

13 Impact Assessment Conclusions

The Long-Term Plan was the product of several years work. It is not surprising, therefore, that it was deemed to have the fewest potential impacts and greatest potential to deliver benefits.

13.1 Human Health

The Long-Term Plan appears to benefit human health by conducting mosquito control in an IPM framework. The potential for human health impacts from WNV appears to be on the order of 16 deaths and 150 serious neurological illnesses requiring hospitalization per year, if there were no vector control management in Suffolk County (see Section 9). Current operations have limited WNV impacts to 26 illnesses, four of which resulted in death, over seven years of exposure (counting 1999 and 2005) (there were seven cases of West Nile virus illnesses in the County in 2005 [S. Campbell, SCDHS, personal communication, 2006]) (see Section 3). The Long-Term Plan is expected to maintain this effectiveness against the disease.

Table 13-1. Comparison Between Modeled and Actual WNV Cases, Suffolk County

	2000	2001	2002	2003	2004	Totals
Actual Cases	0	1	8	10	0	19
Actual Deaths	0	0	2	2	0	4
Modeled Cases	152	157	151	156	24	639
Modeled Deaths	15	16	15	16	0	64

As discussed in Section 7, continued control of bridge vectors and comprehensive surveillance to guide control operations are expected to continue to provide County residents with protection against EEE, and to guard against impacts when a novel disease is introduced. Expanded surveillance and treatment of storm water structures, and greater outreach for maintenance of these devices, is expected to reduce disease threats presented by *Culex pipiens* mosquitoes. Efforts to remove discarded tires, and continued source reduction steps in general are expected to keep mosquito breeding opportunities to a minimum. It should be noted that the chance of local cases of malaria, Dengue fever, or yellow fever is considered to be extremely small, but that surveillance and the control program ensure that any impacts from these diseases would also be limited.

Control of the major human-biting species ensures that non-clinical impacts are also minimized under the Long-Term Plan.

These benefits to human health in the County must be weighed against any potential impacts to human health. However, no aspect of the Long-Term Plan appears to have the potential to increase risks to human health. The risk assessment found that the selected pesticides (Bti, Bs, methoprene, resmethrin, sumithrin, permethrin, natural pyrethrum, and malathion) all have no potential to increase risks to human health impacts. A qualitative assessment of the carcinogenic potential of permethrin found it has an exceedingly small chance of generating excess cancer within the County, even if used extensively for a prolonged period of time. A literature search found no epidemiological evidence that the selected agents would harm children's health or cause breast cancer, but the potential for impacts to children's health was noted (realizing the potential would require exposure to doses great enough to cause the effect; the risk assessment deemed that exposures at sufficiently great concentrations would not occur).

Mitigation of pesticide use (and the remote chance for human health impacts) is an essential goal of the Long-Term Plan. By relying on progressive water management, it is anticipated that the use of aerially-applied larvicides can be reduced by 75 percent over the next 12 years. In association with that decrease in larvicide use, gained by considering progressive water management in the marshes that require larvicides at this time and implementing those projects that have no consequential environmental impacts, it is anticipated that adulticide use might also be reduced. The means to accomplish this are not as transparent, as it is difficult to directly reduce pathogen presence in mosquitoes. The County's careful determination of the location and potential for pathogen transmission associated with human-biting mosquitoes will enable it to take control measures that may lessen the need for adulticide applications. Reductions in pesticide use, even if the pesticide is believed to be safe for people as applied, is beneficial because:

- The chance for accidental spills or mistakes in applications is minimized
- Reliance on pesticides for control is not as effective as source reduction steps

- The potential for resistance occurs with pesticides use, and increases with increased usage
- Suffolk County has a local law that seeks the phase-out of pesticide use

Reductions in pesticide use will also be realized through optimization of application techniques, enabled by use of the Adapco weather station-deposition model-flight control system.

13.2 The Environment

The IPM approach to mosquito control, especially when guided by comprehensive surveillance and using progressive water management techniques, not only has minimal potential for environmental impacts, but has the potential to generate environmental benefits.

Environmental benefits can accrue through implementation of progressive water management techniques. These range from allowing reversion of the ditches to conducting major alterations to the existing marsh conditions. Selection of techniques is key, as the greater the alteration, usually the better the chance of achieving improvements to current conditions, and generating environmental benefits. The basis for the environmental improvement is that progressive water management relies primarily on natural predation of mosquito larvae by killifish to achieve control. Creating improved habitat for killifish in proximity to mosquito breeding areas generally results in improved water quality, enhanced tidal circulation, and more/better habitat for other guilds of marsh biota. Careful review of proposed projects by the Screening Committee, for major projects, and by local environmental resource departments for minor projects, will help to ensure that the only projects that are undertaken are those where the achievement of environmental benefits is extremely likely. The County is also anticipating the generation of an overarching, County-wide marsh management policy that will be based on maximizing marsh health. This policy will also steer project selection towards those sites where the greatest benefits can be realized.

The Long-Term Plan also avoids some environmental impacts associated with previous mosquito management approaches. Fresh water environments are singled out for further study, to ensure that those with local information can help SCVC adopt techniques to minimize effects to sensitive organisms or environments. *Gambusia* (the mosquito fish), which has the potential to

be invasive when introduced into novel environments, will be phased out, replaced by other species with more benign local presences. Use of fish introductions in fresh water settings will be conducted warily, to ensure that predator-free environments that may be important (locally or for at-risk species) remain so. Ditch maintenance is no longer the primary water management technique to be employed by the County; minimization of the maintenance of the legacy grid ditching across the County's marshes means the potential for negative impacts associated with those ditches is minimized. The selected larvicides (Bti, Bs, and methoprene), according to analysis of the relevant literature, the quantitative risk assessment, and several field investigations conducted as part of the Long-Term Plan development, do not cause increases in risks of ecological impacts. Furthermore, the implementation of the progressive water management program is expected to reduce aerial larviciding by three-quarters, further reducing opportunities for impacts due to pesticides use. The County will also be seeking opportunities to implement numerical triggers on larval abundance, which may also minimize larvicide use.

There is the potential for environmental impacts from aspects of the Long-Term Plan, however. The implementation of progressive water management, if not accomplished in a sound, scientific, and defensible manner, has the potential to cause harm to the County's wetlands. For this reason, reversion is to be the presumptive interim action for County marshes, and no actions for mosquito control purposes are likely to be even considered in nearly one-quarter of the salt marsh acreage in the County. To guard against unwise selection of water management techniques, SCVC will be conducting its work through consultation and review with local and concerned agencies, and a process has been established to enable technical input and guidance into major project design and implementation. Monitoring of County wetlands in general, and project sites in particular, will be necessary to ensure that management actions attain their intended goals.

Although the Long-Term Plan emphasizes the use of surveillance and source reduction to primarily achieve its human health and quality of life goals, the use of pesticides to control mosquitoes at some times appears to be inevitable. Adulticides were selected that have been shown to be effective, have the ability to meet County management needs in terms of potential application areas and means of application, and also cause little to no environmental impacts. These agents all have the potential to cause harm to various living things, and can be toxic at

very low concentrations. However, because mosquitoes are fragile insects, and application means have been developed that result in the use of extremely small amounts of pesticides to treat substantial areas, the concentrations resulting from modern mosquito control applications tend to be even lower than the potential toxic levels. Field work, including tracking the applications of resmethrin in a salt marsh in Mastic-Shirley, and determining if that application might affect fish and shrimp in a nearby marsh, showed no effects from the applications. This echoed the standard findings reported in scientific literature. The quantitative risk assessment also found no substantial risks of ecological impact from applying the pesticides. However, each of the compounds showed a potential increase in risks for harm to flying insects during an application. This was based on a model developed to determine impacts to bees. Most of the literature believes that the concentrations used, which are much less than those needed for effective results against agricultural pests, will not result in harm to other insects. A study in California, while finding some decreases in flying insect biomass in conjunction with mosquito control adulticide applications, also found that the control site also experienced decreases in flying insect biomass, and the populations rebounded very quickly post-application. A few other, less relevant studies, found similar results. Thus, the impacts from pesticides to flying non-target insects have generally been found to be small and fleeting in duration. In addition, two of the selected compounds, permethrin and malathion, were found to have the potential to increase risks for impacts to aquatic invertebrate populations. When it was assumed that the impact would occur, sophisticated ecosystem modeling for permethrin found that the impacts did not propagate in the food web, as the complexity of the natural order allowed for organisms to compensate for the losses. The invertebrate populations that were assumed to be impacted were modeled over time; the modeling found that the populations tended to quickly recover, and under no circumstances were any long-term impacts found. All modeled populations recovered completely by spring (following late summer applications), except perhaps for amphipods, and for those invertebrates the impacts were not significant. The potential for impacts are mitigated in that resmethrin and sumithrin are the preferred pesticides (if adulticides are needed to be used), and these compounds did not show similar elevated risks. In addition, the local field work strongly suggested that resmethrin (at least) is much more ephemeral in the environment than the conservative modeling allowed for. If the pesticides degrade more quickly than modelers anticipated, then it is even less likely that the impacts will be realized. Finally, the extent of

adulticiding, even under past practices, has been over a maximum of six percent of the County in recent years. This also limits the potential of significant impacts on a County-wide basis, even if some local effects did occur. Therefore, if adulticides need to be used, there is a potential for impacts, but the potential for effects is not significant, and is mitigated by other factors.

The Long-Term Plan is expected to lead to decreases in human health risks, improved public welfare due to the alleviation of quality of life impairments, and not contribute to any increase in human health impacts as all treatment choices appear to have no risks of effects to human health. Its reliance on water management to achieve mosquito control goals, and the implementation of progressive water management, means that many of the County's marshes may be restored as part of management to control mosquitoes. Other aspects of the Long-Term Plan also may improve environmental conditions by refining aspects of current vector control practices. There is a significant potential for environmental effects, particularly if water management implementations are not carefully considered, but programmatic controls and processes are intended to minimize opportunities for missteps. The use of biorational larvicides appears to result in little to no ecological impacts from their use, except for potential application effects, especially using low-flying airplanes (which is mitigated by the goal of reducing aerial applications by three-quarters over the next 12 years). Adulticides will continue to be the last option for vector control; the preferred compounds (resmethrin and sumithrin) appear to have no impact on non-target biota (except, in some application means, and for bees and sensitive flying insects that intercept pesticides as they are applied). Two other options, permethrin and malathion, may also have some impacts to aquatic invertebrates. Modeling suggested the permethrin impacts are fleeting, and it is thought the same processes making permethrin impacts short-lived will also make any potential malathion impacts not significant.

13.3 Alternatives

The existing program has similar impacts, but may have fewer benefits, as it currently does not employ progressive water management. Various improvements in surveillance, public education and outreach, source reduction, use of biocontrols, and larvicide and adulticide decision-making make the Long-Term Plan superior to current practices – but the current program has many overall similarities to the Long-Term Plan, and so their general impact level is approximately the

same (with the exception of water management). Although no significant risks for impacts were determined for pesticides used under the current program, implementation of the Long-Term Plan is anticipated to result in up to 75 percent reductions in larvicide applications, and reductions in adulticide use (although probably not of the same scale). This avoids potential impacts from pesticides (even if the work presented here suggests potential impacts from pesticides will not be realized), should lead to more consistent (and thus better) control of mosquitoes, and supports the important County policy of reducing, wherever possible, the use of pesticides. Thus, the Long-Term Plan appears to be superior to the current means of conducting mosquito control.

None of the considered IPM alternative agents or practices offered any significant reduction in human health or ecological risks – and in fact, almost all of them substantially increased one or the other, or both.

The considered option to have no vector control at all did not compare well to the Long-Term Plan. With no vector control, there appears to a significant risk for much larger human tolls from mosquito-borne disease, and there does not seem to be any offset in terms of health benefits garnered from having no control activities. Ecologically, there will be some reduction in potential risks from not using adulticides. There also will be no benefits from implementing progressive water management, and there are some indications that a program of no management of area wetlands will lead to deterioration in at least some of those important environments.

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