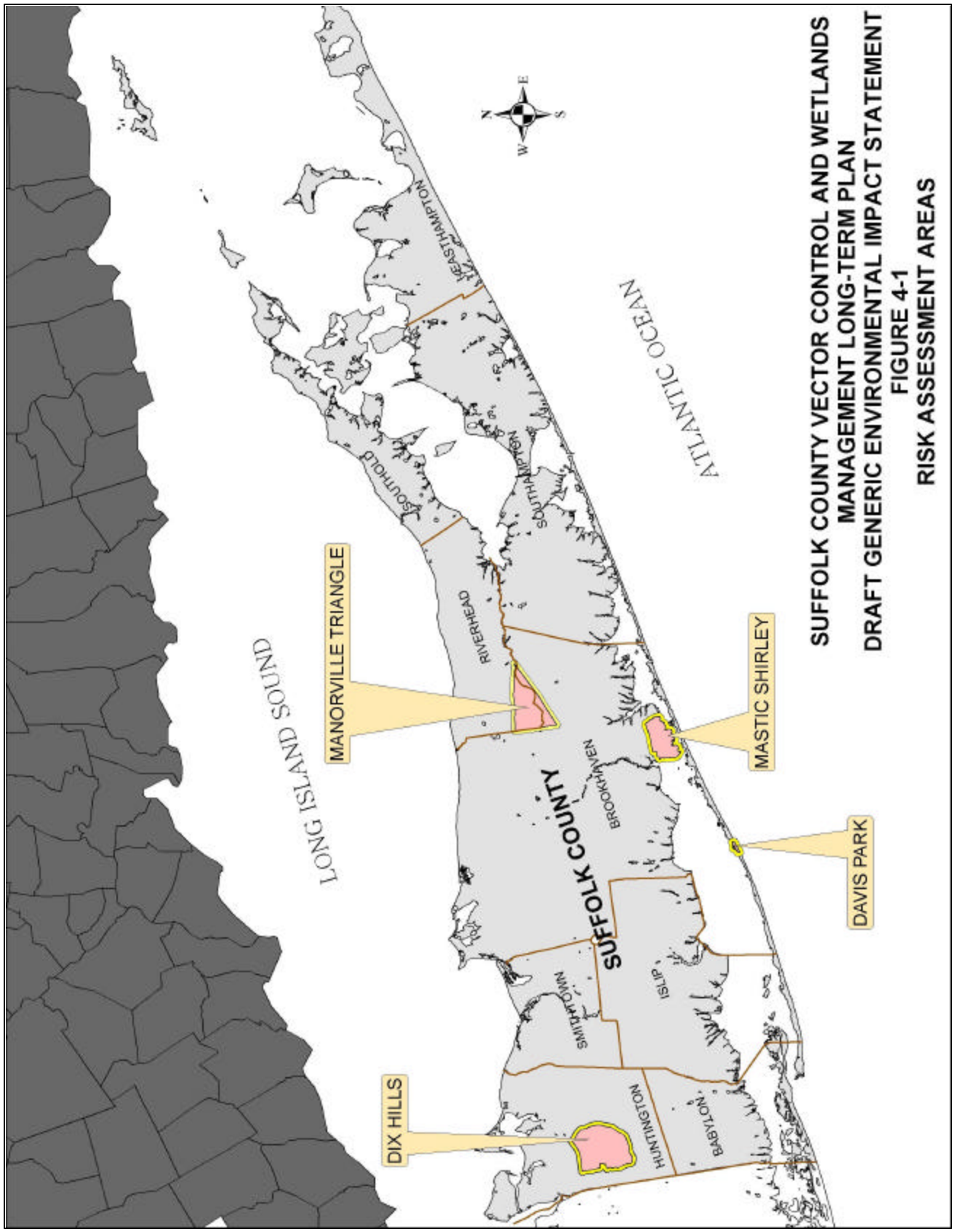
Table 4-2. Additional Agents Considered

AGENT	CLASS	TRADE NAME
Ethoxylated Fatty Alcohols	Larvicide/Pupicide	Agnique
Temephos	Larvicide	Abate
Naled	Adulticide	Dibrom, Trumpet
Pyrethrum	Adulticide	Pyrocide, Pyrenone
Deltamethrin	Adulticide	Decis
Golden Bear Oil	Larvicide/Pupicide	GB-1111
DEET	Repellant	
Fenthion	Adulticide	Baytex, Entex
Chloripyrifos	Adulticide	Dursban, Lorsban
Octanol	Used in Traps	
Propane	Used in Traps	

4.2 Risk Assessment Study Areas

4.2.1 Introduction

Archetypes of the ecological habitats and geographical areas, as well as rural and urban landscapes, present within Suffolk County were selected as the areas on which the risk assessment of pesticide use would be conducted. Each area was also important to the County's vector control program in that they represent very different kinds of pesticides usages (especially, adulticide uses). This was important, because it was expected that the adulticides might represent the greatest potential impacts under the risk assessment (based on the toxicological evaluations of the pesticides [CA-IC, 2005; CA-SCDHS, 2005]), and so the variety of adulticide uses would allow for a complete evaluation of all aspects of County pesticide use, in terms of likely future application scenarios (based on past practices). The areas selected were Manorville, Huntington (Dix Hills), Mastic Beach-Shirley and Davis Park (see Figure 4-1).


SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS
MANAGEMENT LONG-TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 4-1
RISK ASSESSMENT AREAS
LONG ISLAND SOUND
ATLANTIC OCEAN
SUFFOLK COUNTY
MANORVILLE TRIANGLE
MASTIC SHIRLEY
DAVIS PARK
DIX HILLS
RIVERHEAD
SOUTHOLD
SOUTHAMPTON
EASTHAMPTON
BROOKHAVEN
SMITHTOWN
ISLIP
HUNTINGTON
BABYLON
N
S
E
W

Manorville

The Manorville study area measures approximately 1,800 hectares (4,500 acres) and is located in Manorville. Most of the study site is in the Town of Riverhead, although the southern part is in the Town of Brookhaven. It lies south of the former Calverton Naval Weapons Industrial Reserve Plant (NWIRP) and east of the Robert Cushman Peconic River County Park. The study area contains wetlands and pond systems that drain into the Peconic River, and so it is considered part of the upland portion of the PEP study area. The PEP is part of the National Estuary Program, and is administered by SCDHS. The study area is mostly undeveloped, has a low population density, and a variety of fresh water and wooded habitats. It is a historical EEE amplification area, as it contains swaths of red maple swamps, which support *Culiseta melanura*, the primary amplification vector of the disease. In the 1990s, the County twice conducted extensive, multiple application adulticide programs in the area to contain an EEE health threat. The area was therefore selected so as to allow modeling of sensitive fresh water wetlands, and because it constitutes an area where pesticides may be used to prevent an EEE outbreak.

Huntington (Dix Hills)

The other major disease threat in the County is WNV. The need to model an area where adulticides were used to control for WNV was clear. Adulticides are only applied, in any one year, to a relatively small portion of the County (approximately five percent of the County most years). Therefore, when adulticides are applied to control WNV, it generally is the only adulticide application received by the area. Therefore, an area where applications are generally not made for vector control purposes could serve as an archetype for most of the County.

As of the beginning of 2004, the only portion of the County that had received multiple (two) applications for WNV purposes was some areas in Huntington. Because vector control applications are generally not made in Huntington, it was selected as one of the study areas. The particular study area was defined by the second WNV application (in 2002). This Dix Hills-centered application, totaling 2,500 hectares, was chosen because the study site contained a variety of interesting land uses and habitat types. Much of the area contains a variety of typical suburban development patterns (one and two acre zoning, but also quarter acre and smaller plots, and some multi-family housing), but the application area also included a mall, a major County

Park (West Hills Park), and a variety of environmental settings, including many recharge basins, ponds, and associated wetlands.

Mastic Beach-Shirley

The Mastic Beach-Shirley study area measures 2,061 acres and is located on the south shore of the Long Island mainland, in the Town of Brookhaven, within the Mastic Beach-Shirley peninsula. Land use tends towards high-density suburban housing on relatively small lots. The study area has a great many different aquatic habitats in its near vicinity. The peninsula is bounded by Great South Bay on its west, Narrow Bay to the south, and Moriches Bay to the east. The study area borders the Carmans River, and includes part of Wertheim National Wildlife Refuge. The William Floyd Estate, which is part of FINS, is also included in the study area. Several tidal creeks are located on the southern edge of the peninsula including, from west to east, Unchachogue Creek, Johns Neck Creek, Sheep Pen Creek, Pattersquash Creek, and Lawrence (Odell's) Creek. The study area also contains a low-lying area of fresh water wetlands situated between Pattersquash Creek, to the west, and Odell's Creek/William Floyd Estate, to the east.

The area is repeatedly infested with salt marsh mosquitoes and generates more complaints about adult mosquito biting than any other part of the County. Not only do the local wetlands enumerated above serve as breeding locations for mosquitoes, but FINS lies directly south and west of the area. FINS does not allow water management or larviciding in the parkland portions of the Seashore. The uncontrolled marshes in FINS have been shown to contribute mosquitoes to mainland areas (Ginsberg, 1986). Mastic-Shirley receives a great deal of water management and larval control attention, and also generally receives multiple applications of adulticide for vector control purposes. WNV control has also occurred in this area.

Davis Park

Davis Park is located in the Town of Brookhaven, on the Fire Island barrier island south of Great South Bay and north of the Atlantic Ocean. The Davis Park study area measures 100 acres and includes the summer resort community of Davis Park. Davis Park, although privately owned, is part of FINS.

Davis Park contains approximately 400 houses, and in summer hosts between 1,000 (weekdays) to 3,000 (weekends) people. It has no roads, per se, and access is almost entirely limited to boats or ferries. Vegetation is limited to barrier island salt tolerant species; there are some very small fresh water wetlands. Davis Park itself has only a small salt marsh along the Great South Bay, but immediately to its east are extensive wetlands, including the West Watch Hill Primary Study Area (see Section 5).

FINS restricts water management within its jurisdiction, and will not allow larviciding outside of the privately-owned lands. The untreated salt marshes and fresh water wetlands of FINS produce many mosquitoes (Ginsberg, 1986). To alleviate the quality of life impacts from these mosquitoes, SCVC schedules weekly adulticiding (using hand-held applicators) in Davis Park and several other Fire Island communities. If weather holds for the scheduled application days, Davis Park can receive more than 10 adulticide applications in any one year. This clearly represents a maximal exposure to adulticides for any Suffolk County resident, and so it was thought to be appropriate to include this as a means of determining worst case pesticides exposure.

4.2.2 Manorville

General Land Use

The Manorville Risk Assessment Area (RAA) is largely rural. Many former agricultural uses, such as cranberry farming and row crops or potatoes, are no longer pursued. Scattered houses are found on large lots amidst much undeveloped land. There are few amenities in the area, although there are some private sportsman (hunting-fishing) clubs. The Calverton NWIRP is now unused, as well. Residential and commercial development increases toward the hamlet of Riverhead. The surrounding areas such as Robert Cushman Peconic River County Park and the Peconic River are used for outdoor recreation.

Groundwater

The Manorville RAA is located in groundwater management zone III (Long Island Regional Planning Board, 1992). The range of depth to ground water for the entire RAA is 4.5 to 6.0 meters (15 feet to 20 feet) (USGS, 1984) (see Map 1 in Cashin Associates, 2005d).

Soils

The Manorville Risk Assessment Area is primarily composed of Carver and Plymouth Sands, with zero to three percent slopes and three to 15 percent slopes. Muck and Berryland Mucky Sands are found along the Peconic River, coastal plain ponds and former cranberry bog sites. Plymouth Loamy Sands are common in the northwestern corner, while Atsion Sands are common in the northeastern corner of the area, along the banks of the Peconic River (US Department of Agriculture and Soil Conservation Service in cooperation with Cornell Agricultural Experiment Station, 1975) (see Map 2 in Cashin Associates, 2005d).

Hydrology and Significant Surface Waters

The north/south groundwater flow divide of Long Island bisects the northern perimeter of the site causing the general direction of water flow through the RAA to be northwest to southeast.

The headwaters of the Peconic River start near the Brookhaven National Laboratory. The Peconic River is one of only four rivers on Long Island and is the longest groundwater-fed river in New York State (US Fish and Wildlife Service, 1997). The waters of the Peconic River tend to be reddish-brown, due to the presence of tannins and iron, relatively warm, nutrient poor and naturally acidic (Edinger et al., 2002). The river and its associated watershed support numerous types of regionally or globally rare habitats, such as coastal plain ponds, Atlantic white cedar swamps, and pine barrens.

Human Demographics and Human Uses

According to the 2000 census, 11,385 people inhabit the town of Manorville (US Census Bureau, 2000). Approximately 2,846 (25 percent of the total population) people live within the study area. The most common ethnicity in Manorville is white (92.8 percent). The median age of residents in Manorville is 37, while median household income is $62,895. Residential percentages for ethnicity, age and income ranges within Manorville are displayed in Table 4-3, Table 4-4, and Table 4-5.

Table 4-3. Manorville Ethnicity

Ethnicity	Percent
White	92.8
Black	1.2
Hispanic	5.1
Native American	0
Asian	0.3
Other-includes multiple races	0.5

Table 4-4. Manorville Age Groups

Age	Percent
0-4	8.1
5-9	8.4
10-20	12.9
21-29	7.9
30-39	20.5
40-49	15.1
50-59	10.2
60-64	3.7
65 plus	13.3

Table 4-5. Manorville Household Incomes

Income ($)	Percent
<10,000	4.5
10,000-20,000	7.1
20,000-30,000	6.4
30,000-40,000	9.9
40,000-50,000	8.5
50,000-60,000	8.4
60,000-75,000	14.0
75,000-100,000	20.9
100,000-150,000	14.5
150,000-200,000	3.3
>200,000	2.4

Ecological Habitats

General Habitat Settings

The Peconic River dominates the environmental setting of the RAA. The headwaters of the Peconic River begin near the Brookhaven National Laboratory, which lies to the west of the RAA. The river meanders in an easterly direction from its intermittent/seasonal headwaters for a distance of approximately 16 miles until discharging into the most inland reach of Flanders Bay and the Peconic Estuary, at the junction of Long Island's north and south forks. Over this

distance, the riverbed descends from an elevation of approximately 52 feet above mean sea level to roughly sea level. Throughout most of its length, the Peconic River consists of a relatively warm, slow-flowing, shallow, naturally acidic, and nutrient-poor freshwater stream and ecosystem. Six dams have been constructed along the main stem of the river, and one dam has been constructed along the north-to south flowing Swan Lake tributary. These stream impoundments were constructed primarily for the purpose of assisting early industrial activities and cranberry cultivation operations of long ago and were the antecedent to the creation of Donahue's Pond, Forge Pond (Peconic Lake), and Upper Mills Pond. The Peconic River is the longest river on Long Island and has the distinction of being the longest, groundwater-fed river in New York State. The upper reaches of the Peconic River watershed have remained relatively undeveloped and in its natural condition as a result of considerable effort by the public sector to preserve large tracts of open space and wildlife habitat. Because the river's watershed has remained largely undeveloped, the water quality has been considered to be generally good (Cashin Associates, 2004).

Unique/Critical Habitats

The freshwater wetlands lining the banks of the Peconic River are classified as palustrine wetlands. Many freshwater wetlands are dominated by trees (forested wetlands), while others are characterized by grass like plants and herbs (emergent wetlands), shrubs of various types (scrub-shrub wetlands), or various mixtures of all of the above including ponds (unconsolidated bottoms). The hydrology of palustrine wetlands varies from permanently flooded (e.g. ponds) to seasonally flooded swamps to temporarily flooded (e.g. wet meadows and forested wetlands). The varying hydrology of the area supports a diverse assemblage of plant species. Some typical types of palustrine wetlands are Atlantic white cedar swamps, red maple swamps, and sphagnum bogs (Edinger et al., 2002).

Upland areas of the Pine Barrens are predominantly pine-oak forests (NYSDEC, 1999), with a dense understory of shrubs. North of the Peconic River, the pine barrens vegetation becomes upland forest dominated by oak and beech trees. Shrub density and the number of herbaceous species present in these areas are low.

Species Surveys

Common Species

Species common to bogs, coastal plain ponds, wetlands and coastal plain streams, along with Atlantic white cedar swamps, red maple swamps and Pine Barrens are listed in Table 1 to Table 17 in Cashin Associates, 2005d.

Rare, Threatened and Endangered Species

Endangered, threatened and rare plant and animal species associated with coastal plain ponds and the freshwater wetlands present along the Peconic River and vicinity are listed in Table 18 to Table 20 in Cashin Associates, 2005d.

4.2.3 Dix Hills

The Dix Hills RAA measures 6,227 acres and is a highly developed urban area encompassing South Huntington, as well as portions of West Hills, Huntington Station, and Melville. State Routes 110 and 25 (Jericho Turnpike) traverse the site; Route 110 runs north and south through the RAA, while Route 25 runs east and west. These two roads divide the site into four unequal quadrants:

1) northwest quadrant (300 hectares);
2) northeast quadrant (680 hectares);
3) southwest quadrant (380 hectares); and
4) southeast quadrant (1,125 hectares).

The Northern State Parkway comprises the southern border and runs parallel to Route 25. Each quadrant is comprised of different percentages of hamlets in the area. The northwest and northeast quadrants are entirely comprised of Huntington Station. Approximately 75 percent of the southwest quadrant consists of West Hills, while 25 percent is South Huntington. Approximately 60 percent of the southeast quadrant is in South Huntington, while the other 40 percent is in Melville.

General Land Use

The seven major land uses within the Dix Hills RAA (Figure 1 in Cashin Associates, 2005c) are listed below.

Residential

Residential land use is densest in the areas closest to Routes 25 and 110 and decreases away from these main roads. Residential use is densest in the northwest quadrant and least in the southeast quadrant.

Commercial

Commercial land use is concentrated around Routes 25 and 110. Numerous storefronts and strip malls line Route 25 and a large shopping plaza (28 hectares/72 acres), the Walt Whitman Mall, borders Route 110.

Schools

There are nine schools in the study area.

Industrial

Industrial use is minimal, but where present is found around the Long Island Rail Road (LIRR) tracks, and along Route 110 and the Northern State Parkway. Some industrial parcels are scattered throughout the southeastern quadrant.

Open Space

Eleven parks are located within the site. West Hills County Park is partially contained (130 hectares) within the RAA. This large, 312 hectares (total size) park includes the highest elevations in Suffolk County, and has a variety of wooded and meadow habitats within it. West Hills County Park also includes large picnic and ball field areas, and many equestrian paths. The RAA also contains three small recreational areas.

The largest amount of open space and vacant land is found within the southeast quadrant. Homes here are less numerous and are built on larger parcels. Much of the area is dominated by forest. Scattered vacant land also can be found in each of the other quadrants (see the Figure in Cashin Associates, 2005c).

Recharge Basins

There are 101 recharge basins in the RAA (see Figure 4-2 in Cashin Associates, 2005c).

Agricultural

A farm of approximately nine hectares is located in the southeastern quadrant between Old Country Road and Quintree Lane.

Groundwater

The Dix Hills RAA is located in groundwater management zone I (Long Island Regional Planning Board, 1992). The range of depth to ground water for the entire RAA is 20 meters to 60 meters (60 feet to 200 feet) (USGS, 1984). Table 21 in Cashin Associates, 2005c lists the groundwater depth ranges for each quadrant.

Soils

The Dix Hills RAA is primarily composed of Riverhead and Haven soils (approximately 55 percent), Carver and Plymouth Sands (approximately 15 percent), and Montauk soils (approximately 10 percent). The remaining 20 percent is evenly divided among Haven Loam, Urban, Montauk Silt Loam, and recharge basin (US Department of Agriculture and Soil Conservation Service in cooperation with Cornell Agricultural Experiment Station, 1975) (see Figure 3 in Cashin Associates, 2005c).

Hydrology and Significant Surface Waters

The Dix Hills RAA contains thirteen coastal plain or kettle ponds along with 101 recharge basins. Rivers, lakes, and streams are not present.

Human Demographics and Human Uses

The population of the RAA was estimated by using the hamlet populations reported in the US census, and apportioning them evenly as the hamlet was included in the DHRAA. This resulted in a population estimate of 38,966 within the study area (U.S. Census Bureau, 2000).

According to the 2000 census, the most common ethnicity within Huntington Station (60.6 percent), South Huntington (90.1 percent), West Hills (94.1 percent) and Melville (87.2 percent) is white. The median ages of residents in Huntington Station, South Huntington, West Hills and Melville are 35, 40, 41 and 39, respectively. The median household income for Huntington

Station is $61,760, $77,950 for South Huntington, $87,295 for West Hills, and $92,527 for Melville. Residential percentages for ethnicity, age and income ranges within the Dix Hills study area are displayed in Table 4-6, Table 4-7, and Table 4-8.

Table 4-6. Dix Hills Ethnicity

Ethnicity	Huntington Station (%)	South Huntington (%)	West Hills (%)	Melville (%)
White	60.6	90.1	94.1	87.2
Black	10.8	1.1	0.9	2.1
Hispanic	22.4	3.8	3.3	3.4
Native American	0.5	0	0	0
Asian	3	3.4	0	4.4
Other-includes multiple races	2.7	1.6	1.7	2.9

Table 4-7. Dix Hills Age Groups

Age	Huntington Station (%)	South Huntington (%)	West Hills (%)	Melville (%)
0-4	7.8	6.1	6.1	7.4
5-9	7.3	6.9	7.8	7.1
10-20	14.2	11.3	11.5	13.1
21-29	11.9	8.6	8.6	7.9
30-39	19.0	18.1	14.8	16.4
40-49	15.6	15.4	18.4	15.5
50-59	9.9	12.8	16.3	13.8
60-64	3.8	4.2	3.5	4.7
65 plus	10.5	16.7	13.0	14.2

Table 4-8. Residential Income Percentages within the Dix Hills Study Area.

Income ($)	Huntington Station (%)	South Huntington (%)	West Hills (%)	Melville (%)
<10,000	4.5	3.2	1.5	2.7
10,000-20,000	8.1	4.748	4.7	4.5
20,000-30,000	9	7.5	3.0	6.1
30,000-40,000	9.2	8.0	5.6	6.1
40,000-50,000	8.6	7.6	7.1	5.6
50,000-60,000	8.3	6.8	4.7	6.0
60,000-75,000	13.5	10.6	11.0	8.5
75,000-100,000	16.6	16.1	21.4	15.1
100,000-150,000	14.5	20.6	16.0	20.3
150,000-200,000	5.2	7.1	12.4	11.2
>200,000	2.5	7.7	12.5	13.9

Ecological Habitats

General Habitat Settings

The habitats contained within the Dix Hills RAA are not ecologically diverse as much of the area has been developed for residential, commercial and industrial use. There is a farm of approximately nine hectares.

No rivers or lakes are present. However, a considerable portion of the RAA lies within the West-Hills Melville Special Groundwater Protection Area (SGPA) (approximately 132 hectares lies within the RAA and one hectare lies within the quarter-mile buffer zone) (see Figure 4 in Cashin Associates, 2005c) (Long Island Regional Planning Board, 1992), and thirteen coastal plain or kettle ponds are found within the RAA.

A total of 101 recharge, or stormwater, basins are present within the RAA. These shallow, excavated areas are designed to temporarily hold surface water runoff from area highways, parking lots and housing developments before gradually discharging it into the ground or nearest body of water. Basins vary in size and retention times (U.S. Department of Agriculture and Soil Conservation Service in cooperation with Cornell Agricultural Experiment Station).

Unique/Critical Habitats

A considerable portion of the RAA lies within the West-Hills Melville SGPA. All SGPA are considered Critical Environmental Areas (CEAs) by the NYSDEC and Suffolk County.

The State and the County specifically identify the Little Plains area of Huntington as a CEA. The Little Plains area is located within the quarter-mile buffer zone of the Dix Hills RAA and measures less than one hectare.

A total of thirteen coastal plain or kettle ponds (approximately 24 acres or 10 hectares total area) exist within the RAA. Each of the thirteen ponds is located within a residential area, with the exception of a pond located inside West Hills County Park and one located inside Depot Road Park (northeast quadrant). These ponds formed in the glacial retreat when falling ice compressed ground below, or fallen ice prevented loess or other airborne materials, or outwash or other waterborne materials, from infilling the depression. When the ice melted, the depression that would become the pond was created. Kettle ponds, like the ones in this RAA, that are located

above the regional groundwater table, are clearly fed by a local perched water table. Generally, kettle ponds contain dark, acidic water, and have sandy to mucky bottoms (Edinger et al., 2002).

Species Surveys

Common Species

Species commonly associated with coastal plain ponds, perimeter and inland wetlands and recharge basins within the Dix Hills Risk Assessment Area are listed in Table 22 to Table 27 in Cashin Associates, 2005c.

Rare, Threatened & Endangered Species

Five rare and endangered species have been identified in the West-Hills Melville SGPA (Long Island Regional Planning Board, 1992). Three "significant" plant species were identified in the southeastern portion of Half Hollow Hills, which is located just south of the Dix Hills Risk Assessment Area. The other two rare and endangered species are found in the Cold Spring Harbor area, which is north and outside of West-Hills Melville SGPA. The rare and endangered plants include St. Andrew's cross, dwarf plantain, and tick-trefoil. The only currently known New York location of bushy St. John's wort is found in the West-Hills Melville SGPA.

4.2.4 Mastic Beach-Shirley

General Land Use

The Mastic Beach-Shirley RAA is approximately 824 hectares (2,061 acres). Land use designations in the RAA include:

- Residential
- Commercial
- Recreational and Entertainment
- Community Services
- Public Service
- Wild, Forested, Conservation and Public Lands
- Underwater Land

- Vacant

The predominant land use in the RAA is single-family residential development on small lots that range in size from 400 to 900 square meters (4,000 to 10,000 square feet). The total size of residential development within the RAA is approximately 475 hectares (1,212 acres), including the buffer zone. The Mastic-Shirley community had 41,421 residents as of the 2000 Census. The hamlet of Shirley had a total population of 25,935 located in 28 square kilometers (11.13 square miles), and the hamlet of Mastic is home to 15,486 residents located in 11 square kilometers (4.48 square miles) (Cashin Associates, 2003).

An area of one-acre residentially-developed lots is located in Shirley, between William Floyd Parkway and the Wertheim National Wildlife Refuge. A 22-unit condominium complex is situated on the east side of William Floyd Parkway, fronting on Narrow Bay.

The Mastic Beach business district is located along Neighborhood Road, which includes a variety of small retail establishments that are primarily oriented toward serving local needs, as well as a small office supplies store, a realtor's office, and community center. Further to the east within the RAA, there is a transition from commercial land use to a mix of single-family residential development and institutional/community uses such as the Mastic Beach Fire Department, several churches, a pre-school, and the Mastic Beach Property Owners Association headquarters. Land use becomes entirely residential further to the east until reaching the FINS William Floyd Estate Park.

Extensive areas of recreational land and undeveloped open space exist, owned either by governmental entities or the Mastic Beach Property Owners Association. The northwest segment of the RAA includes a portion of the Wertheim National Wildlife Refuge (WNWR), which is 1,000 hectares (2,500 acres) in size. The Town of Brookhaven Manor of St. George is located just south of WNWR and includes 51 hectares (127 acres) of undeveloped land. Other conservation areas include, from west to east:

- Smith Point County Marina (60 hectares or 149 acres)
- Johns Neck State Tidal Wetlands (30 hectares or 75 acres)
- William Floyd Estate – FINS (245 hectares or 613 acres)

Smith Point County Marina is a popular location for recreational boaters, as is the canal/lagoon located in the southeast segment of the RAA. The Links at Shirley, located in the northern portion of the RAA, is a 36-hole golf facility that includes a championship caliber 18-hole course and an executive style 18-hole course that is fully illuminated for additional night play.

A number of subdivided, vacant parcels held in individual private ownership are situated throughout the RAA, many of which have developmental constraints due to small lot sizes, wetlands, potential for flooding, and high groundwater levels. Wet soils and areas of high water that occur along the shoreline have severe limitations for most land development uses. Important regulatory constraints include SCDHS waste disposal regulations, and Federal Emergency Management Agency (FEMA) flood plain limitations.

New residential development is significantly declining in the Mastic Beach–Shirley area. This is due to the majority of the lots already being developed and a high percentage of the remaining lots falling with wetlands or flood zones.

Groundwater

The entire Mastic Beach-Shirley peninsula is situated within Hydrogeologic Zone VI, as delineated in the Long Island 208 Study. This area is a portion of the south shore shallow flow system that discharges to Moriches Bay, Narrow Bay, and the eastern portion of Great South Bay. Groundwater in this area primarily moves laterally toward coastal waters, possibly with some degree of upward flow as the groundwater discharges to the bay system. Areas with a depth to groundwater of less than one meter (five feet) occupy a substantial portion of RAA, with large areas of designated wetlands where the groundwater table is at or above the ground surface (Cashin Associates, 2003).

Soils

The RAA consists of Riverhead-Plymouth-Carver Association soils. These soils are deep, level to sloping, well-drained, moderately-coarse to coarse-textured soils (on outwash plains). The part of this association near the shore is almost entirely built up, with gradual encroachment into inland areas.

Hydrology and Significant Surface Waters

Great South Bay, Narrow Bay, and Moriches Bay surround the Mastic Beach-Shirley peninsula on its west, south, and east sides, respectively. The RAA borders on the Carmans River. Several tidal creeks are located on the southern edge of the peninsula including, from west to east, Unchachogue Creek, Johns Neck Creek, Sheep Pen Creek, Pattersquash Creek, and Lawrence (Odell's) Creek.

Human Demographics and Human Uses

The Mastic-Shirley community had 41,421 residents as of the 2000 census. The hamlet of Shirley had a total population of 25,935 located in 28 square kilometers (11 square miles), and the hamlet of Mastic is home to 15,486 residents located in 28 square kilometers (4.5 square miles) (Cashin Associates, 2003).

According to the 2000 US census, the most common ethnicity of the Mastic (79.3 percent), Shirley (83 percent) and Mastic Beach (81.8 percent) populations is white. The median age of residents in Mastic is 31, while the median age of residents in Shirley and Mastic Beach is 32 years old. The median household incomes for Mastic, Shirley and Mastic Beach are $53,657, $57,294 and $44,937, respectively. Residential percentages for ethnicity, age and income ranges within each of these hamlets are displayed in Table 4-9, Table 4-10 and Table 4-11.

Table 4-9. Mastic, Shirley, and Mastic Beach Ethnicity

Ethnicity	Mastic (%)	Shirley (%)	Mastic Beach (%)
White	79.3	83.0	81.8
Black	5.8	3.0	3.7
Hispanic	11.5	10.4	10.9
Native American	1.7	0.4	0.1
Asian	0.3	1.7	0.6
Other-includes multiple races	1.4	1.5	2.9

Table 4-10. Mastic, Shirley, and Mastic Beach Age Group Percentages

Age	Mastic (%)	Shirley (%)	Mastic Beach (%)
0-4	7.8	7.6	8.6
5-9	10.2	9.5	9.3
10-20	18.7	18.4	16.9
21-29	11.8	11.8	12.3
30-39	18.8	17	16.8
40-49	14.4	16.2	15.5
50-59	10.1	11.1	10.4
60-64	2.1	2.3	2.7
65 plus	6.1	6.2	7.5

Table 4-11. Mastic, Shirley and Mastic Beach Household Incomes

Income ($)	Mastic (%)	Shirley (%)	Mastic Beach (%)
<10,000	5.7	3.9	7.1
10,000-20,000	7.9	7.2	11.3
20,000-30,000	10.0	8.0	10.6
30,000-40,000	10.8	11.0	12.7
40,000-50,000	10.6	10.5	11.6
50,000-60,000	10.7	12.4	11.8
60,000-75,000	17.5	14.7	15.0
75,000-100,000	13.6	17.3	10.1
100,000-150,000	11.1	11.8	8.3
150,000-200,000	1.2	2.3	0.4
>200,000	0.8	1.2	1.3

Ecological Habitats

General Habitat Settings

Several small naturally occurring ponds and two artificial ponds, within the Links Golf Course, and the upper reaches of some of the tidally influenced streams are the fresh water bodies present in the RAA.

The RAA and buffer zone contain approximately 12 hectares (29 acres) of freshwater wetlands. There are five state-designated wetland areas located within the study area:

- William Floyd Estate — comprising a fringe along the upland edge of the tidal wetland along the Estate's southerly and easterly edges
- Unchachogue Creek — at the head of the creek and upland of the State-designated tidal wetland on the east side
- Johns Neck Creek — at the head of the creek and upland of the State-designated tidal wetland

- Pattersquash Creek — at the head of the creek
- Mastic Beach Area (30 hectares or 75 acres)— comprising an extensive network of wetlands separated by the developed roadways, in the area between Pattersquash Creek to the west and Lawrence Creek to the east, especially south of Dogwood Road

The RAA contains a total of 33,515 linear feet of coastal shoreline, which includes the banks of all its rivers, creeks, and canals. The main coastal waters surrounding the Mastic Beach-Shirley peninsula include:

- the eastern portion of Great South Bay to the west
- Moriches Bay to the east
- Narrow Bay to the south.

A series of small tidally-influenced creeks and basins are present along the study area shoreline. These include, from west to east:

- Shirley Marina basin, immediately west of the Smith Point Bridge
- the confluence of Unchachogue and Johns Neck Creek
- Sheep Pen Creek (Section V Basin)
- Pattersquash Creek; "The Lagoon"
- Lawrence Creek, which runs along the westerly side of the William Floyd Estate

The RAA contains extensive areas of tidal wetlands. Approximately 110 hectares (276 acres) of tidal wetlands are located in the RAA, 31 hectares (78 acres) of which are situated within the buffer zone.

The abundance of coastal wetlands within the RAA is due largely to the low topographic relief of the waterfront area on the peninsula. Major areas of vegetated tidal wetlands are described as follows:

- Manor of St. George — high marsh (HM), fresh marsh (FM) and formerly connected tidal wetlands (FC) cover an extensive contiguous area on the northern portion of this property;
- Shirley Marina Property — an extensive area of HM is present, with patches of intertidal marsh (IM) extending along the main tidal channels;
- Unchachogue Creek — the west bank is stabilized (including a series of canals), and supports essentially no mapped marshes; however, the east bank comprises the Johns Neck Creek Conservation Area, which contains extensive HM, with some fringing IM;
- Johns Neck Creek — most of the west bank contains small patches of IM; the westerly side of the creek's mouth and a large segment of the east bank comprise the Johns Neck Creek Conservation Area, which contains extensive HM, with fringing IM;
- Sheep Pen Creek (Section V Basin) — some patches of HM are present on the south side;
- Pattersquash Creek — contains fringing IM, with bands of HM further inland, on both shores along most of the tidal reach of this creek; and
- William Floyd Estate — contains expansive areas of IM and HM along the Estate's southerly and easterly edges

Coastal shoals, bars and mudflats account for approximately 46 hectares (117 acres) of the RAA, 45 hectares (113 acres) of which are located within the buffer zone. Unvegetated tidal flat areas are most common in the RAA as shallow-water extensions of the vegetated tidal wetland areas described above.

The native upland vegetation of the RAA primarily consist of coastal oak-hickory forest and pitch pine-scrub oak woodlands that are dominated by white oak, black oak, scarlet oak, hickory, and pitch pine (Cashin Associates, 2003).

Unique/Critical Habitats

South Shore

The entire study area falls within the boundaries of the Town of Brookhaven South Shore CEA. The South Shore CEA includes all the lands along the south shore mainland bay shorelines (Cashin Associates, 2003).

Great South Bay-East

Great South Bay-East comprises approximately one-half of the largest protected, shallow, coastal bay area in New York State. This broad expanse of open water is highly productive, and supports a tremendous diversity of fish and wildlife species, and therefore has been designated as a New York State Significant Coastal Fish and Wildlife Habitat. The entire fish and wildlife habitat of Great South Bay-East is approximately 12,800 hectares (32,000 acres), generally defined by the mean high water elevation on the north and south sides (exclusive of federal lands), by the Brookhaven town line to the west, and by Smith Point Bridge over Narrow Bay to the east (Cashin Associates, 2003).

The Great South Bay-East habitat encompasses a vast area of relatively shallow open water (typically less than 12 feet deep at mean low water), and is connected to the ocean by Fire Island Inlet and Narrow Bay. The bay is bordered on the north and east by dense residential and commercial development, including extensive marina and harbor facilities. Many of the remaining wetland areas along the north shore of Great South Bay-East are owned by NYSDEC to protect their natural values. Elsewhere, the bay is bordered by federally owned wetlands (FINS and WNWR), open water, and low density residential development in some areas of Fire Island (Cashin Associates, 2003).

Species Surveys

Common Species

The entire fish and wildlife habitat of Great South Bay-East is approximately 12,800 hectares (32,000 acres), generally defined by the mean high water elevation on the north and south sides (exclusive of federal lands), by the Brookhaven town line to the west, and by Smith Point Bridge over Narrow Bay to the east.

Based on surveys, it appears that Great South Bay-East supports the largest wintering waterfowl concentrations in New York State, and is probably one of the most important areas for diving ducks in the northeastern United States. Waterfowl use of the bay during winter is influenced in part by the extent of ice cover each year. Concentrations of waterfowl also occur in the area during spring and fall migrations (March through April and October through November, respectively). Many species of migratory birds that typically occur in coastal habitats are found nesting or feeding in the remaining natural areas along the north and south shores of Great South Bay-East (Cashin Associates, 2003).

In addition to having significant bird concentrations, Great South Bay-East is an extremely productive area for marine finfish, shellfish, and other wildlife. Much of this productivity is directly attributable to the salt marshes and tidal flats found throughout Great South Bay. Great South Bay-East serves as a major spawning, nursery, and foraging area. A commercial fishery for Atlantic silverside and white perch has been established in the Bellport Bay area. Most of the bay waters are certified for shellfishing, resulting in a commercial and recreational harvest of statewide significance. Species commonly found in Great South Bay-East are listed in the Table 28 in Cashin Associates, 2005e.

William Floyd Estate National Park

The William Floyd Estate is located in Mastic Beach, fringing Moriches Bay at the mouth of the Forge River. The Estate property is owned by NPS and is managed as part of FINS. The Estate is comprised of 245 hectares (613 acres) of uplands, submerged lands, islands, five freshwater ponds, and over 60 hectares (150 acres) of wetlands. The William Floyd Estate supports the kinds of wildlife found across the peninsula, and is especially well-known for a long-studied population of box turtles (first marked in the 1910s). Approximately 82 hectares (205 acres) of the William Floyd Estate lie within the RAA buffer zone.

Wertheim National Wildlife Refuge (WNWR)

WNWR is operated by USFWS. It is comprised of approximately 1000 hectares (2,500 acres), and is bisected by the Carmans River which flows into Great South Bay-East. The Carmans River is a New York State designated Wild and Scenic River.

A portion of WNWR's terrestrial habitats includes pioneer hardwoods, dominated by black cherry and sassafras. Pitch pine forests are the most prominent upland habitat. Other canopy species include white oak, red oak, and black oak. Areas of warm season grasslands are dominated by little bluestem, switch grass, Indian grass, broomsedge, and big bluestem. Non-native grasses, including meadow grass, orchard grass, timothy, fescue, and crab grass, dominate cool season grasslands. One native cool season grass (sweet vernal grass) occurs on forest edges and as a component of forest meadows (USFWS, undated).

Close to 500 vertebrate species have been documented at WNWR (see Table 29 in Cashin Associates, 2005e). The refuge encompasses many of the vegetation types on Long Island, providing habitat for a variety of wildlife ranging from forest interior nesting, neotropical migrant birds to marine mammals. The coastal location of the refuge also makes it part of a major migration corridor for a variety of birds including waterfowl, water birds, raptors, and songbirds. Waterfowl use is extensive and WNWR serves as important wintering habitat for waterfowl from October through April. Waterbird use is common with peak periods for long legged wading birds, terns, shorebirds and other water birds occurring in the warmer months. Nine species of herons, egrets and ibises are commonly observed on the refuge (USFWS, undated). In addition, WNWR contains the largest breeding population of wood ducks on Long Island, and one of the Island's largest wild turkey populations. From October through April, the refuge harbors up to 400 black ducks, hooded mergansers, gadwall, and greater scaup.

The salt marsh supports various killifish species, bays provide seasonal habitat for many important commercial marine species, tidal rivers and streams support both catadromous and anadromous species, freshwater streams serve as trout habitat, and ponds and impoundments support warm water fisheries. More than 100 species of fish have been identified at the refuge.

Rare, Threatened & Endangered Species

Endangered, threatened and rare plant and animal species associated with WNWR are listed in Table 30 in Cashin Associates, 2005e.

4.2.5 Davis Park

General Land Use

The community of Davis Park is a seasonal beach community, measuring approximately 38 hectares (96 acres) in size. The majority of the residents in Davis Park are present only during the summer months. The summer population of Davis Park is estimated to fall between 1,200 and 2,800 residents (Jerry Stoddard, Fire Island Association, personal communication, 2004). Significantly higher numbers of people are observed during summer weekends and holidays, such as Fourth of July and Labor Day. Less than ten residents reside in Davis Park year-round.

Davis Park and the surrounding areas of Watch Hill and Blue Point Beach attract many non-residents with the recreational opportunities available at local beaches during the summer months. Recreational boaters often anchor just offshore in the Great South Bay, and can be found swimming, fishing, and sunbathing in the area. In addition, "day-trippers" make significant use of the ferries to access the regions secluded ocean beaches. While Davis Park is, for the most part, residential (more than 75 percent), several non-residential land uses exist including: a grocery store, snack bar, public restroom, park, and restaurant.

Davis Park is accessible primarily by water via the Great South Bay. Residents must use either private watercraft or public ferries to travel to and from the area. The majority of the residents reach their destinations by the Watch Hill Ferry Terminal that travels from Patchogue (on the mainland) to the Davis Park Marina. All ferries servicing the barrier island are seasonal and service is generally limited or discontinued during off-season months.

Fire Island is comprised of multiple beach communities and a series of Federal, State, and County parks that extend from west to east along the barrier island. Fire Island Inlet marks the western boundary of Fire Island and separates it from Jones Island, the next barrier beach system to the west. Fire Island Inlet receives considerable use from commercial and personal watercraft, as it is the only access point to the Atlantic Ocean in the Great South Bay for several miles in each direction.

Groundwater

Davis Park is located offshore from Hydrogeological Zone VI, as defined by the Long Island 208 Study. This area does not lie in any of the major Long Island drainage basins.

Underneath Fire Island is a lens of freshwater that floats on top of saltwater. This freshwater may extend as deep as 35 meters (120 feet) or more below sea level. In many places on Fire Island the groundwater comes right to the surface, which results in the formation of wetlands (National Park Service, 2004). It has been suggested that mosquito ditches may drain the fresh water lens aquifer (Crosland, 1974)

Soils

The RAA consists of a dune land-tidal marsh-beaches soil association. The topography of the association is typical of sand dunes and beaches. Beaches are made up of sand, gravel, or cobble areas between water at mean sea level and dunes. Dune land is made up of mounds or small hills of sand that have piled up by wind. Slopes of dune lands range from one to 35 percent. Both the beach and dune soils resources have been critically eroded and the native vegetation is currently very sparse on both (FINS, 2003). Fill land/dredged material is made up of areas that have been filled with material from hydraulic or mechanical dredging operations used mainly to widen or deepen boat channels. Tidal marshes are made up of wet areas that are not inundated by daily tide flow, but are subject to flooding during abnormally high moon or storm tides. Tidal marsh soils have an organic mat on the surface that ranges from a few inches to several feet in thickness, which overlies sand (US Soil Conservation Service in cooperation with Cornell Agricultural Experiment Station, 1975).

Hydrology and Significant Surface Waters

Within the boundary of the buffer zone in Watch Hill is a nine hectare (23 acres) tidally-restricted wetland. The center and northern portion of the marsh is grid ditched and contains a series of pools (these ditches have not been maintained since the 1960s). This portion is completely covered by approximately one foot of water. As a result of the tidal restriction and high groundwater level, the areas of open water and ditches within the marsh possess bog-like characteristics.

A bog lake is an aquatic community of a dystrophic lake (naturally acidic and rich in organic matter) that typically occurs in a small, shallow basin that is protected from wind and is poorly drained. Characteristic features of a dystrophic lake include murky water that is stained brown, with low transparency; water that is low in plant nutrients, with naturally low pH; and possible oxygen deficiencies in areas of deeper waters (Edinger, et. al, 2002).

Human Demographics and Human Uses

Approximately 4,100 homes are situated within FINS on Fire Island, including two incorporated villages, each of which have their own governing bodies. Approximately 350 to 500 of the residences are inhabited year round. The beach communities increase significantly during the warmer summer months. The number of visitors can be as high as 100,000 between the park areas and beach communities during the summer season (FINS, 2004).

According to the 2000 US census, the most common ethnicity of the FINS population is white (90.2 percent). The median age of residents is 42 years old, while the median household income is $73,281. Residential percentages for ethnicity, age and income ranges within FINS are displayed in Table 4-12, Table 4-13, and Table 4-14. It should be noted that the census data are not necessarily representative for summer residents.

Table 4-12. FINS Ethnicity

Ethnicity	Percentage
White	90.2
Black	0
Hispanic	5.2
Native American	0
Asian	0
Other-includes multiple races	4.6

Table 4-13. FINS Age Groups

Age	Percentage
0-4	1.3
5-9	4.9
10-20	16.1
21-29	3.9
30-39	12.8
40-49	29.8
50-59	15.1
60-64	4.6
65 plus	11.5

Table 4-14. FINS Household Income

Income ($)	Percentage
<10,000	4.1
10,000-20,000	8.8
20,000-30,000	8.8
30,000-40,000	11.6
40,000-50,000	12.2
50,000-60,000	1.4
60,000-75,000	6.8
75,000-100,000	8.2
100,000-150,000	19
150,000-200,000	10.2
>200,000	8.8

Ecological Habitats

General Habitat Settings

Davis Park is located in the Town of Brookhaven on Fire Island, within FINS. The Davis Park study area is approximately 40 hectares (100 acres) in size and includes the community of Davis Park. The study area buffer zone around the perimeter of Davis Park is approximately 187 hectares (469 acres) in size. The buffer zone includes portions of the Great South Bay, FINS at Blue Point Beach, Davis Park, FINS at Watch Hill, and the Atlantic Ocean.

The shallow, highly productive waters of the Great South Bay are a regionally significant habitat for marine finfish, shellfish, and wildlife. Finfish use the waters of the Great South Bay and the Atlantic Ocean for spawning, as a nursery habitat, feeding and general living space. Scientific studies have shown that more than 150 species of finfish occur in the waters adjacent to FINS.

Small sections of coastal wetlands exist along the northern boundary of the barrier island in Davis Park and the adjacent buffer zone. Coastal wetlands comprise two hectares (five acres) within the study area, and 76 hectares (192 acres) within the buffer zone.

The sandy beaches and dunelands of the barrier beach provide nesting sites for several avian species including the least tern and piping plover. Tidal flats habitat occur along the Great South Bay portion of Davis Park. Mudflats, beaches and dunes account for 1.5 hectares (three acres) in the study area and 174 hectares (184 acres) in the buffer zone.

Maritime beach heather communities occur behind primary and secondary dunes with infrequent overwash from heavy storm surge. This vegetation community is widespread on Fire Island, and

is found from one end of the island to another predominantly, although not exclusively, in the interdune zone (Conservation Management Institute, 2002). Conversely, northern dune shrublands occur on the leeward side of primary dunes and receive overwash during storm surges.

Unique/Critical Habitats

Fire Island Barrier Beach

Fire Island National Seashore, including Davis Park, is considered a unique and significant coastal habitat by the USFWS and is listed as one of the "Areas of Highest Priority in Great South Bay." Table 31 in Cashin Associates, 2005b lists unique, critical, and sensitive species found in Great South Bay. The barrier beaches of Fire Island provide protection for diverse terrestrial and aquatic habitats, while serving as the mainland's first line of defense against severe coastal storms and erosion.

Otis Pike National Wilderness Area

Although this wilderness area falls approximately 880 meters (3,000 feet) east of the study area, it is of worthy mention since it is a 6.4 kilometers (four miles) stretch of almost completely undeveloped, natural barrier island. A federal "wilderness area" designation assures that the area will be kept forever wild and natural. The peninsulas and coves of its bay side are rimmed with salt marshes of cord grass, salt hay and glasswort. Just inland are freshwater marshes of common reed grass (*Phragmites australis*). The slope of the land rises into the back secondary dunes. These shelter little groves of maritime woods are made of American holly, sassafras, and shadbush. They alternate with thickets of bayberry, poison ivy, wild grape, beach plum, winged sumac, and beach rose. In pockets between the woods and thickets are freshwater bogs of cattails. Towards the ocean, a low area between the secondary dunes and the primary line of dunes are desert-like in climate, with sunlight reflecting off the dune slopes, causing temperature extremes (National Park Service, 2004).

Primary dunes, up to 11 meters (40 feet) tall, separate the dune swales from the ocean beach. The dunes are vegetated by beach grasses, beach rose and poison ivy. The unstable dunes are barren, classic "sand dunes" whose sand grains are blown and shifted by wind. The vegetation

of the sandy sweep of Great South Beach are green algae (especially sea lettuce), brown algae (such as rockweed), and red algae (National Park Service, 2004).

Species Surveys

Common Species

A wide variety of animal and plant species are present within FINS during the year. Several species reside in the uplands and nearshore waters year-round while others utilize the barrier beach system as seasonal or migratory grounds at some point during the year (National Park Service, 2002). Species common to aquatic, transitional and terrestrial settings within the DRAA are listed in Table 31 to Table 35 in Cashin Associates, 2005b.

Researchers have identified more than 330 species of birds within FINS. Fire Island is located along the Atlantic flyway for shorebirds, waterfowl, and other birds that nest in the north and migrate south for the winter.

Rare, Threatened & Endangered Species

The federally-threatened piping plover and the federally-endangered least tern are known to nest on Fire Island. Piping plovers arrive on Fire Island in March, and begin egg laying and incubation during the months of April, May, and June. Plover chicks are generally hatch between May and August. The birds then migrate southward for the winter during August and September. Species associated with the RAA that are considered to be endangered, threatened or of special concern are listed in Table 36 in Cashin Associates, 2005b, while species of special emphasis in Great South Bay are listed in Table 37 in Cashin Associates, 2005b.

4.2.6 Study Area Pesticide Applications

Table 4-15 lists the applications of pesticides used to define the exposures for the purposes of the risk assessment. Table 4-16 lists adulticide application frequencies.

Table 4-15. Study area adulticide application rates, frequency and timing

Vector Control Management Plan Characteristics for Each Risk Assessment Area

Plan Characteristics	Impact Assessment Study Area Adulticide Data			
	Manorville	**Dix Hills**	**Mastic Beach-Shirley**	**Davis Park**
Agent	-----***	All	All	All
Delivery Method	-----	aerial	ULV-truck mounted or aerial	Handheld - backpack sprayer
Spraying Season	-----	mid June to early Sept.	mid June- mid Sept.	late June - early Oct.
Time of Day for Applications	-----	4-6 p.m.	dusk + 3 hrs	4-6pm
# Applications/ Spraying Season*	-----	2000-1 2002- 1	2000-8, 2001, 2003 & 2004- 5	2000 & 2004 - 8
	-----		2002 - 4	2001 & 2003 -12, 2002 - 14
# Days between Applications	-----	-----	min = 1 wk intervals	primarily once/week
	-----		2000 - 0,1,2,5,6,7,12,13	2000- range 6 to 14 days
	-----		2001- 5,7,58 2002 - 0,10,33,41	2001 & 2002- 7, 2003-7 except once 14
	-----		2003- 0,6,9,23,26 2004- 1,6,7,21,27	2004- 7 except once 28
# areas treated**	-----	1	-----	-----
Mean # of treatments/ season	-----	1	6.8	10.8
Maximum # of treatments/ area	-----	1	13	14
95% confidence interval	-----	-----	-----	-----

*Number of Applications During Spraying Season = the number of times a particular location received pesticides. If there were multiple applications/day for an area, the application was counted once.

**Number of Areas Treated = Number of SCVC ID locations.

***Manorville has not received adulticide from 2000-2004

Table 4-16. Study area adulticide applications for West Nile Virus and nuisance, 2000-2004

	Study Area			
Year	**Manorville**	**Dix Hills**	**Mastic Beach-Shirley**	**Davis Park**
2000	0	1W	9	7
2001	0	0	3	12
2002	0	1W	1	14
2003	0	0	1	8
2004	0	0	4 (2W)	8

W = West Nile Virus response application

4.2.7 Representativeness across Suffolk County

These areas were chosen to ensure that the range of pesticide applications used by the County would be included in the analysis. For larvicides, applications include aerial (Mastic-Shirley), truck (Manorville), and hand (Davis Park) applications, with examples of catch basin treatments (Mastic-Shirley and Dix Hills) and recharge basins (Dix Hills) included. Adulticide applications included those strictly for disease control, made by air (Manorville, Dix Hills, and Mastic-Shirley), and those strictly for vector control basis on a frequent basis by hand (Davis Park), and those made much less frequently by truck (Mastic-Shirley). A wide variety of the County's population was included, and land use included small lot to large lot residential, some multi-family housing, institutional uses, commercial sites, some industrial locations, vacant lands and parks of various types, and even a farm. Significant upland habitats (deciduous forests and pine barrens), important sensitive fresh water wetlands (coastal plain ponds, the Peconic River, kettle hole ponds), less sensitive wetland types (recharge basins and degraded fresh water stream systems), salt marshes, and open estuarine waters were all included in these areas. The selection is biased somewhat towards the western part of the County (where most people live) and perhaps not biased enough to the south shore, where most vector control work occurs. Nonetheless, it seems clear that no important ecological area in Suffolk County, or major land use, was excluded from the analysis. This means that the specific results associated with the risk assessment should be applicable to the County as a whole.

4.3 Alternatives Modeled

4.3.1. Evaluation Framework

The risk assessment was to evaluate two sets of management options that were considered by the County to support development of the Long-Term Plan.

The first, referred to as the evaluation management plan, was developed by the County essentially as a "straw-man" plan to support detailed assessment of a defined set of management options. Pesticide use, which was one component of the overall evaluation management plan, was the focus of this quantitative risk assessment.

In addition, a second set of management options was specified to address possible additions, modifications, or refinements to the overall management plan. This second set of options was referred to as alternative management options.

The risk assessment presented a detailed evaluation of the potential human health and ecological risks associated with the evaluation management plan, and then addressed how those risks might change if alternatives are implemented (see Sections 7 and 8).

4.3.2. Pesticides

The evaluation management plan considered the use of larvicides, adulticides, and repellants for application in the County. Larvicides are pesticide products that are used to control mosquito larvae. Adulticides are pesticide products used for the control of adult mosquitoes. Repellants are pesticide products that are used to ward off insects. The pesticides considered in the evaluation management plan are presented in Table 4-17 and discussed below.

Table 4-17 - Pesticide & Pesticide Products Considered in the Evaluation Management Plan

Agent	Pesticide Category	Class	Trade Name® ™ Representative Products
Bacillus thuringiensis israelensis (Bti)	Microbial pesticide	Larvicide	Vectobac, Teknar
Bacillus sphaericus (Bs)	Microbial pesticide	Larvicide	Vectolex
Methoprene	Insect growth regulator	Larvicide	Altosid
Malathion	Organophosphate	Adulticide	Fyfanon, Atrapa, Microflo
Permethrin	Pyrethroid	Adulticide	Permanone, Aquareslin
Resmethrin	Pyrethroid	Adulticide	Scourge
Sumithrin	Pyrethroid	Adulticide	Anvil
Piperonyl butoxide	Microsomal enzyme inhibitor	Synergist	--
Garlic oil	Biochemical pesticide	Repellant	Garlic Barrier

4.3.3. Larvicides

Larvicide applications were evaluated as a management tool to control mosquito abundance in high-density mosquito areas. Applications were assumed to occur via hand or via a variety of delivery systems, including backpack blowers and sprayers, truck and aerial (helicopter)

sprayers. Larvicides were assumed to be applied directly to mosquito breeding areas, including catch basins and wetlands. The larvicides identified in the evaluation management plan were:

- *Bacillus thuringiensis (var.) israelensis* (Bti). Bti is a naturally occurring soil bacterium that produces toxins that are effective against mosquito and black fly larvae. Bti products include Vectobac and Teknar.
- *Bacillus sphaericus* (Bs). Bs is a naturally occurring bacterium found in soil and aquatic environments that produces toxins that are effective against mosquito larvae. Bs products include Vectolex.
- Methoprene. Methoprene is a biochemical larvicide that acts as an insect growth regulator, initially preventing mosquito larvae from maturing and ultimately causing mosquito mortality. Methoprene is the active ingredient in the larvicide product Altosid.

4.3.4. Adulticides

Adulticide applications were evaluated as a management tool to reduce public welfare impacts associated with adult mosquito populations, and to reduce public health risks when mosquito-borne diseases pose a public health emergency, the latter to be defined using guidelines from CDC and NYSDOH. The application scenario for Davis Park was based on a consideration of reducing public welfare impacts from mosquitoes, as were some of the application scenarios for Mastic-Shirley. The application scenarios for Manorville and Dix Hills, and some of those for Mastic-Shirley, were based on consideration of reducing public health disease threats during public health emergencies.

The adulticides selected for consideration in the evaluation management plan were:

- Pyrethroids. Pyrethroids are synthetic chemical insecticides that act by disrupting nerve cell activity in insects, which ultimately leads to insect paralysis. They are most commonly used in combination with the synergist piperonyl butoxide (PBO) which is added to increase potency, and thereby decrease the amount of pyrethroid used in the formulation. The pyrethroid products considered in this assessment along with their synergist PBO are:
    - Resmethrin + PBO (Scourge);

- Permethrin + PBO (Permanone , Aquareslin); and
- Sumithrin + PBO (Anvil).

- Organophosphates. Organophosphate (OP) pesticides consist of a broad class of chemicals that act through the inhibition of the neurotransmitter enzyme acetylcholinesterase (AChE). In insects, this inhibition interferes with the nerve-muscle communication, which ultimately causes paralysis. The pesticide malathion was the OP pesticide identified in the evaluation management plan. Malathion is the active ingredient in the pesticide products Fyfanon, Atrappa, and Microflo and was evaluated in this risk assessment. In addition, this evaluation also considered malaoxon and isomalathion, which can be present as impurities in the formulated product and/or formed via environmental degradation.

4.3.5. Chemical Repellants

Chemical repellants also were evaluated as a management tool for broad-scale application. Chemical repellants are pesticides that are used to prevent or limit insect and other pest activity. Repellants are used in a variety of applications, including those associated with the protection of humans, pets, livestock and plants. Garlic oil was the repellant considered in the evaluation management plan. Garlic oil products include Garlic Barrier AG+ and Mosquito Barrier.

4.3.6. Application Methods, Frequency, Timing

The evaluation management plan considered a variety of options for the method, frequency, and timing of pesticide applications. Tables 4-18 and 4-19 present the application scenarios evaluated for each of the study areas.

Table 4-18- Summary of Study Area-Specific Larvicide Applications in Evaluation Management Plan

		Frequency				
Study Area	**Application Method**	**Average**	**Maximum**	**Time Between Applications**	**Season**	**Time**
Davis Park	BP-B, H	2	8	14-30 days	May-Sep	Day
Dix Hills	H, BP-S	1	2	40 days	May-Sep	Day
Manorville	H, BP-S	1	2	Not applicable	Apr-Aug	Day
Mastic-Shirley	BP-B, BP-S, H	3	14	7-30 days	Apr-Sep	Day
Mastic-Shirley	Truck-ULV	1	5	1-2 x per season	Apr-Sep	Day
*Mastic-Shirley	Helicopter	7	20	7-30 days	Apr-Sep	Day

*Mastic-Shirley is the only area that receives aerial applications of larvicides applied over marsh.
Notes: BP-B = Backpack blower; BP-S = Backpack sprayer; H = Hand application; ULV = ultra-low volume

Table 4-19 - Summary of Study Area-Specific Adulticide Applications in Evaluation Management Plan

		Frequency				
Study Area	**Application Method**	**Average**	**Maximum**	**Time Between Applications**	**Season**	**Time**
Davis Park	GC-HS, BP-S	11	14	7 days	Jun-Oct	4-6 pm
Dix Hills	Helicopter	1	1	Not applicable	May, Jun, Aug	Day
Manorville	Helicopter	2	2	14 days	Jun-Sep	Day
Mastic-Shirley	Helicopter	2	2	7 days	Jun-Sep	Dusk+3 hr
Mastic-Shirley	Truck-ULV	5	8	7 days	Jun-Sep	Dusk+3 hr

Notes: BP-B = Backpack blower; BP-S = Backpack sprayer; GC-HS = Golf cart with hand held sprayer; H = Hand application

The application frequencies listed for each study area were calculated based application frequencies in Suffolk County during the period 1999 to 2004. For risk assessment purposes, the maximum number of applications was used to ensure conservative results.

The range of application methods considered also were based on past practices, but were dictated largely by the nature and configuration of the study area with respect to inhabitants, mosquito breeding areas, and sensitive environments (e.g., wetlands), as well as the physical nature of the pesticide product (e.g., solid formulation larvicides such as Altosid briquettes). For example, hand-held sprayers and handguns are standard one- or two-gallon, garden style pump-up sprayers used to treat small isolated areas. A backpack sprayer also is used to treat smaller areas, typically for applying a pellet or small granular material. Truck and helicopters can be used to treat larger areas.

Liquid formulations can be delivered as thermal fogs or ULV applications. Currently, all adulticide applications by the County are ULV. ULV dispersal, as defined by the USEPA, is a method of dispensing liquid insecticides at the rate of one half gallon or less per acre. Insecticide is applied as an aerosol consisting of particles ranging in diameter from 0.1 to 50 microns (um), depending upon product specifications. Currently, for truck ULV and hand-held ULV sprayers, the County achieves a droplet spectrum with a mass median diameter (MMD) of 10 to 15 um. For helicopter ULV the MMD is 26 to 28 um. In the future, the County might consider thermal fogging (which is essentially a pesticidal smoke) to treat small tire piles or as a barrier treatment[2] on vegetation using on the order of 100 µm droplets.

[2] Barrier treatment is useful for small areas (e.g., a few acres) in areas where mosquitoes rest on vegetation.

4.4 Air Modeling Description

4.4.1. Introduction

An air dispersion modeling analysis was prepared in support of the overall assessment of using pesticides for mosquito control in Suffolk County (Cashin Associates, 2005a). The following summarizes the results of the modeling.

The initial work involved a literature review to identify the various approaches that have been used historically. Based on the literature, a select group of atmospheric dispersion and deposition models were chosen for use in quantifying impacts. These models were verified by means of field experiments and then applied to predict worst case and central tendency values for areas where pesticides used for mosquito control are sprayed.

4.4.2. Literature Review Findings

A literature review was conducted to identify and evaluate techniques used to predict atmospheric dispersion and deposition processes within the pest control industry. The review included techniques for aerial and ground-based application platforms. Several key parameters were identified as critical to model prediction accuracy. Various models for quantifying atmospheric dispersion rates as well as deposition rates were considered. A summary of the findings is presented below, along with the models selected for further evaluation.

Historically, the technology used to predict the behavior of pesticides from the point of release to the point of impact has evolved in response to a variety of different needs. The US Department of Agriculture - Forest Service developed models such as AgDRIFT and AgDISP to predict impacts from crop spraying with large droplets, near the canopy, aerial spray techniques (Barry, 1996; Bilanin et al., 1989; Teske, 1996). USEPA, on another front, was developing point source dispersion models for use in industrial settings. USEPA models include algorithms such as ISCST3, CALPUFF, AERMOD, CAMEO and CALINE that have a variety of capabilities for predicting the behavior of airborne gases and aerosols. Since each approach was attempting to solve a specific problem, it can be expected that the current uses of ultra low volume, fine droplets, and aerial application techniques for adulticides in the mosquito control industry will also require a specifically designed set of algorithms (Cashin Associates, 2005a).

There were several advances made in the mosquito control industry that required subsequent modifications of the modeling techniques that were traditionally used by the agricultural industry to predict the behavior of pesticides. For example, in agricultural pest control, an aircraft is positioned close to the ground, releasing a dense cloud of large droplets that coat the vegetation to halt or prevent insect activity. This provides maximum deposition directly onto the target area with minimal off-target drift. In contrast, for mosquito control, the aircraft can be positioned 200 feet above the surface and releases a fine droplet cloud. Fine droplets are necessary to control the mosquito population by contact, and elevated flight paths are used to minimize deposition on any surface. The objective is to contact flying insects. As one might expect, adjustments to traditional agricultural models were necessary to accurately predict mosquito adulticide behavior (Cashin Associates, 2005a).

Currently, there are several systems that are designed to assist pesticide control staff with meeting application protocol requirements. One of the most advanced systems has been designed by Adapco, Inc. The Adapco system consists of a Global Positioning System (GPS), real-time meteorology and the AgDISP model including a far field air dispersion extension. The system provides real-time measurements of ambient conditions during spray events and continually adjusts the spray pattern to impact the target area with the desired dose while minimizing off-target drift. The system was conceptualized in 2001 and continues to undergo improvements to address special and site-specific conditions (Cashin Associates, 2005a).

The models that were selected for use in this case for predicting adulticide and larvicide application impacts are platform-specific. For aerial applications, the selected model system uses the AgDISP model to predict the release of the pesticide from a helicopter and then tracks the plume until ambient atmospheric conditions predominate. At this point, the solution is transferred to the ISCST3 dispersion model to predict impacts in the far field. This combination of models allows for the prediction of both air concentrations and surface deposition rates specific to the aircraft parameter, meteorological conditions and surface conditions. For surface applications in this case, the selected modeling system uses the ISCST3 dispersion model only to predict the release and dispersion of a truck or other surface-based technology. Model parameters are set to simulate the specific release, elevation of spray cloud, topography, meteorology during the spray event, and thereby, predict the air concentration and deposition rates for each specific application (Cashin Associates, 2005a).

4.4.3. Health Risk Assessment Requirements

An assessment of the health and ecological risk posed by the use of various adulticides and larvicides via various application platforms to control mosquito populations is an integral part of the Long-Term Plan planning process. As such, the risk assessment requires a variety of impact analysis estimates to be able to calculate the individual and combined risks associated with the SCVC mosquito control program. A series of impact analyses for several areas where adulticides and larvicides are used was therefore developed to provide the data base for calculating risk.

The selected study areas were Dix Hills, Manorville, Mastic-Shirley and Davis Park. Aerial spraying of adulticides is possible in Dix Hills, Manorville, and Mastic-Shirley. Truck spraying is associated with Mastic-Shirley. Hand held spraying is performed in Davis Park. Larvicides are applied in Mastic-Shirley via truck and helicopter.

For adulticide applications, the time period of interest is any period during which a spray event can occur. The normal mosquito spraying season is July through September. Therefore, the Islip Airport hourly meteorological data over a five-year period (1987 to 1991), using the hours of 7:00 PM through 2:00 AM, when winds were less than 10 miles per hour, and temperatures greater than 65ºF, were used to define the overall range of potential meteorological conditions when spraying might occur (Cashin Associates, 2005a).

The list of potential adulticides included:

- Scourge containing resmethrin and PBO
- Anvil formulation containing sumithrin and PBO
- Fyfanon, which primarily consists of malathion
- Permanone, which contains permethrin and PBO

Model runs were executed for each compound individually for all study areas, for both air concentration and deposition rates for projected events during a spray season (Cashin Associates, 2005a).

Model predictions were required for all areas including one quarter mile buffer zones around the target areas. A square grid of receptors was positioned over each area of interest. A receptor

grid density of 250 meters by 250 meters in the target area and in the buffer zone was used to define hourly maximum and average values. In all, more than 1,550 hours of potential meteorological conditions were used to define maximum hourly air concentration and deposition rates (Cashin Associates, 2005a). Integral Consulting then applied these hourly estimates to calculate acute and chronic risk factors.

4.4.4. Deliverables for Risk Analysis

The deliverables package for the risk assessment for adults included estimates for both air concentrations and deposition rates. Individual estimates were provided for each spray area (total of four areas), for each application method (aerial, truck, hand held), and for each potential adulticide in use (total of seven pesticides). The values represented individual air concentrations and deposition rates at all receptor location input into the air dispersion modeling system. The values do not account for losses due to tree canopies, buildings or other obstacles. No chemical or physical degradation of the adulticides is assumed. The air dispersion estimates of larvicide impacts were only supplied for the Mastic-Shirley area where aerial spraying of larvicides occurs. Modeling estimates of impacts for larvicide applications by truck/hand held sprayers were not provided because the sprays contain very large droplets that are not dispersed by the wind. However, box model calculations were performed and results were provided for risk analysis (Cashin Associates, 2005a).

In summary, the following modeling files were supplied:

- Hourly air concentration values for optimized spray protocols for each of the 1,553 hours within the target area and in a quarter mile buffer zone surrounding the target area.
- Period average (1,553 hours) air concentrations for optimized spray protocols within the target area and in a quarter mile buffer zone surrounding the target area.
- Hourly total deposition for optimized spray protocols for each of the 1,553 hours in the target area and buffer zone
- Total deposition impacts over period (1,553 hours) for the target area and buffer zone.

Period average values for air concentrations are developed from taking all hours when spraying could occur over a five year period, and modeling all hours in one model run. In essence, this assumes a continuous source releasing adulticides for 1,553 hours and then dividing by the 1,553

hours to calculate an average value. This maximum central tendency value is approximately 40 percent of the individual hourly maximum concentration values (Cashin Associates, 2005a).

Period average values for deposition are the total deposition that would occur for a continuous release over 1,553 hours. When this value is divided by 1,553 hours, the result is an average deposition rate case per hour over any one spray event hour. Depending on the number of hours of spraying in an area, this value can be adjusted to account for individual events. The value can be further adjusted for the maximum number of events per year to obtain a total deposition rate over one worst case spraying season. This could be further expanded by averaging in the average number of events per year to generate an average total deposition rate over a lifetime (Cashin Associates, 2005a).

Air concentration and deposition impacts caused by aerial larvicide applications were calculated using the AgDISP model for two larvicides used by SCVC in the Mastic-Shirley area. Deposition impacts were also provided to the risk assessment project team for a truck release based on the actual flow rate, assuming no dispersion of the spray (Cashin Associates, 2005a).

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