MOSQUITO & BLACK FLY MANAGEMENT PLAN

2015 – 2019

Adopted 20 January 2016

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

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PART A – STRATEGIC OVERVIEW

1.1 Executive Summary

Banana Shire Council has developed a Mosquito and Black Fly Management Plan in accordance with the Mosquito Management Code of Practice developed by the Local Government Association of Queensland. This Plan was also put together to satisfy Council's legislative responsibilities to effectively manage a practical control program.

The Mosquito & Black Fly Management Plan identifies specific objectives and goals; aligned with some specific actions which enable Council to meet their goals. The core principals underlying these goals include:

- *Reduce Pest and Disease Impact on the region;*
- *Appropriate Surveillance and Resources;*
- *Appropriate Competencies;*
- *Program Performance Review; and*
- *Community Awareness.*

The main focus of the Mosquito & Black Fly Management Plan is to characterise the distribution and ecology of key mosquito species throughout the region to better understand the risk posed and, accordingly, identify appropriate vector management activities to be implemented, where necessary. These activities will mitigate the risk to the community of contracting vector-transmitted diseases as well as reduce the nuisance value of the pests. The Plan will similarly look at distribution and ecology of Black Fly throughout the region and identify appropriate pest management activities to be implemented, where necessary. The Plan also focuses on proactive management activities, with the aim of reducing reactive management activities.

Banana Shire Council (BSC) is committed to the implementation of the Plan which has been developed with consideration for relevant best practice methods, legislation and the environmental amenity of the region.

1.2 Vision

To protect the health, lifestyle and welfare of residents within the Banana Shire Council area.

1.3 Mission Statement

Gather appropriate information and data to determine the level of risk associated with mosquito breeding within the Banana Shire Region; and reduce the incidence of vector borne diseases and the nuisance value created by recognised mosquito pests and black flies with the Banana Shire Council area.

1.4 Objectives

- *To identify and control vectors of disease using the most cost effective and environmentally sound management methods;*
- *To identify triggers for implementing management measures to control vectors and nuisance pests (mosquitoes and black fly) emergence and identify appropriate actions;*
- *Implement surveillance and monitoring programs to understand mosquito breeding and populations within our region;*
- *To increase preparedness in relation to vector borne disease and nuisance complaints;*
- *To continually review and adopt best practice methods of vector surveillance and management;*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Provide an effective and equitable mosquito & black fly management service to the communities of Banana Shire Council;*
- *To increase community and stakeholder awareness of Council's Mosquito & Black Fly management Plan;*
- *Undertake mosquito management in a manner consistent with Mosquito Management Code of Practice and the Australian Mosquito Control Manual;*
- *To have sufficient resources and knowledge, within Council, to react to mosquito and black fly complaints and inundations;*
- *Utilise an integrated management approach which minimizes chemical use, is sustainable and considers the environmental assets of the region; and*
- *Commit to an adaptive management framework to develop and implement proactive and effective operational procedures.*

1.5 Goals

- ***Goal 1*** *- Reduce the pest and disease impact of vectors on the Banana Shire Region.*
- ***Goal 2*** *– Ensure that mosquito surveillance and management is conducted in a cost effective manner and is consistent with the Mosquito Management Code of Practice for Queensland and The Australian Mosquito Control Manual.*
- ***Goal 3*** *– Increase knowledge of key vector species and promote, educate and inform Council (management and Staff) and the community about Mosquito and Black Fly Management.*

1.6 Aims

Specifically, the BSC aims to achieve the following through the implementation of the Mosquito & Black Fly Management Plan:

- *Identify priorities for surveillance of mosquitoes based on the associated risk;*
- *A risk-based approach will be used to identify locations where and times when surveillance activities should be conducted. Further, best practice tools will be adopted to enhance surveillance efforts;*
- *Gather information to make informed decisions regarding mosquitoes and black flies*;
- *Surveillance activities will assist the acquisition of knowledge regarding local species which, over time, may identify triggers for emergence. Local observations should include - collate weather data to determine prime breeding conditions, identify breeding and monitoring sites*;
- *Increase capacity and preparedness to respond to identified risks and disaster situations*;
- *The BSC aims to increase its capacity to respond to perceived mosquito risk including (but not limited to) nuisance complaints, vector borne disease cases and, disaster situations. Response actions will be enhanced through the establishment of communication and a good working relationship with stakeholders and increased knowledge and skills amongst the workforce.*
- *By increasing knowledge and capacity to respond to risk, the BSC will be better placed to deal with local transmission of vector borne diseases and incursions of exotic mosquitoes, by having response methods and resources identified*;
- *Identify resources required to achieve a sustainable program*; *and*
- *As a part of The Plan, BSC will project a forward view of mosquito management by implementing sustainable procedures and recognising future, training and, community education*.

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PART B – PRELIMINARY INFORMATION

2.1 Introduction

The effective management of mosquitoes in the Banana Shire Council (BSC) area is of considerable importance given the impact on public health due to diseases such as Ross River, Barmah Forest and potentially Dengue fever, kunjin and chikungunya; and to the impact on outdoor activities of residents due to nuisance biting of mosquitoes and black flies.

Further surveillance is required to identify the various mosquito species present within the BSC area. Once this information is gathered the risk of disease transmission and the extent of the nuisance can be better appreciated. Importantly, key vector species including *Aedes aegypti* 'primary vector of Dengue viruses' and *Culex annulirostris* vector of 'Ross River viruses are both found within the BSC region.

The Banana Shire Council's Mosquito & Black Fly Program aims to gather and provide current information regarding the distribution and abundance of important mosquito species to better understand risk posed by mosquitoes to the community. Further, the program aims to keep mosquito populations at acceptable levels through the effective provision of various forms of treatment and control measures. It also aims to reduce the nuisance factor from black flies in accordance with guidelines set by Queensland Health.

2.2 Scope

- *Mosquito & Black Fly Management Plan specifically highlights Mosquito surveillance and control programs.*
- *Identify suitable surveillance methodologies and locations which should be monitored with priority, based on local risk from mosquitoes.*
- *Identify species of mosquitoes within the region and determine the Public Health Risk.*
- *Identify potential and actual mosquito and black fly breeding sites within the region.*
- *Determine the relative densities of mosquitoes and black flies and the seasonal fluctuations.*
- *Identify resting sites for mosquitoes and black flies that impact on the community.*
- *Identify training needs to implement the Plan.*
- *Provide the community with general information regarding mosquitoes including habitats and life cycle.*
- *Provide the community with general information regarding black flies including species habitats and life cycle.*
- *Follow guidelines provided by Queensland Health when dealing with Black Fly and Mosquitoes during disasters. (Queensland Health Guidelines for Controlling Public Health Risks relating to Mosquitoes, Flies and Black Flies in a Flood Event).*
- *Identify triggers for interventions and consider treatment options currently available.*
- *Examine chemical usage options and measurement of treatment efficacy.*
- *Examine environmental considerations ensuring compliance with Environmental Protection Act 1994 and guidance contained in the Mosquito Management Code of Practice 2002.*
- *Institute a climate of continual research and development for Mosquito Management programs.*

2.3 Legislative Framework

Pursuant to the *Public Health Act 2005*, Queensland Health in conjunction with Local Government has the responsibility for the control of communicable diseases in Queensland. A number of vector-borne diseases come under the classification of a communicable disease including Ross River, Barmah Forest, Dengue Fever and Malaria.

The control of mosquitoes is a responsibility specifically delegated to Local Government under the *Public Health Act 2005*. The Act places responsibility on owners, occupiers and local government to perform

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appropriate works or actions to prevent the breeding of mosquitoes in areas under their control or responsibility.

In cases where the owner or occupier fails to comply with requirements, the Act gives power to Local Government to issue Penalty Infringements Notices and/or undertake the necessary works. Where Council is required to undertake works, any cost incurred will become a charge on the land and thus recoverable.

There is currently no legislative requirement for Local Government to have a Mosquito/Vector Management Plan.

Other legislation relevant to Mosquito/Vector management activities include:

- *Agricultural Chemical Distribution Act 1966 and associated Regulation;*
- *Chemical Usage (Agricultural and Veterinary) Control Act 1988;*
- *Environmental Protection Act 1994;*
- *Fisheries Act 1994 and associated Regulation;*
- *Nature Conservation Act 1992 and associated Regulations;*
- *Pest Management Act 2001 and associated Regulation; and*
- *Public Health Regulation 2005.*

2.4 Council Policy

The implementation of the Banana Shire Council Mosquito & Black Fly Management Plan can be associated with certain outcomes of Council's Corporate Plan.

2.4.1 Corporate Plan Outcomes

The Mosquito & Black Fly Management Plan can be associated with the following outcomes within Council's Corporate Plan:

- 1.2.2 Communications

    a. Community Engagement

    - *Implement Council's Community Engagement Plan;*

- 1.2.4 Emergency Management

    - *Minimize the impact of any emergency and respond to community needs.;*

- 3.1 Environment

    To promote and manage the unique natural resources of Banana Shire, ensuring a healthy and sustainable environment where the community's social, physical and economic well-being is enhanced for present and future generations; and

- 3.2.1 Natural Environment

    a. Pest and Weed Management

    - *Continuously review, improve and implement a pest management plan to protect our natural environment.*

Council will require a sufficient budget to cover initial surveillance, equipment purchase, contract work, treatments, monitoring, health promotion media and television advertising. Funding also needs to incorporate costs of staff undertaking surveillance specifically for the urban breeding *Aedes aegypti*.

2.5 Environmental and Safety Considerations

The inherent nature of mosquito and black fly management activities has the potential to adversely affect the environment. The *Environmental Protection Act 1994* Chapter 7, Part 1 Division 1, Section 319 makes

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clear statements of intention in relation to a person's responsibility and the environment, known as General Environmental Duty. Section 319 of the *Environmental Protection Act 1994* states the following:

- '*A person must not carry out any activity that causes, or is likely to cause environmental harm unless the person takes all reasonable to practicable measures to minimize the harm'.*

The Act stipulates that all activities, including mosquito management activities, should take environmental issues into consideration. The Mosquito Management Code of Practice for Queensland and the Australian Mosquito Control Manual provide further guidance.

Due to the nature of mosquito and black fly control operations through the use of 4WD vehicles, all-terrain vehicles and the continual use of chemicals, safety of the operator is imperative. All activities associated with the implementation of the Plan will be consistent with Council Workplace Health &Safety Policy and Plans.

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PART C – BACKGROUND

3.1 Mosquito Borne Disease Significance

Mosquitoes are blood sucking insects that are responsible for the transmission of many pathogens throughout the human and animal populations of the world. Within Australia there are more than 300 different species of mosquito but only a small number are of major concern to public health. Clinical symptoms associated with vector borne disease range from mild fevers, to a severe and potentially life threatening haemorrhagic disease. Several important human diseases are transmitted in Australia by these insects including Dengue fever, Australian encephalitis, Ross River virus disease and Barmah Forest virus disease; malaria has been transmitted locally in Australia only rarely in recent decades. Chikungunya is also emerging as a possible threat. The disease is evident in South East Asia and has been found more recently in Papua & New Guinea. This is an extremely debilitating disease and mosquitoes that are known to be able to transmit the disease are found in Australia. In addition to being disease vectors, mosquitoes can cause major disruptions, through their persistent biting, to occupational, recreational and social activities.

3.1.1 Notifications

Each year in Queensland, there are over 3000 cases of mosquito borne disease, with the most common being Ross River Virus, Barmah Forest Virus and dengue. There have been notifications of Barmah Forest virus and Ross River virus in communities within the Banana Shire in 2013.

Despite an absence of dengue notifications in the BSC area in recent years the presence of the dengue vector, *Aedes aegypti*, in towns within the BSC highlights the vulnerability of the region. Indeed, dengue cases imported into the region could present a public health risk with each providing an opportunity for local transmission if sufficient mosquito vectors are present. Thus, ongoing monitoring of *Aedes aegypti* populations is necessary to accurately assess risk across the BSC region. If dengue cases are notified to the Public Health Unit, contact will be made with local government to assess risk and consider possible mosquito control measures.

3.2 Mosquito Overview

Mosquitoes belong to the family of flies called Culicidae and are small fragile insects that have two wings covered in scales and a head equipped with a forward projecting proboscis which conceals and protects the long piercing and sucking mouthparts. These biting insects have a complex life cycle; the immature stage is totally aquatic while the adult is terrestrial. The adult female returns to a water habitat for a brief period to lay each batch of eggs. Importantly, mosquito species vary in their breeding habits, biting behaviour, host preferences and flight range. Most mosquitoes disperse less than two kilometres; some move only a few metres away from their original breeding place, others can fly some five (5) or ten (10) kilometres, and a few species will disperse up to fifty (50) kilometres downwind from the larval habitats.

On average, a female mosquito will live two (2) to three (3) weeks, but the male's lifespan is shorter. Within their lifetime both adult male and female will feed on nectar and plant fluids, but some females will also seek a blood meal. The majority of species require this blood meal as a protein source for egg development. Female mosquitoes are attracted to a potential host through a combination of different stimuli that emanate from the host including carbon dioxide, body odours, air movement or heat. Upon locating a suitable host, the female will probe the skin for a blood capillary then inject a small amount of saliva, presenting a potential pathway for the transmission of pathogens such as viruses to enter a host. After engorging on the host's blood the female will find a resting place to digest the meal and develop eggs before dispersing to deposit them in a suitable aquatic habitat.

As stated earlier mosquitoes have the ability to breed in a wide range of environments including; freshwater wetlands, salt marshes, highly polluted waters and artificial containers.

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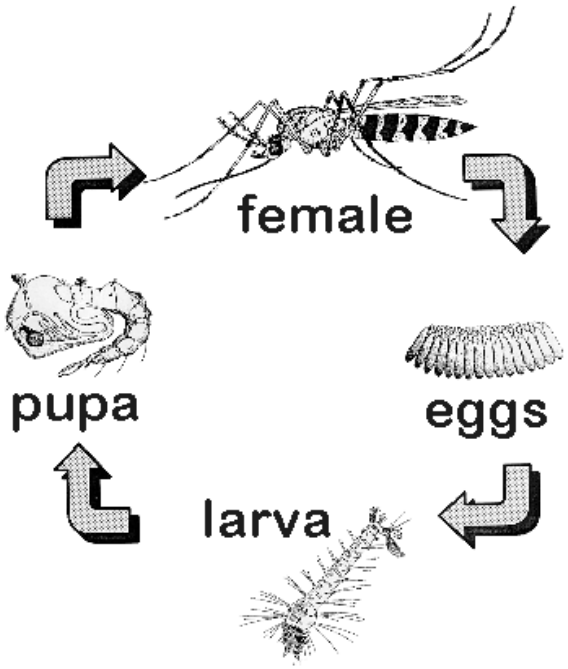
Within the Banana Shire Region there are two distinct habitats:

1. *Groundwater/freshwater/polluted water breeding, and*
2. *Urban/Container breeding*

3.2.1 Lifecycle



Mosquito eggs are laid either on damp surfaces, just above water level or on the surface of water as a raft as shown in the diagram. The eggs of some species may survive drying and can remain viable for many years awaiting rainfall or tidal inundation to facilitate hatching. The eggs hatch into larvae (wrigglers) that need to feed continuously to progress through the four (4) developmental larval stages (increasing in size with each stage). This development is dependent on the availability of food and the prevailing conditions, particularly temperature, but generally takes at least one to two (2) weeks. The final larval instar develops into a non-feeding pupae stage. The adult mosquito emerges from the pupal skin, generally within two (2) days and feeds, then mates and develops eggs for the next generation.

With the exception of a few species, female mosquitoes require a blood meal for egg development, with a single female capable of laying between 200 and 400 eggs within a two (2) to four (4) week lifecycle. Male mosquitoes do not bite but feed only on plant sugars.

The length of the breeding cycle is very much dependent of climatic conditions with the characteristic hot days often experienced in the Banana Shire region potentially shortening a complete cycle and accelerating development.

Mosquitoes differ in their biology and required larval habitat between species. Further, different species vary in their host feeding preferences and ability to transmit various pathogens. Accordingly, surveillance and control methodologies must be tailored to the biology and ecology of target species to maximize the impact of interventions. For the purposes of description of surveillance and control methodologies, two (2) general classes of mosquitoes can be described: those that inhabit groundwater including flooded pools and saltmarshes and those that inhabit small containers in urban environments.

Not all mosquitoes bite humans. Currently the number of competent vectors within the Banana Shire region is unknown, but this Plan aims to ensure the required information is gathered so that informed decisions on appropriate responses/actions can be made.

3.2.2 Prevention

A variety of active mosquito control measures are available. Large scale activities that can be undertaken by government bodies and large organisations include:

- *habitat modification in order to reduce water availability for breeding of the larval stage, and*
- *use of appropriate insecticides for controlling the larval or adult stage.*

Activities that can be undertaken by the community include:

- *taking precautions against being bitten by mosquitoes;*
- *avoiding being outside during times of heavy infestation of mosquitoes;*

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- *using insect repellents (containing Diethyl Toluamide {DEET} or picardin) and wear protective, light coloured long sleeve shirts and long pants;*
- *screening living and sleeping areas; and*
- *checking your home for potential mosquito breeding areas e.g. any uncovered water containers should be discarded, screened or emptied and cleaned regularly.*

The link below, prepared by 'Cameron Webb, Westmead Hospital University of Sydney' provides information regarding personal protection.

http://medent.usyd.edu.au/RepellentGuidelines.pdf

Other preventative measures include government based programs that undertake mosquito monitoring and virus surveillance from mosquitoes. These programs aim to act as an early warning system for virus activity by monitoring mosquito populations, viruses such as Ross River or Barmah Forest and weather patterns.

'**Note**': *The biology and preventative action for the black fly is described in appendix 7.*

3.3 Mosquito Habitats

Council's Mosquito & Black Fly Management Program targets species based on their ability to transmit pathogens (vectorial capacity), nuisance value and cohabitation with humans. Generally the different habitats can be classified as follows:

3.3.1 Fresh Water

Ground water

1. **Natural habitats**
    a. Lakes and swamps – vegetated margins and floating vegetation,
    b. Streams – vegetated margins, isolated quite reaches, backwaters and billabongs,
    c. Temporary and semi- permanent ground pools, rain filled depressions, animal wallows and hoof prints,
    d. Rock pools – sides of or in stream bed and rain filled, and
    e. Flooded animal burrows and crayfish tunnels.
2. **Man- made habitats**
    a. Irrigation ditches and runoff, overflow and tail drains,
    b. Dams – usually more important after stabilization and when vegetated, and
    c. Excavations – borrow pits, road works, wells and mining operations.

Container Water

1. **Natural habitats**
    a. Tree-holes,
    b. Leaf axils,
    c. Fruits, bromeliads and husks.
2. **Man-made habitats**
    a. Domestic items – water tanks/barrels, roof guttering, animal drinking troughs/bowls, boats and pot plant bases/saucers, and
    b. Discarded/hoarded items – tins, tyres, plastic containers, tarps and car bodies.

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3.3.2 Polluted Water

Septic Tanks

Drains and sullage pits

Ground water at garbage dumps

3.3.3 Brackish Water

Estuarine marshes/swamps

Tidal reaches of river margins

Rain pools/irrigation run-off in inland areas with saline soil

3.3.4 Salt Water

Pools on coastal rock platforms

The techniques used for surveillance and response vary depending on the breeding/larval habitat. In BSC the type of breeding/larval habitats can be grouped into two (2) general classes for surveillance and response purposes:

1. *Groundwater/freshwater/polluted water species, and*
2. *Container/Urban species*

3.3.5 Groundwater/freshwater/polluted water habitats

There are a wide range of mosquito habitats that fall in to this category. The diversity of mosquitoes present and the productivity of the individual sites are predominately dependent on the characteristics including water depth, water quality vegetation composition, vegetation density and predator (fish and macro invertebrate) populations. Important vector/pest mosquitoes associated with the habitats are *Culex annulirostris, Culex linealis* and *Culex quinquefasciatus.*

3.3.6 Container/Urban habitats

Generally, these habitats are divided into two categories; those high in organic matter and small/large water holding containers found around residential areas. The most important vector/pest mosquitoes associated with these habitats are *Aedes aegypti* and *Aedes notoscriptus* in containers and *Culex quinquefasciatus* in areas with a high organic content.

There is limited information available regarding the species found in BSC. Documentation from 2000 states that mosquito surveillance was conducted in Biloela for four nights and container/urban surveillance has also been conducted in Biloela more recently (2012 and 2013).

The following mosquitoes capable of transmitting disease were identified during these surveys:

- *Aedes aegypti,*
- *Culex annulirostris,* and
- *Aedes notoscriptus.*

The following mosquitoes that are known to bite humans were also identified:

- *Culex quinquefasciatus*

3.4 Surveillance

Surveillance is essential for the planning, operation, and evaluation of any effective mosquito control program. All control decisions should be based on as much science as possible. Surveillance will ensure the timing and choice of response methodologies will have a scientific basis. An initial survey will

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determine the nature and extent of the problem and indicate an appropriate response. The initial survey can be used to determine:

- *The species of mosquito present,*
- *Source/s (breeding sites),*
- *Relative densities, and*
- *Dispersal or flight range.*

If baseline data is not collected prior to commencement of a control program, any evaluation at a later stage may not be accurate. Surveillance undertaken during/after a disaster situation or a weather event, should also be compared with baseline data, to determine the subsequent impact on mosquito and black fly populations.

Routine surveillance yields the location of breeding habitat and identification of problem sites where control should be concentrated. Survey data will provide vital information, such as:

- an increase in adult numbers within an area suggesting a need for or increased control;
- a dominance of one species may indicate missed or novel breeding habitat that can be investigated; or
- timing treatment to catch the most number of larvae and adults within a given breeding habitat or location.

Surveillance will also detect disease activity, allowing for control measures prior to an epidemic.

3.4.1 Routine Mosquito Surveillance Provides:

- *A list of mosquito species within a local area,*
- *An estimate of adult and larval mosquito populations,*
- *Insight onto mosquito breeding habitats, and*
- *Source of female mosquitoes for disease surveillance.*

The surveillance and monitoring methods used will depend on the type of environment the mosquito inhabits.

'Note': *A list of surveillance and monitoring methods for groundwater mosquitoes are presented in Part E, Appendix 1. Similarly, surveillance and monitoring requirements for urban/container mosquitoes are presented in Part E, Appendix 3.*

3.5 Response

In most cases it will not be possible to eradicate mosquitoes or even eliminate a particular species from an area. If there is a significant risk or nuisance then an appropriate response should be determined. Methods used to control mosquitoes vary according to the species concerned and the local situation and circumstances. Economic and environmental considerations also influence response methodology. Therefore, the accurate identification of the target species and its habitats is important to ensure controls are efficient and pose no/limited risk to the environment.

When determining which response methodology to utilize, consideration should be given to using the most appropriate control rather than the most expedient method. Long term benefits usually outweigh short term gains. An 'integrated control' method should be used and this essentially means the use of a combination of methods that are complimentary, and will limit the sources and reduce the abundance of the mosquito populations, and protect the health and well-being of the human community, and exert minimal detrimental effects on non-target species and the environment. Integrated control programs will usually include a blending of informed methods of environmental management, application of chemical insecticides, consideration of the use of biological control agents and public awareness campaigns.

'Note': *A list of response methods for groundwater mosquitoes is presented in Part E, Appendix 2. Similarly, response methods for container/Urban mosquitoes are presented in Part E, Appendix 4.*

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3.5.1 Environmental Management

Advances in habitat modification techniques have shown that the suppression of mosquito populations is possible without reliance on chemical control or endangering the flora, fauna or ecological function of the wetland itself. However, it is important to note that any modification to the environment to reduce to the production of mosquitoes may have the potential to impact other components of the local ecosystem and should be fully investigated before any strategies are implemented.

Strategies to reduce the productivity of mosquito habitats without the use of control agents are generally achieved by the manipulation of water flows and/or vegetation to reduce the suitability of the habitat for mosquito production. In urban environments, source reduction is generally directed towards habitats such as sullage pits, drains, guttering, backyard containers and other areas where water is retained for long periods of time.

3.5.2 Chemical Control

Chemical control is often seen as the initial method of choice to reduce vector populations and interrupt transmission and disease. This is short term control, but it will continue to be the pivotal component of 'epidemic-control' for many years to come. However, product contamination or environmental pollution can lead to community concerns and legal problems. Chemical control programs should use the most species specific chemicals available, but this is often difficult due to the broad toxicity of many of the available insecticides.

The *Pest Management Act 2001* and the Australian Pesticides and Veterinary Medicines Authority restrict the types of chemicals that can be used for mosquito control.

Chemical attack on pest or vector mosquito populations will be aimed at either the point of source with the larval stages (larviciding), or at the point of nuisance with the adult stages (adulticiding), or both.

The most effective, and generally environmentally friendly, strategy to control mosquito populations, and minimize nuisance and public health risks, is to target larval populations and their habitats. However, the effectiveness of larval control is very dependent on the timing of the applications.

Adulticiding may be considered when quick reductions in adult pest or vector numbers are required. However, the effectiveness can be unreliable and this method may have a greater negative impact on non-target species. As with larviciding the correct timing of application is essential. During an epidemic of mosquito-borne disease or during a disaster situation, adulticiding can be considered essential. Refer to the Queensland Health – Guidelines for Controlling Public Health Risks relating to Mosquitoes, Flies and Black Flies in a flood event for recommended actions.

Repellents are chemicals that tend to produce avoidance reactions in mosquitoes approaching a host, block the host-detection senses or at least 'cover' the attractiveness of the host. Repellents are often the most practical agent for personal protection against mosquitoes. The most common commercial anti-mosquito repellents contain ingredients such as DEET or piciradin.

As stated earlier the types of breeding habitats in the Banana Shire region can be grouped into two classes and treatment responses vary accordingly.

'Note': *Part E contains specific response methodologies and a risk assessment guide is located in Part E, Appendix 8*.

3.6 Community Engagement/Awareness

One of the most important aspects of mosquito management is engaging the community in the program. It is important for local authorities to assist in the dissemination of accurate information on the public health risks associated with mosquitoes and strategies to reduce those risks, to the community. It is also crucial

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that the community is aware of mosquitoes in the local environment and the reasons why specific management strategies have been employed in the region.

There is often a lot of misinformation in the community regarding mosquitoes. A lack of understanding of the diversity of mosquito species, their life cycle and habitat associations is common. Concise, accurate information regarding the local mosquito populations can not only provide important public health messages, it may also encourage a greater interest in the ecology of local wetlands and the importance of environmentally sensitive mosquito management.

Generally public health messages, detailing disease potential and personal protection, relating to mosquitoes dominate most community awareness programs. However, benefits could be gained by the inclusion of biological and/or ecological facts and figures associated with the local mosquito.

Public engagement/awareness campaigns often involve the production of posters, fact sheets, stickers, radio bites and videos, usually undertaken by local government and/or health authorities. The content, formatting and distribution of this material will be determined by the intended target audience of the campaign. It is important for BSC to have the appropriate resources prepared and available for distribution when the need arises. Resources should consist of a combination of fact sheets and online advice presented on websites. Consideration of social media may be useful, particularly in outbreak or disaster situations.

Artificial containers found in the yard setting account for a significant portion of the summer mosquito population in many urban areas; improving property owners awareness about this habitat and the importance of its removal may be just as effective as trying to treat all that habitat. This communication also offers the opportunity to increase awareness about mosquito avoidance, with respect to peak mosquito activity, and effective repellents like those containing DEET or Picaridin.

Engagement with management from local mine sites, the cotton and grain industry could also prove to be fruitful. These industries and the associated processes may produce potential breeding sites for various mosquitoes and also transit routes for container breeding mosquitoes. Encouraging these industries to become involved in mosquito surveillance, and where appropriate management programs, will provide invaluable assistance. Identifying, whether vehicle/people movement includes known breeding areas for *Aedes aegypti*, will assist BSC in determining the potential risk of importing *Aedes aegypti* into the region. If people regularly travel to locations where Dengue Fever is prevalent and they return to an area within BSC where the *Aedes aegytpi* mosquito is breeding, there is a greater potential for imported cases of Dengue Fever within the BSC region.

When mosquitoes are abundant, local authorities may receive complaints regarding nuisance biting in the residential or recreational areas. These complaints may provide information on areas where mosquito impacts are greatest. However, the tolerance of individuals to mosquitoes varies greatly and the number of complaints within and between seasons may not be directly related to actual mosquito populations. There are a number of factors that will influence an individual's sensitivity to mosquitoes and also their likelihood of making a complaint to local authorities. Ongoing surveillance and monitoring data should be used to augment the number of complaints received by local authorities to measure mosquito activity. The quantity and frequency of complaints may, at times, be due to factors such as increased publicity regarding mosquitoes and arboviruses in the media or within local action groups, and not an actual substantial increase in mosquito abundance. However, if some significant linkage can be established, then a public complaint 'threshold' can be a useful trigger for further investigation or intervention.

When a complaint is made, it is important that it is directed to a person supplied with information on the local mosquito surveillance and management program, and able to provide appropriate information on reducing nuisance-biting impacts. A database of complaints should be kept and, if time and resources allow, an adult trap could be operated overnight in the local area to determine the mosquitoes likely to be causing the nuisance impacts. These short investigations also provide an excellent opportunity to connect the local community with the mosquito management program.

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Dealing with the media is an important component of community education because it provides an opportunity for the dissemination of accurate information on mosquitoes and personal protection strategies, as well as opportunities to publicise the local mosquito management program.

It is crucial that representatives of local authorities dealing with media have appropriate training and/or resources to answer questions regarding general mosquito biology, locally important pest mosquitoes, personal protection strategies and background on the local mosquito surveillance and any mosquito management programs.

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PART D – GENERAL APPENDICES

Appendix 1 – Dengue Fever

Aedes aegypti, is the principal mosquito vector of the dengue viruses and the insect is closely associate with humans and their dwellings. People not only provide the mosquitoes with blood meals, but also water-holding containers in and around their homes that the mosquito needs for breeding. The mosquito lays her eggs on the sides of containers holding water and eggs hatch into larvae when the water level reaches the eggs. People also provide shelter for the *Aedes. Aegypti* as it likes to rest in darker cool areas, such as closets and this leads to their ability to bite indoors. The *Aedes aegypti* flight range is generally no more than 400m but usually only about 100m.

It is very difficult to control or eliminate *Aedes aegypti* mosquitoes because they have adaptations to the environment that make them highly resilient. They are also able to rapidly bounce back to initial numbers after being disturbed by either natural phenomena (e.g., droughts) or human interventions (e.g., control measures). One such adaptation is the ability of the eggs to withstand desiccation (drying) and to survive without water for several months on the inner walls of containers. For example, if we were to eliminate all larvae, pupae, and adult *Aedes aegypti* at once from a site, its population could recover two (2) weeks later as a result of egg hatching following rainfall or the addition of water to containers harbouring eggs, (e.g. or when people water pot plants or top up pet water bowls). Recent research has also shown that the eggs are only killed if the temperature exceeds 45^{o}C.

Social and environmental factors – including increased urbanization (particularly of poor populations lacking basic health services) as well as expansion of international travel and trade – are linked to the resurgence of the dengue disease. Climate change may also have affected transmission, as dengue mosquitoes reproduce more quickly and bite more frequently at higher temperatures. It should be noted that these mosquitoes do not breed in creeks or depressions in the ground, they breed in containers around people's dwellings.

Dengue Fever is a mosquito-borne viral infection.

The dengue virus is not endemic in Australia, which means the virus is not normally present in Queensland. In Australia, most locally acquired cases of dengue occur in North Queensland, particularly around Townsville and Cairns. It is important to note that this disease does not spread directly from person to person and is not passed from mosquito to mosquito. It can only occur after a person is bitten by an infected mosquito. If a mosquito that is capable of transmitting Dengue Fever (eg *Aedes aegypti*) bites a person who is infected, and the infection is still active, then that mosquito will become infected; and if that mosquito then bites other people they will become infected. Patients who are already infected with Dengue Fever can transmit the infection (for generally four [4] to five [5] days; maximum of twelve [12] days) after the first symptoms appear.

Dengue fever is a severe, flu-like illness that affects infants, young children and adults, and occasionally develops into a potentially lethal complication called Dengue Hemorrhagic Fever (DHF)/severe dengue.

Dengue should be suspected when a high fever (40°C) is accompanied by two of the following symptoms: severe headache, pain behind the eyes, muscle and joint pains, nausea, vomiting, swollen glands or rash. Symptoms usually last for two (2) to seven (7) days, after an incubation period of four (4) to ten (10) days which can only occur after the bite from an infected mosquito. There are 4 types of the dengue virus that cause dengue fever – Dengue Type 1, 2, 3 and 4. People become immune to a particular type of dengue virus once they've been infected, but can still get sick from the other types of dengue if exposed. People who catch different types of dengue, even years apart, are at risk of developing severe dengue.

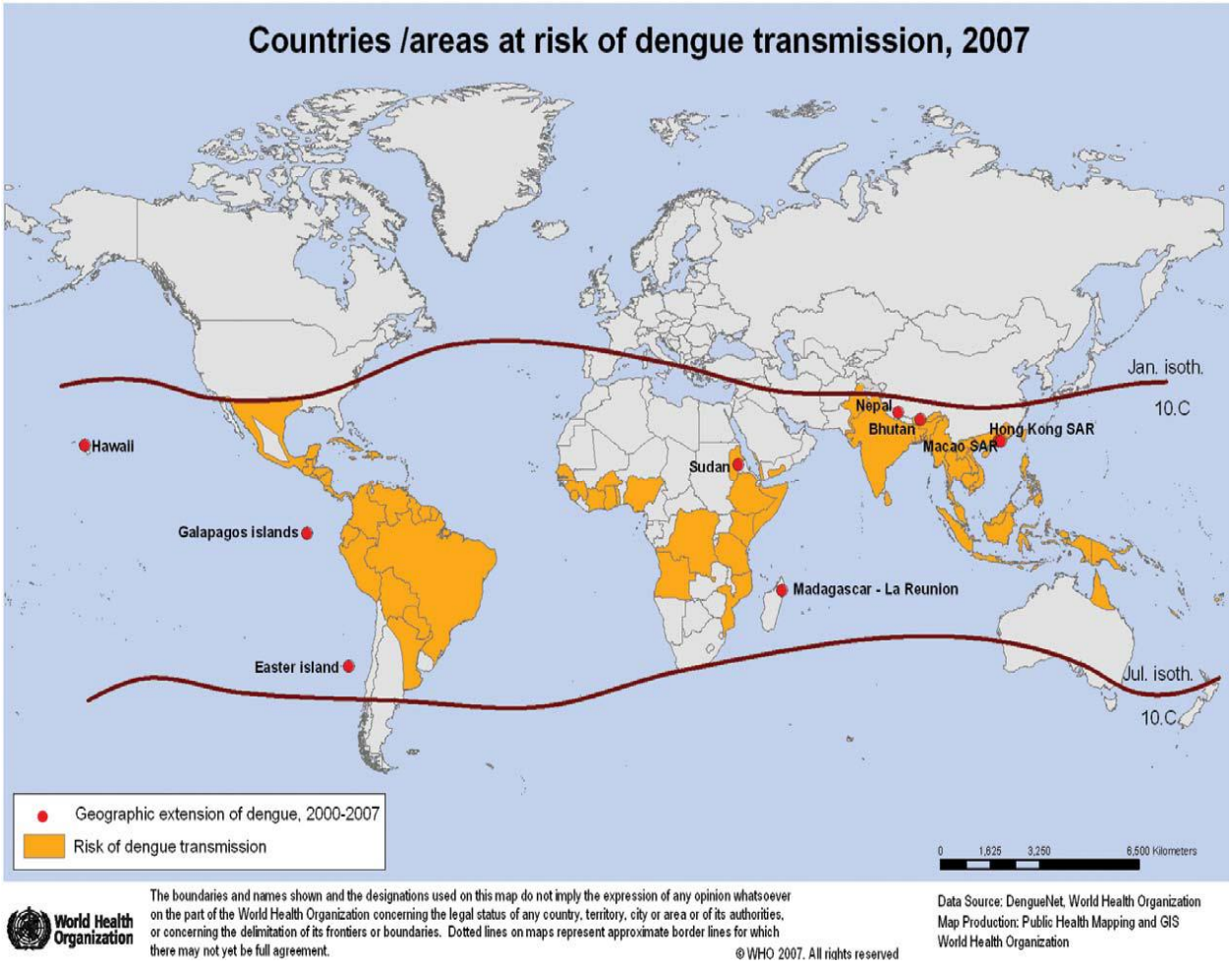
Severe dengue is a potentially deadly complication due to plasma leaking, fluid accumulation, respiratory distress, severe bleeding, or organ impairment. Warning signs occur three (3) to seven (7) days after the

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

first symptoms in conjunction with a decrease in temperature (below 38°C) and include: severe abdominal pain, persistent vomiting, rapid breathing, bleeding gums, fatigue, restlessness, blood in vomit. The next 24 to 48 hours of the critical stage can be lethal; proper medical care is needed to avoid complications and risk of death.

The World Health Organisation currently estimates there may be 50 to 100 million dengue infections worldwide every year. Of those, about 500,000 people contract DHF/ severe dengue, which is a potentially life-threatening. In 2010, 1.6 million cases of dengue were reported in the Americas alone, of which 49 000 cases were severe dengue. An estimated 500 000 people with severe dengue require hospitalization each year, a large proportion of whom are children. About 2.5% of those affected die. There is no specific treatment for dengue or severe dengue, but early detection and access to proper medical care lowers fatality rates below 1%.

The global incidence of dengue has grown dramatically in recent decades. About half of the world's population is now at risk. Dengue is found in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas. The largest outbreak on record so far for the Townsville/Cairns region was in 09/10 with over 1,000 cases and one fatality recorded.



Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 2 – Ross River Virus

Ross River virus (sometimes called epidemic polyarthritis) is a disease caused by a virus which is spread by the bite of an infected mosquito. Ross River virus disease occurs widely in Australia. In northern and central Queensland, cases of Ross River virus occur throughout the year, but most cases occur between February and May. Areas under intensive irrigation and localities close to saltmarshes, are most productive for mosquito populations and hence tend to result in the highest number of human cases of disease. Outbreaks occur when local conditions of rainfall, tides and temperature promote vector abundance.

Everybody who becomes infected with Ross River virus will recover, however, the time taken to recover fully is prolonged in some people.

Ross River virus has been isolated from many mosquito species, indicating wide susceptibility among mosquitoes. In inland regions, the major vector is *Culex annuliristris* which breeds in freshwater habitats, especially in irrigated areas. Along coastal regions, saltmarsh mosquitoes represent the major threat, including *Aedes vigilax* and *Aedes camptorhynchus* in northern and southern coastal regions respectively. There is some evidence that 'floodwater' *Aedes* species such as *Aedes. normanensis* play an important role in transmission in inland regions following heavy rains or floods, and *Coquillettidia linealis* is a secondary vector in areas with established wetlands. In the domestic urban situation, there is evidence to suggest that *Aedes notoscriptus* may be a vector, while *Culex quinquefasciatus* is not (although not all entomologists agree with this last point).

The virus infection cannot be spread from human to human but must first pass through an animal host. Serological studies and laboratory investigations have indicated that native mammals, most likely kangaroos and wallabies, are natural hosts for Ross River virus

Human infection with Ross River virus, may result in the clinical condition known as polyarthritis. The effects range from a symptomless condition, through a transient rash and mild illness with fever, to polyarthritis (joint pain and swelling) affecting chiefly the ankles, fingers, knees, and wrists, but other joints may be affected. The disease is not fatal. Symptoms become evident from three (3) to twenty-one (21) days (average nine [9] days) after infection, and mild cases may recover in less than one month but many persist for months to years. People of working age are most likely to be afflicted with the diseases, whilst symptoms are rare in children.

There is no specific drug treatment for Ross River virus infection. Treatment involves managing the symptoms that develop. Your doctor may provide advice on treatment for joint and muscle pains. A combination of plenty of rest and gentle exercise are important to keep joints moving and to prevent overtiredness, but medication may sometimes be necessary.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 3 – Barmah Forest Virus

Barmah Forest virus is the name given to a virus that is carried by mosquitoes. The mosquito may have contracted the virus from infected marsupials particularly possums, kangaroos and wallabies or from infected humans. The infection is not fatal and all people who develop the disease do recover. Australia is the only country where Barmah Forest virus has been identified. There are over 400 cases of Barmah Forest virus reported in Queensland each year.

Barmah Forest virus has been isolated from a variety of mosquito species. In inland regions, the major vector is *Culex annuliristris* which breeds in freshwater habitats, especially in irrigated areas. Along coastal regions, saltmarsh mosquitoes represent the major threat, including *Aedes vigilax*. In the domestic urban situation, there is evidence to suggest that *Aedes notoscriptus* may be a vector.

Barmah Forest virus causes inflammation and joint pain and has similar symptoms to Ross River virus infection (epidemic polyarthritis), but usually lasts for a shorter duration. The symptoms may include fever, headache, tiredness, painful joints, joint swelling, muscle tenderness, and skin rashes. Some people, especially children, may become infected without showing any symptoms.

The initial fever and discomfort only lasts a few days but some people may experience joint pain, tiredness and muscle tenderness for up to six (6) months. Most people can return to work within a few days of becoming ill, although joint and muscle pain may cause some longer term restrictions in some occupations.

The virus is passed to humans by the bite of an infected mosquito. It cannot be passed directly between humans.

Most people become unwell within three (3) to eleven (11) days after being bitten by an infectious mosquito.

There is no specific drug treatment for Barmah Forest virus infection. Treatment involves managing the symptoms that develop.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 4 – Murray Valley Encephalitis/Kunjin Virus

Previously Murray Valley encephalitis virus and Kunjin virus were known collectively as Australian encephalitis. Infected patients contract the virus from the bite of an infected female mosquito. Murray Valley encephalitis is permanently present in the northern regions of Western Australia (Pilbara and Kimberley) with at least one encephalitic human disease case occurring every year.

For Murray Valley encephalitis virus infection, there is a high subclinical rate and perhaps only 1 in 500 or more infections become noticeably ill. Cases vary from the mild to severe and fatal. Symptoms almost invariably include a sudden onset of fever; anorexia and headache are common, while vomiting, nausea, diarrhoea and dizziness may also be experienced. Brain dysfunction may be experienced after a few days with lethargy, irritability, drowsiness, confusion, convulsions and fits; neck stiffness can be expected, and both coma and death may ensue. It is rare for recovery from the encephalitic syndrome to occur without some residual mental or functional disability.

Infection with Kunjin virus can cause symptoms that are similar to Ross River virus disease, such as swollen and aching joints, fever and rash. However in rare cases, Kunjin, like MVE, can cause more severe symptoms which include headache, neck stiffness, fever, delirium and coma.

It is now generally acknowledged that both MVE and KUN viruses have a natural endemic cycle, which involves water birds as the vertebrate host and *Cx annulirostris* (which breeds in freshwater environments) as the major vector, in northern regions of Australia.

There are no specific therapies to treat the disease or control the virus, therefore supportive treatments are used (such as respiratory support in severe disease).

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 5 – Malaria

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected *Anopheles* mosquitoes. Australia was declared malaria free in the 1980's. In 2012, malaria caused an estimated 627 000 deaths (with an uncertainty range of 473 000 to 789 000), mostly among African children. Unlike the other diseases discussed in this document Malaria is preventable and curable. But non-immune travellers from malaria-free areas are very vulnerable to the disease when they get infected.

Malaria is caused by *Plasmodium* parasites. The parasites are spread to people through the bites of infected *Anopheles* mosquitoes, called "malaria vectors", which bite mainly between dusk and dawn.

There are four parasite species that cause malaria in humans:

- *Plasmodium falciparum,*
- *Plasmodium vivax,*
- *Plasmodium alariae, and*
- *Plasmodium ovale.*

The first two are the most common and most important, and *Plasmodium falciparum* infection often can be fatal in the absence of treatment.

The *Plasmodium* species are blood parasites, although some also invade liver cells where they lie dormant until later release brings a relapse with fevers associated with the destruction of red blood cells. The vector mosquitoes absorb the parasites with the bloodmeal, and the sexual stages unite in the mosquito gut to create a stage which invades the gut wall and forms a cyst, which in turn releases many infective stages (sporozoites) which invade the salivary glands, and are injected into a new host when the mosquito feeds. The sporozoites invade liver cells and later developmental stages of the parasite invade red blood cells which they disrupt (causing fever), form sexual stages and the cycle is completed.

Malaria is an acute febrile illness. In a non-immune individual, symptoms appear seven (7) days or more (usually ten [10] to fifteen [15] days) after the infective mosquito bite. The first symptoms – fever, headache, chills and vomiting – may be mild and difficult to recognize as malaria. If not treated within 24 hours, *Plasmodium falciparum* malaria can progress to severe illness often leading to death. Children with severe malaria frequently develop one or more of the following symptoms: severe anaemia, respiratory distress in relation to metabolic acidosis, or cerebral malaria. In adults, multi-organ involvement is also frequent. In malaria endemic areas, persons may develop partial immunity, allowing asymptomatic infections to occur.

For both *Plasmodium vivax* and *Plasmodium ovale*, clinical relapses may occur weeks to months after the first infection, even if the patient has left the malarious area. These new episodes arise from dormant liver forms known as hypnozoites (absent in *Plasmodium falciparum* and *Plasmodium malariae*); special treatment – targeted at these liver stages – is required for a complete cure.

Prevention of malaria in many countries has been heavily dependent on anti-malarial drugs and residual insecticides since the 1950s, but this has broken down in a lot of places for various reasons, including development of drug resistance by the parasites, insecticide resistance by the mosquitoes, and failures in administrative and logistical systems at central, regional and local government levels. Thus, the importance of self-protection for local inhabitants and visiting travellers in "at-risk" areas has become more and more emphasised in recent years.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 6 – Chikungunya Virus

Chikungunya is a viral disease that is spread by mosquitoes. The virus is transmitted from human to human by the bites of infected female mosquitoes. Most commonly, the mosquitoes involved are *Aedes aegypti* and *Aedes albopictus*, two species which can also transmit other mosquito-borne viruses, including dengue. These mosquitoes can be found biting throughout daylight hours, although there may be peaks of activity in the early morning and late afternoon. Both species are found biting outdoors, but *Aedes aegypti* will also readily feed indoors. After the bite of an infected mosquito, onset of illness occurs usually between four (4) and (8) eight days but can range from two (2) to twelve (12) days.

Although locally-acquired Chikungunya has not been detected in Australia (to the end of January 2010), mosquitoes capable of transmitting the Chikungunya virus occur in Queensland. Chikungunya has been diagnosed in travellers from affected countries who have recently arrived in Australia.

It causes fever and severe joint pain. Other symptoms include muscle pain, headache, nausea, fatigue and rash. The joint pain is often very debilitating, but usually ends within a few days or weeks. Most patients recover fully, but in some cases joint pain may persist for several months, or even years. Occasional cases of eye, neurological and heart complications have been reported, as well as gastrointestinal complaints. Serious complications are not common, but in older people, the disease can contribute to the cause of death. Often symptoms in infected individuals are mild and the infection may go unrecognized, or be misdiagnosed in areas where dengue occurs.

There is no cure for the disease. Treatment is focused on relieving the symptoms.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 7 – Black Fly Overview

Black flies are not generally present in large numbers within the Banana Shire Region, but the population may increase significantly following heavy rain or a flood. Black flies are not known to transmit disease, but can cause allergic reactions and bacterial skin infections can occur when bites are scratched.

Female black flies are blood feeders – they are aggressive daytime biters preferring low wind conditions.

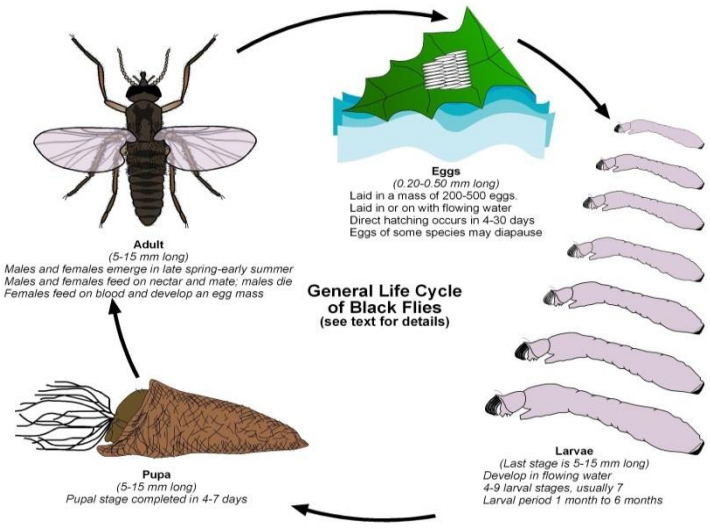
Black flies often land and take off repeatedly without biting. Their numbers, and their tendency to bite, increase as sunset approaches. Their peak activity period tends to occur from sunrise to mid-morning (10am) and late afternoon (4pm) to sunset. Even when they are not biting, however, their buzzing presence and constant crawling is as irritating as the bloodsucking itself. Mercifully, relief comes after dark, for unlike mosquitoes and biting midges, black flies do not attack at night. They are not restricted to shaded or humid sites, and usually do not go indoors. Generally, if they enter a vehicle; once they sense being trapped their attention seems permanently diverted to escape and they spend the rest of the time crawling up the screen or window pane, until they can escape.

They are attracted to hosts from a distance by smell, heat, and by sight. The female flies swarm around and crawl on the host preferring the head, hair, and ears as well as any skin that is exposed or that they can crawl onto. Some people are very attractive to black flies and have strong feeding reactions. Others appear to repel black flies and are bitten little if at all.

Adult black flies are small insects that measure one (1) to five (5) mm in length, and possess a shiny thorax (middle of the fly) that ranges in colour from black to various shades of grey or yellow. They breed in running water–and once flood water recedes the numbers of black flies rapidly decrease.

All black flies require cool, running water for development and favour sites with cobbled bottoms (pebbles, small rocks) that are largely clear of silt. The black fly larvae attach themselves to rocks or other submerged materials and feed on organic particles they filter from the passing waters. Trailing vegetation or rotted aquatic plants also are attractive to black flies, providing sites for the larvae to attach for feeding. Breeding may also occur in rivulets formed by the flooding of fields.

7.1 Lifecycle



Females deposit eggs, 200 to 800 per female, on vegetation just below the water surface. This stage is the resistant stage of the life cycle for some species can withstand desiccation, then hatch after a flood/heavy rain event. Duration of the egg stage varies from one (1) day to nine (9) or ten (10) months depending on the species and water temperature. Larvae emerge from eggs and will remain at the hatching site if the substratum and food supply are adequate otherwise they will drift downstream on a silken thread to a more suitable site. Larvae attach themselves to aquatic or emergent vegetation as well as rocks. They will be particularly abundant near culverts under roads, attached to plants trailing in the water. Most black fly larvae are filter feeders, with the larvae feeding on nutrients in the water as it flows by. The larval period varies and in warm waters it generally lasts only a few weeks. Larvae pass through six (6) stages and during the final instar the larvae spin variously shaped silken cocoons that anchor and protect the developing pupae.

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Duration of the pupal stage varies according to water temperature, but usually lasts four (4) to seven (7) days. Adults emerge from the pupal case through a slit and float to the surface on a bubble of air. In most cases the adult immediately flies to a resting spot to allow its cuticle to harden.

Mating can occur shortly after emergence or just before oviposition and takes place in flight or while landed. Females of some species require a blood meal for maturation of the eggs, either before or after mating. Females lay their eggs in a variety of aquatic environments ranging from the smallest trickle to the largest rivers; the choice of habitat will vary with the species. Oviposition varies from the free distribution of eggs while the female taps her abdomen on the water surface during flight, or ovipositioning while landed on wet surfaces such as grass trailing in the water, or crawling underwater to deposit the eggs. As stated earlier, length of the cycle from egg to adult is variable, depending on the black fly species and water temperature. The time interval for *Simulium slossonae* is estimated to be from three (3) to four (4) weeks. Emerging adults live from two (2) to three (3) weeks, to as long as 85 days.

7.2 Control

Because black flies are widespread native insects, their eradication from any one locality seems unlikely. These insects are highly mobile and readily move away from breeding grounds in search of a meal. Adult control is problematic, again due to the migratory behavior of the insects. Effective chemical control of black flies targets the breeding and resting sites, which means it must be a community-based project.

Options for chemical control are extremely limited. A microbial pesticide containing *Bacillus thuringiensis israelensis* or Bti, is used in America, but unfortunately in Australia the target species on the label does not include black flies. Therefore this product cannot currently be used in Australia against black fly.

Spatial sprays and barrier applications of insecticides for adult black fly control may offer some temporary relief. A spatial spray is a fine spray, mist or aerosol, consisting of very small droplets of insecticide solutions that are dispersed by movement of air. The droplets contact adult black flies that are in flight or at rest. However, because spatial sprays produce no effective residual deposits of insecticides, the relief is temporary and treatments may have to be repeated daily while adults are a problem.

Spraying of vegetation and structures in areas where the black flies are known to rest; with insecticides that have residual properties (barrier treatments) may also provide temporary relief from black fly attack.

Pesticides containing organophosorus compounds, bifenthrin or permethrin can be used. Pesticides must always be used in accordance with their label, which must state that it is suitable for the target pest and must always be dispersed by a suitably licensed operator. Treatments can be undertaken in areas where Black Fly rest along banks of running water, which should reduce their dispersion into the community areas. If emergence has already taken place and the Black Fly has dispersed treatment can be undertaken in resting areas within the Black Fly flight path (ie, vegetation). If significant numbers are observed (confirmed by special traps or biting counts), fogging (using Ultra Low Volume [ULV] or thermal fog) the high risk areas can be considered.

The best defence against Black Fly is personal protection.

'Note': *Part E contains specific response methodologies and a risk assessment guide is located in Part E, Appendix 8.*

7.3 Personal Protection

Black flies are small enough to pass through some window screens or come indoors on or in the hair. They do, however, prefer to bite out of doors.

Avoid being bitten by black flies by:

- *applying insect repellent in accordance with manufacturers recommendations. Personal repellents containing DEET or picaridin tend to last longer than other repellents depending on the concentration. Repellents containing less than ten (10) per cent DEET or picaridin are considered*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

safe for children, however the use of topical repellents is not recommended for infants under three (3) months of age. Young children should not apply repellents themselves. Repellents should be applied to the hands of a carer first, and then applied evenly to the child's exposed skin;

- *using physical barriers, such as nets on prams and cots, to protect infants less than three (3) months of age;*
- *where possible, avoid outdoor activity during the morning and afternoon;*
- *wear light coloured loose fitting clothing when contact with black flies is likely;*
- *keep shirt sleeves and your shirt front closely fastened (shirts with zippered fronts keep flies out better than buttoned shirts), and tuck trousers inside socks or high boots;*
- *ensure insect screens on doors and windows are intact; and*
- *use a knock-down insect spray in living areas.*

Media releases can be used to provide public health advice on managing Black Fly bites. The following actions are recommended to prevent secondary infections:

- *Use calamine lotion or other anti-pruritic cream to discourage scratching;*
- *Clean and cover open wounds; and*
- *Wash hands before and after touching open wounds.*

Medical advice should be sought if insect bites or scratches become infected (hot, red, swollen, painful) or if a fever arises. Rest and elevate the limb if there are multiple infected bites.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 8 – Mosquito Species

Council's Mosquito and Black Fly Management Program intends to target species of mosquitoes based upon vector capability, nuisance value and cohabitation with primary target species. The following sections will group mosquitoes according to:

- *Disease Carrying Groundwater Breeding Species*
- *Disease Carrying Container/Urban Breeding Species*
- *Nuisance and other Species*

8.1 Disease Carrying Mosquitoes – Groundwater Breeding Species

*8.1.1 Culex annulirostris **

Culex annulirostris is an efficient vector of a range of arboviruses including Ross River, Barmah Forest, Japanese Encephalitis, and Kunjin viruses as well as being a vector for myxomatosis and an effective carrier of dog heartworm.

Culex annulirostris is wide spread throughout Queensland. Preferred breeding areas include freshwater wetlands and low lying grassy areas that are commonly inundated following rain as well as irrigation areas with heavy organic effluent component.

Peak feeding activity is predominantly at dusk (up to two [2] hours following), and to a lesser degree at dawn. They feed off both animals and humans and have the capacity to travel five (5) to ten (10) km from breeding sites.

8.1.2 Aedes vigilax

Aedes vigilax is the primary vector of Ross River (the etiological agent of epidemic polyarthritis) and Barmah Forest viruses in Queensland. Both Ross River and Barmah Forest disease are notifiable, and can have debilitating effects on those infected.

Throughout Queensland *Aedes vigilax* is widespread along the coastline, but may also be found inland. Mosquitoes that are found inland may be breeding in areas with a high salt content or they may have travelled on the wind. The major breeding sites of *Aedes vigilax* include temporary brackish pools and marshes filled as a result of tidal inundation and are commonly associated with salt-water couch grass (Sporobolus). The habits of the adult mosquito include resting amongst dense foliage for shelter throughout the day where possible. They are a voracious biter, will feed off humans and animals day or night and can travel up to 50km from larval habitat. Peak feeding activity occurs at dawn and dusk.

8.1.3 Coquillettidia linealis

Coquillettidia linealis can be a significant nuisance pest in some localities in both coastal and inland areas but is not generally regarded as a major problem.

Ross River and Barmah Forest viruses have been isolated from the species on the north and south coasts of NSW and in the inland southwest, and it should be considered as a vector of concern.

* *Indicates that this species of mosquito has been found with the BSC Region*

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Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.2 Disease Carrying Mosquitoes – Container/Urban Breeding Species

*8.2.1 Aedes aegypti**

Aedes aegypti is of great importance as it is the major carrier of Dengue Fever and Dengue Hemorrhagic Fever in Queensland (and throughout the world). This mosquito is associated with human habitation.

The *Aedes aegypti* can be found in natural breeding places such as tree holes, fallen palm fronds and plants such as bromeliads. It has however adapted very successfully to human habitation breeding in any available artificial container such as pot plant bases, buckets, tyres, rain water tanks and roof gutters. This mosquito has a limited flight range, up to one (1) km (if necessary, but generally only between 100 and 400m), in seeking a blood meal. This mosquito is very elusive, tending to bite persons around the feet, ankles, and under tables. The *Aedes aegypti* mosquito is generally an indoor day time biter.

8.2.2 Ochlerotatus notoscriptus also known as Aedes notoscriptus**

Ochlerotatus notoscriptus can be a domestic pest species. Its importance relates to the similarity with the *Aedes aegypti* mosquito and the common breeding area shared.

As with *Aedes aegypti*, *Ochlerotatus notoscriptus* are primarily considered a domestic species taking advantage of a range of artificial containers. Laboratory studies have shown this mosquito capable of carrying a number of arboviruses and it is believed to be a suitable vector for Barmah Forest, Ross River and Heartworm in dogs.

8.3 Nuisance and Other Species *(Potentially Abundant within in the Region)*

*8.3.1 Culex quinquefasciatus * also known as Culex fatigans**

This is the major domestic pest in many urban areas, particularly as indicated by indoor biting; with respect to human disease it has been shown to be able to carry Murray Valley Encephalitis (MVE) and West Nile viruses in laboratory studies, but its role in the transmission remains unclear.

It is a vector (not particularly efficient) of dog heartworm (and human filariasis in more northern tropical regions), an important vector of fowl pox, and possibly involved in myxomatosis transmission in some areas. Larvae of *Culex quinquefasciatus* can develop in a range of habitats, but is often found near human habitation in containers holding water.

8.3.2 Culex sitiens

Culex sitiens can become a major pest during summer months.

Current research indicates that this species is also a competent vector of Ross River Virus within the laboratory setting, with further research continuing to determine transmission efficiency as a possible field vector.

Culex sitiens is found along most coast lines of Australia and has the ability to travel large distances (up to 35 km) in order to seek a blood meal. The major breeding site of the

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

sitiens is the same as *Aedes vigilax* – temporary brackish pools and marshes filled as a result of tidal inundation. Larvae of *Culex sitiens* are often found in the same habitat with *Aedes vigilax* but *Culex sitiens* also has the ability to adapt to freshwater habits.

8.3.3 Coquillettidia xanthogaster

This is a very distinctive mosquito of orange appearance. Larvae breed in swamps, lagoons and creeks. This species is a major pest in many parts of northern Australia. This species is susceptible to Ross River virus infection in the laboratory although vector status is largely unknown.

8.3.4 Aedes procax

This is a medium sized species that breeds in temporary freshwater ground pools. It has a lighter brown colouring with distinct white bands on the abdomen and legs.

It is increasingly being recognised as a significant occasional pest, and has been shown to be a very efficient carrier of Ross River virus. Its breeding sites can be very cryptic and well hidden in bush land, where they may be dry for many months before producing hundreds of larvae after rain fills the site.

8.3.5 Aedes vittiger

Can be a significant pest in irrigation areas and after floods in rural riverine areas; has been shown to be able to carry Murray Valley Encephalitis virus in laboratory studies but there is no field evidence for any role in transmission of human disease.

8.3.6 Anopheles annulipes

The species is only rarely a pest even when relatively abundant as it does not preferentially attack humans; it is known to be a laboratory vector of malaria and almost certainly has been responsible for transmission of malaria in many areas of southern Australia.

Can carry human filaria and dog heartworm (but is not an efficient vector), has yielded isolates of Ross River virus but overall is not thought to be an important vector of human disease.

8.3.7 Aedes alternans

Aedes alternans can reach reasonably high pest levels following extended periods of rain. They have the ability to breed both in temporary brackish pools and marshes on the coast along with *Aedes vigilax* and further inland in freshwater areas with *Aedes vittiger*.

Aedes alternans are very aggressive biters, will attack throughout the day and night and have the ability to travel five (5) to eight (8) km from breeding sites in search of a blood meal. As with *Aedes vittiger*, this species may continue to be a pest from one to three weeks after breeding areas are inundated. Ross River Virus has been isolated form *Aedes alternans* (in the laboratory), however this is yet to be proven in the field.

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.3.8 Verrallina funerea

Verrallina funerea may be a major pest in communities where residential housing is in very close proximity to breeding sites. *Verrallina funerea* has the ability to breed in both fresh and slightly brackish water.

Verrallina funerea is considered a very aggressive and painful biter. This species travels very little distance from breeding ground and is thus not considered a major pest for areas not adjacent or in close proximity to their coastal breeding areas. *Verralllina funerea* has been shown to carry a number of arboviruses in the laboratory.

8.3.9 Mansonia uniformis

Mansonia uniformis has been identified as a major pest problem particularly in rural areas after extensive rain events. It has the unique larval structure of a piercing siphon which allows it to attach to a wide range of aquatic plants such as water hyacinth, as well as aquatic grasses and sedges.

Mansonia uniformis are more aggressive during the night but willing to feed during the day in protected/shaded areas. The flight range of the *Mansonia uniformis* is limited to about three (3) to six (6) km making this species more of nuisance to those living near fresh water areas. This species has been shown to be a competent vector for Ross River Virus, Murray Valley encephalitis and Kunjin viruses in the laboratory however there is no field evidence incriminating the species as a disease vector in Australia.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

PART E – OPERATIONAL APPENDICES

Appendix 1 – Surveillance and Monitoring Methods – Ground/Fresh/Polluted Water Mosquito Breeding & Black Fly Breeding

An integral component of any mosquito surveillance program is the recording of data. Information collected from mosquito surveillance can be used to determine the need for a control program and to later evaluate the effectiveness of the program. The first step in the program will be the acquisition of relevant information concerning local mosquito problems:

- *What species are to be found in the area?*
- *Which of these are of a concern as potential pest or vector species?*
- *What biological data relevant to the pest or vector species is available?*
- *What periods of the year are the pest or disease situations likely to occur?*
- *What triggers breeding cycles and which treatment option/s is/are appropriate?*
- *What resources and assistance is available for the instigation of a local surveillance program?*
- *What resources and assistance is available for control of a pest or disease situation?*

1.1 Habitat mapping and record keeping

The next step will be production of a Vector & Pest Control layer in Council's mapping program. The layer will show all local features pertinent to actual and potential mosquito and black fly breeding habitats. The habitats will be plotted with GPS equipment and details of topography, vegetation type, and seasonal meteorological data which can be related to the production of habitats from rainfall, run-off and/or flooding will be gathered.

All mosquito and black fly habitats within a given area should be mapped; this is best done by foot, but often aerial photos, government drain maps, and other sources can be utilized. An invaluable source of information is the historical data maintained by BSC in a paper format. The highlighted areas will be visited and if a potential breeding sites are evident, these sites will be added to the Vector & Pest layer within Council's mapping system.

There is one major difference, between mosquitoes and black flies, when looking for habitats. Mosquitoes will be found breeding in still water, whereas black flies require running water. Inspecting by foot will visually confirm mosquito and black fly breeding habitats. Records of visits to these mapped sites for treatment or surveillance should be kept, noting presence of mosquitoes/black flies and changes in the habitat. Keeping records of habitat quality and where control is needed or taken place will help ensure an effective and efficient control program.

BSC will collate a register of mosquito breeding and resting sites, and where possible black fly breeding and resting sites. These will be categorised dependant on the associated risk; the type of breeding area; and other relevant information (e.g. 'No Go Zones' for treatment due to local industry).

BSC will interpret gathered data to identify triggers (e.g. climatic conditions, rainfall) that will generally indicate the mosquito and/or black fly populations will increase to an unacceptable level. Protocol for instigating the appropriate response will also be developed.

1.2 Identifying mosquito species in the area

Two sampling techniques will be used for determining species within these areas:

- *Larval sampling, and*
- *Adult sampling.*

Both sampling methods will be incorporated due to the biology and lifestyle of the mosquito. Adult mosquitoes may breed outside the BSC and cone into the area to rest and feed and visa versa.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

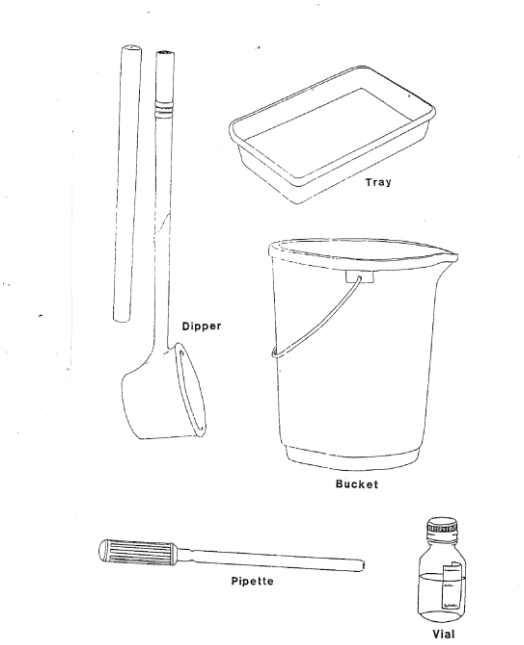
1.2.1 Larval Sampling

Local knowledge (e.g. Land Protection Officers, Roads and Drainage Officers) and Council's mapping system will be used to identify potential breeding sites. Typically larvae are found in non-moving water, in shallow habitats or at the edges of deeper water. However, floating and emergent vegetation will provide shelter and protection for larvae and pupae, and they may be found in deeper areas.

The aim is to sample every potential breeding site during the initial survey. For shallow areas, larvae are most commonly sampled with a white coloured, metal or plastic 'dipper' about 100mm in diameter and 300ml volume. An extendable or long handle is recommended for the dipper. Alternatively, a small fine-mesh net can be used in conjunction with a tray into which the net's contents can be washed. For larger habitats, a bucket can be used to strain large quantities of water with the residue poured into a shallow tray (preferable white) for inspection. When searching for larvae that attach themselves to plants (*Mansonia* and *Coquillettidia*), water plants and reeds should be quickly uprooted and transferred to a bucket of water which is then agitated. The water should then be poured into a shallow tray and allowed to settle, the dislodged larvae will tend to lie on the bottom of the container.

Equipment required for larval sampling

- *Dipper (white, 100mm in diameter and 300ml volume, extendable or long handle),*
- *White plastic dish,*
- *Pipettes (plastic,)*
- *Sample bottles/tubes/vials (plastic),*
- *Labels, pens, notebook, survey form, tablet,*
- *Rubber boots,*
- *Carry bag, and*
- *Esky (where necessary).*



Sampling Method

- *Mosquito larvae are very sensitive to light and movement and most species will dive to the bottom when disturbed. Approach the water body slowly and cautiously with the sun in your face so you do*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

not create a shadow on the water surface. If this is not possible, once you have arrived at the site stand still and wait for approximately five (5) minutes, to allow time for the larvae to come back to the surface for air;

- *Quietly observe the water for signs of larvae before actually dipping;*
- *Dip on the down-wind side of the water body (if possible) and close to the edge. The dipper should be placed in the water quickly using a scooping motion to collect the larvae;*
- *Do not discard the water from each dip back into the water body so as not to disturb any other larvae in the water body. This practice could also see first instar larvae being returned to the water body as they may not be seen with the naked eye;*
- *The same number of dip samples will be performed at each sampling point so that comparisons of larval numbers between sites or surveys can be determined. Generally at least ten (10) dips or samples should be collected at each sampling point and a record of the larvae per dip or samples will be recorded including negative ones, representing the population density;*
- *In large habitats, such as a farm pond, the dips shall be taken from different points or within the habitat to best represent the resident larval population. The number of dips and the number of larvae per dip, along with the larval stage (instar) information will be collected and this information will assist control personnel with determining the emergence time and what control effort/s to use;*
- *The larval collection form/tablet will also require details of the breeding site, including where possible GPS coordinates (so that the exact same place can be visited again) including vegetation type, shade, water body type, predators (e.g. fish) etc.;*
- *Any larvae required to be kept for identification should be transferred, using a pipette, into a labelled clear, clean vial or small container, with a screw cap so as to prevent leakage. Care should be taken to ensure that predator mosquito larvae are separated when samples will not be identified for some hours;*
- *The container will be labelled immediately with the date and details of the collection site. This is best done with a waterproof pencil*
- *The larval collection will also be recorded on a larval collection form detailing sample numbers and after identification has been undertaken – larval identification;*
- *Sampling from a crab hole or tree hole mat often require the use of a turkey baster (or flexible long tube on the end of a pipette).*

If larvae are not going to be kept for breeding purposes specimens may be placed into 70% alcohol (ethanol) or methylated spirits in vials (ethanol is the preferred medium). Prior to placing in the ethanol larvae will be killed using hot water. These vials will be labelled with date and sample location and there must be a clear link to the information on the larval collection form.

When larval treatment is undertaken pre and post treatment larval surveillance will be undertaken. The pre-treatment survey will be used to assess the need for treatment and assist with determining the type of product to be used. The post treatment larval survey allows for the quantitative visual evidence of a treatments success, and will assist in the determination of re-treatment activities.

1.2.2 Adult sampling

The purpose of adult sampling is generally to detect potential pest or vector species and monitor population abundance trends and fluctuations; and as a measure of a program's success. Sampling can also be in response to a specific complaint or event. Methods for collecting mosquito adults can be classified as either 'attractive' or 'non-attractive'. 'Attractive' traps are usually used because they generally produce larger and more diverse samples. A number of commercial trapping units are available that utilise attractants (e.g. light, heat, carbon dioxide, odour etc.) to catch and/or kill adult mosquitoes.

Light traps

Many, but not all mosquitoes are attracted to a light source. Light traps are available in a variety of models; some require mains power for operation, but others are more portable and operate from six (6) volt battery

to power a light source and a motor driven fan. The general design involves a light source to attract the mosquitoes into a down draft of air created by the motor-driven fan which directs the mosquitoes into a collection chamber. These traps are generally not very efficient capturing many *Aedes* species.

Dry-ice/Carbon dioxide (CO_2) baited (light) traps

The use of dry ice/CO_2 in conjunction with a light trap has been found to increase both the range of species and number of mosquitoes collected. These traps are generally preferred for routine surveillance as they not only collect a greater range and abundance of mosquito species but, they also collect much fewer numbers of non-target species (e.g. moths) due to the reduced influence of the light source.

Mosquitoes generally move upwind randomly during their host seeking flights. The area sampled by dry ice/CO_2 baited traps, will depend on the conditions, the dispersal of the attractant and the response of the individual species.

If a local supply of dry ice is not available and the use of CO_2 is not viable, dry ice can be produced by using a 'snow pack' attached to a 'G' size bottle of CO_2. Ten (10) to twelve (12) blocks can be made from each 'G' size bottle.

Animal baited traps

The use of animals as bait allows collection of species attracted to particular hosts and at times humans can be used as bait.

Determining Adult Populations

BSC will generally use either light or dry-ice baited light traps for adult mosquito surveillance. To monitor the activity of adult mosquitoes and assess the impact of control strategies, adult mosquito populations should be sampled on a weekly basis. When resources are insufficient for weekly trapping, traps should be set at least every two weeks. Traps are usually set in the late afternoon (at least one [1] to two [2] hours before sunset) and collected the following morning (approximately one [1] to two [2] hours after sunrise). Collections will be influenced by wind and rain, therefore it is important to select an appropriate site for the trap and also monitor the weather forecasts to select the best evening for surveillance.

Initial surveillance will be undertaken for an entire year to determine if there are any seasonal fluctuations in the adult mosquito population within the BSC. Prior to surveillance a risk analysis will be undertaken to determine which areas should be monitored. A number of traps will be set in each area to enhance the capture rate and assist with identifying permanent locations for the routine monitoring traps. *Please note it is important to set the trap in the same location for comparisons between data collection and program evaluation purposes*. Surveillance will be undertaken in each specific area at least three times during the year (twice in the summer and at least once in winter).

Equipment required for light and dry-ice/CO_2 baited light traps

- *Dry-ice canister or (for dry-ice baited traps);*
- *Catch net and container (for mosquitoes);*
- *1.8m battery leads;*
- *Fan and light bulb (replaceable);*
- *Chain/hanging cord;*
- *6 volt 7 amp hour rechargeable Battery;*
- *Battery Charger; and*
- *Optional – CO_2 gas cylinder, spanner, regulator hose and regulator (for CO_2 baited traps).*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

6 volt 7 amp hour batteries

CO_2 gas cylinder regulator, regulator hose and spanner

Sampling Method

- *Adult traps should be set away from other light sources (such as street or house lights) and animal host sources;*
- *Protected from strong winds, and where possible sheltered from the rain;*
- *It should be suspended from a tree, bush or post about one (1) to two (2)m above the ground;*
- *Do not set the trap in any location where the top of the trap is over one and a half (1.5)m off the ground, the closer to the ground the more effective the trap;*
- *The trap should preferably be placed in a concealed location to limit vandalism, interference and/or theft of the trap;*
- *Traps should be placed near vegetation but not within too heavy vegetation cover as the attraction produced by a trap that is located in heavily vegetated areas may only be 100m downwind from the trap.*

A light rain may increase capture numbers, but strong wind and rain will seriously reduce collections; winds above 10km/hr can be expected to preclude mosquito activity; and temperatures below 10^{o}C usually reduce mosquito activity. Cloud cover is also important, as clouds reduce competing moonlight, increase humidity and temperature.

Trap construction and placement

- *Use the chain/chord provided to secure the light trap in a hanging position in a suitable tree or secure location;*
- *Attach the catch net and collection container to the base of the light trap securely on the lip provided;*
- *Check that there are no holes or tears in the catch net. The catch net requires regular inspection to avoid mosquitoes escaping (net material is easily torn);*
- *Ensure clear tubing for CO_2 dispersal is clear and open (i.e. no kinks) and placed in through the hole provided so that the gas is released downwards (when being used);*
- *Attach battery leads to the battery and place battery in a secure position;*
- *Ensure the battery leads are not tight and straight (allow for some slack) as this can interfere with battery operation particularly in wet weather;*
- *If using CO_2 gas cylinders - use a shifting spanner to attach the regulator to the gas cylinder;*
- *Securely fix the regulator hose in the hole where the CO_2 is dispersed from when using dry ice. The end of hose should be placed in same position as the end of the tube when using dry ice;*
- *Ensure the hose is correctly fitted to allow flow, filter is located near the regulator and the green connector should be at the opposite end to the regulator;*
- *Ensure gas cylinder is placed in a secure, inconspicuous position;*
- *Do not adjust flow on the regulator as this is set in the factory;*
- *Light trap is now ready to run.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Dry-ice baited light trap

Trap Operation and Retrieval

- *Once the trap is running check for the sound of the fan to ensure the fan is working and that the light bulb is lit;*
- *If required -Turn on the gas (only a small amount) you can usually hear a slight hissing sound that indicates that the gas is on;*
- *Leave trap in position over night;*
- *Return to retrieve the trap;*
- *The fan must be running when the catch net and container bag is collected to prevent mosquitoes escaping;*
- *If relevant, switch off gas and remove regulator hose from the trap;*
- *Place your hand gently around the outside of the catch net and gently tap at the sides of the net and container to ensure that all the mosquitoes are inside the catch container;*
- *Carefully remove the net by loosening the toggle marginally so that it can be removed from the base of the light trap;*
- *Once removed tighten the toggle until firm and ensure there is no gap in the top of the catch net;*
- *Ensure catch container is clearly labelled with trapping details;*
- *Switch off fan and light by disconnecting the battery and where necessary gas bottle and regulator;*
- *The label (collection details) for the Collection container should be well secured so as to ensure the label does not fall off;*
- *Carefully push the net down into the collection container so as to avoid tears;*
- *Ideally, the collected mosquitoes will be transported within an esky to keep them alive and in good condition;*
- *The label for the collection container should contain the following information date, time, location and any location specific details e.g. Number;*
- *The maximum time a light trap should be left running is for a 24 hour period so as to ensure the battery does not run flat and allow mosquitoes caught to escape. Generally traps for mosquito surveillance must set at least one (1) to two (2) hours prior dusk and retrieved one (1) to two (20 hours after dawn;*
- *Two (2) blocks of dry ice (made with a snow pack) should last for approximately 14 hours. If using dry ice pellets from BOC each container requires about one (1)kg of ice;*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *If the trap is not working check the connecting plugs on the battery, as sometimes the wires become loose and the power doesn't reach the fan;*
- *On return to depot/office recharge the batteries immediately so that they are ready for the next surveillance session;*
- *Light traps and components can be purchased from Pacific Biologics (ABC or PB traps);*
- *Gas cylinders, dry ice pellets and snow packs can be supplied and refilled by BOC gases.*

Adult mosquitoes collected for identification must be handled with great care. Collection containers should be rigid (to protect the mosquito) and enable airflow through the trap. On retrieval the collection container will be removed from the base of the light trap and placed in an esky or box to prevent damage during transit. On arrival back to the depot/office the collection containers will be placed in a freezer, to preserve the catch. Alternatively adults can be killed using carbon dioxide or chloroform in a killing jar.

Collection and identification details will be recorded on a standard form. Information that must be captured includes; date, location/trap run, site location of trap, site characteristics (e.g. rural/open ground/sheltered), weather conditions (e.g. clear/cloudy, overnight and weekly rainfall/ wind speed and direction/moon phase/ max and min temperature/ humidity), details of collection (e.g. time set/ time collected/ any other relevant comments e.g. battery dislodged), species type and number.

Routine maintenance is required to ensure the traps remain operational. Each time the collection net and container is returned to the depot/office for the collection to be identified the netting MUST be carefully checked for holes; the collection netting requires washing (in warm soapy water) on a regular basis to keep it white and prevent dust interfering with air flow. The collection container also require regular washing in warm soapy water to keep them clean and clear of residual insects, dust etc.

1.3 Identifying Black Fly abundance

Information relating to Black Fly control within Australia is limited, with the majority of information coming from North American studies.

Two sampling techniques will be used for determining species within these areas:

- *Larval sampling, and*
- *Adult sampling.*

1.3.1 Larval Sampling

Local knowledge (e.g. Land Protection Officers and Roads and Drainage Officers) and Council's mapping system will be used to identify potential breeding sites. Typically larvae are found in moving water, which has sufficient nutrients to support the growth their growth. The larvae will be attached to aquatic or emergent vegetation as well as rocks. They will be particularly abundant near culverts under roads, attached to plants trailing in the water.

Field staff should constantly monitor streams and running water within their area of responsibility to see if black fly eggs have hatched into larvae.

1.3.2 Adult sampling

The purpose of adult sampling is generally to detect the presence and monitor population abundance trends and fluctuations; and as a measure of a program's success. Sampling can also be in response to a specific complaint or event. Methods for collecting black fly adults are very similar to the methods used for adult mosquitoes. Various styles of traps are available for catching flies and as with mosquito's humans bite counts can be used to determine the abundance of the pest.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 2 – Response/Control Methods – Ground/Fresh/Polluted Water Mosquito & Black Fly Breeding

The term response refers to action taken in response to a complaint, surveillance programs, disease notification, exotic incursion or disaster management. Response and control methods will be determined after undertaking a risk analysis. Other factors that will impact on the type of response will include budget restraints and resources.

BSC will attempt to lead by example. Council land/facilities that are identified as either breeding or resting sites for mosquitoes and black flies will be assessed to determine the associated risk and an appropriate response will be actioned.

2.1 Complaint Response

BSC will develop a procedure for recording mosquito and black fly related complaints that will enable the collection of relevant data. The following information is required:

- *Is the complaint concerning mosquito biting?*
- *Is the complaint concerning black flies?*
- *What times are the mosquitoes biting?*
- *When are the mosquitoes most active?*
- *Where are the mosquitoes/black flies most active?*
- *Is the breeding site known?*
    - *Location (e.g address, private land, Council property, State Land)*
    - *Type (e.g. pool, drain sewerage treatment plant, stream, river)*

2.2 Response/Control Measures

2.2.1 Source Reduction – mosquito breeding

Physical control generally involves source reduction or environmental modification in the order to reduce or eliminate the mosquito larval habitat, although there is some overlap between environmental modification and the first three classifications. Physical methodologies can usually be classified in the following:

Filling

Often self-explanatory, the literal filling-in of mosquito larval habitats with sand or earth or other material so that the depression that retained water no longer exists;

Draining

Is also self-explanatory, and is often required prior to filling. Drainage can be less expensive than filling but the drainage system will require maintenance to ensure a mosquito habitat does not return. (E.g. structures associated with stormwater retention or drains may contain free-standing water that persists and provides suitable habitats for some mosquitoes). The production of mosquitoes from these areas can be avoided by ensuring that the structures are self-draining, have the siltation depth shallow enough to encourage evaporative drying, and that the accumulation of organic material is maintained at low levels. In addition to the design of these structures, a routine maintenance program is essential to remove the inevitable build-up of organic material that can create blockages and, subsequently, opportunities for mosquito breeding.

Water Management

Is a very important technique for controlling mosquito populations when the first two classifications cannot be used (e.g. in large reservoirs, farm dams and irrigated land). Proper management requires detailed knowledge of the biology of the species targeted for control. Mosquito production from natural and constructed freshwater wetlands is dependent on a combination of physical and vegetative characteristics. Aquatic vegetation management is the most useful strategy for mosquito management in these habitats. When wetlands contain large areas of open water and vegetation at the margin is sparse, wind/wave action

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

is relatively high and predatory fish have unobstructed access to the larvae – all these contribute to a reduction in larval population but may not completely eliminate mosquito production.

Environmental Management

Indicates that one or more of the environmental conditions within the mosquito habitat is modified, creating an environment that does not encourage larval growth. Activities which alter habitat include varying the salinity of the habitat; removal or addition of shade; removal of floating or emergent vegetation; providing water surface agitation; periodic flushing of slow moving streams from dam storage; alteration of pH, oxygen, chemical or organic pollution; or increasing retention time to alter the nature of vegetation.

Source reduction of larval mosquitoes may involve: (1) installation of catchments; (2) installation of tile leading to a catchment or drain; (3) modification of grade to permit drainage; or (4) conversion of a mosquito-producing area to a non-mosquito-producing body of water such as an ornamental pond, water hazard, or permanent wetland. For tiling purposes, "sock" tile, which allows water entry but prevents roots and debris from clogging the tile, is very useful when dealing with woodland mosquito habitats. Another type of source reduction is the removal of artificial habitat, such as the filling of abandoned swimming pools or collection and shredding of abandoned tires.

2.2.2 Chemical Control

Larviciding

As stated earlier there is currently no larvicide that has been approved for use against Black Fly in Australia. Breeding sites for mosquitoes that have been identified as posing an unacceptable risk or nuisance value to the community will be continually monitored throughout the year/season. Treatment shall only be undertaken by a Licensed Pest Management Technicians (PMT), or alternatively by a person undertaking study to become a PMT who is being supervised by a PMT. Chemical application will always be undertaken in accordance with the label. The timing of treatment is to be established and will be put in place to intercept the mosquitoes' or black flies' breeding cycle.

Bacterial – Mosquitoes

Three bacterial formulations are available for larviciding activity: *Bacillus thuringiensis israelensis (Bti), Bacillus sphaericus (BS)* and a larvicide derived from the bacterium *saacharopolyspora spinosa.* These bacterium affect larval mosquitoes and some midges by causing cellular breakdown in the midgut resulting in rapid death, usually within eight (8) to twelve (12) hours. It is important to note that these formulations must be ingested by actively feeding mosquitoes so they have no effect on late fourth (4^{th}) instar larvae or pupae. These products are generally available in liquid, briquet, and granular formulation from commercial sources under trade names such as Vectobac®, Aquabac®, and Teknar®. *Bti* works well in a variety of freshwater habitats. Granular formulations are particularly effective against mosquitoes when the larvae are in their second and third stage. *Bacillus sphaericus* does not have the ***Bti's*** broad spectrum of activity, but has a longer period of larvicidal activity. In addition, *Bacillus sphaericus* works well in highly organic habitats. Because of its extended control and effectiveness in organic water, *Bacillus sphaericus* is effective in treating catch basins. These larvicides will last only a few weeks in water and pose no danger to humans, non-targeted animal species, or the environment when used according to directions.

Insect Growth Regulators – Mosquitoes

Methoprene is an insect growth regulator. This product disrupts the mosquito larvae's normal growth pattern by artificially limiting its development, making it impossible to reach the adult stage. It may be used to control second (2^{nd}), third (3^{rd}), and fourth (4^{th}) instar larvae. Treated larvae will pupate but adults will not emerge from the pupal stage; it is not toxic to existing pupal or adult stages. The mode of delivery includes liquid, charcoal pellet, and briquet. This product can be applied to larger bodies of water in the form of time-release briquets which can last from one to five months. Use of this larvicide does not pose an

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

unreasonable health risks to humans or other wildlife and it will not leach into the ground water supply. There is a small acute and chronic risk to some fish and freshwater invertebrate species.

Organopfosphate – Mosquitoes

Tempehos, marketed as Abate and ProVect, is an organophosphate which prevents mosquito larvae from developing resistance to bacterial larvicides which can be delivered as a plaster pellet, liquid, or sand granule. Due to the small amount needed and the fast rate that temephos breaks down in water, this type of larvicide does not pose an unreasonable health risk to humans, but large doses can cause nausea or dizziness. This insecticide has been used by the World Health Organization to treat stored drinking water. However, careless handling or ingestion of any organophosphate increases health risks. As with any insecticide special attention to the label is necessary relative to site use, mixing, and application of material. Similarly, there is not a large risk to terrestrial species, but there is a toxic concern for non-targeted aquatic species. Therefore, temephos should be limited only to sites where less hazardous larvicides are ineffective and with intervals between applications.

Equipment and Dispersal

The use of a four-wheel drive vehicle is recommended for larviciding large areas. A tray back four wheel drive utility can be equipped with a chemical-container tank, a high-pressure, low-volume electric or gas pump, and a spray nozzle. A switch and an extension hose allow the driver to operate the equipment and apply the larvicide from inside the vehicle's cab. Roadside ditches, swales, retention ponds, treatment ponds, and other similar bodies of water can be treated with this setup.

Increasingly, mosquito control agencies are moving towards the use of all-terrain vehicles (ATVs), which allow operators to reach larval habitats that are inaccessible by a larger vehicle. These units can carry a reasonable payload allowing operators to treat a number of remote sites consecutively without having to return to replenish pesticides. As with a utility, a chemical container is mounted on the ATV, a 12-volt electric pump supplies a high-pressure low-volume flow, and a hose and spray tip allow for manual application by an unaccompanied operator while steering the ATV with the other hand. ATVs are ideal for treating areas such as agricultural fields, pastures, salt marsh areas, and other off-road sites. Training in ATV safety and handling should be provided to employees operating these machines.

ATV with equipment suitable for larviciding

Vehicle mounted fertilizer spreaders can also be used to dispense large amounts of granules and/or pellets.

Vehicle mounter Spreader

Hand held Spreader

Additional equipment used in ground applications includes dippers, hand held fertilizer spreaders, handheld sprayers, and backpack blowers and sprayers. Dippers and hand held fertilizer spreaders may be used to

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

broadcast small amounts of granular or pelletized larvicides in spots that require minimal treatment. Hand-held sprayers are standard five (5) to ten (10) litre garden style pump-up sprayers used to treat small isolated areas with liquid larvicide formulations. Backpack sprayers usually have a gas-powered blower with a chemical tank and calibrated proportioning slot. Generally, pellet or small granular material is applied with a gas-powered backpack sprayer. They are extremely useful for treating tire piles. Pump-up backpack sprayers are sometimes used for dispensing liquid larvicides.

Back Pack Sprayer

Powered Back Pack Sprayer

2.2.3 Adulticiding

At times, it may be necessary to undertake a program to control adult mosquitoes that have emerged due to either an interrupted larviciding program; a confirmed outbreak of a vector borne disease; or during a disaster situation. Programs will also be undertaken when black fly numbers create an unbearable situation. It is accomplished by ground-based applications or via aerial application of residual chemical insecticides. Adulticiding programs are often considered to be the method of last resort. Adulticides are broad-spectrum pesticides and that have the potential to impact non-target organisms.

Information on the biology of the pest organism is required, and thresholds must be determined before treatments begin. Once the thresholds have been met, the target can be defined as flying insects, a barrier (vegetation), and/or a solid surface. Then, the appropriate equipment and chemical must be chosen, and the application must be made in a timely fashion. The chemical dose and type has a significant effect on the outcome of an application. The chemical must reach the adult mosquito and/or adult black fly through the most appropriate use of available methods. Chemicals can be dispersed by the following methods:

Space Sprays

Typically use Ultra Low Volume (ULV) technology, sometimes referred to as cold fogging. Space sprays are applied with specialised spray equipment mounted in aircraft, on the back of trucks, or even carried by hand. With space sprays, aerosols are released to drift through a target zone. Chemical concentrates most often are used and, even if diluted, volumes of material used remain low. The aerosol persists in the air column for an appreciable length of time at suitable droplet densities to contact the flying mosquito and/or black fly and is only effective while the droplets remain airborne. Hence, a space spray is short-lived and is not expected to have any residual effect.

Vehicle Mounted ULV

Thermal Fogging

Is appropriately named since it is a device that uses heat to produce a fog without degrading the active ingredient. A thermal fogger produces a range of droplet sizes including a large number of very small droplets. This makes a thermal fogger the preferred type of equipment to reach air spaces in areas highly

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

obstructed by vegetation, or other physical obstructions in buildings. The large number of very small droplets produced in a thermally generated fog also makes the fog highly visible. This can help the operator to monitor the fog and ensure thoroughness of application. Thermal foggers can be small enough to be hand or large enough to require vehicle mounting.

Hand Held Thermal Fogger

Residual Sprays

Are often are referred to as barrier or surface treatments. The mosquito and/or black fly is required to land on a surface deposit of the insecticide to pick up a toxic dose. A barrier treatment can be applied to kill and/or prevent adult mosquitoes and adult black flies from moving into an area such as a stadium, park, or resident's yard. Barrier treatments can also be used close to known breeding sites. After emergence both mosquitoes and black flies look for suitable resting areas, generally some form of foliage. The foliage in these resting areas can be treated, but this should not occur whilst in flower. Treating foliage in flower could see various non-target species affected by the chemical. Barrier treatment can also be applied to structures such as buildings and fences (e.g. school building, sports ground buildings, hospitals). When small areas are treated handheld devices such as a backpack mist blower or a compression sprayer are employed. For larger areas the chemical can often be applied with a modified vehicle mounted hydraulic sprayer.

Hand Held

Trolley Mounted

4WD Mounted

ATV Mounted

Timing

Timing is essential for space sprays to target actively flying mosquitoes and/or black flies. The timing needs to be precise because different species are active at different times. In general, most mosquito species targeted by space sprays are active around dusk and dawn, and, hence, most adulticide applications for mosquitoes occur around those times. Black flies are generally active from sunrise to mid-morning (10am) and late afternoon (4pm) to sunset. Problems may arise with timing applications because:

1. The meteorology (weather conditions) is inappropriate for good downwind dispersal;
2. Continuous late nights and overtime can cause personnel management problems; and
3. Ground spray missions are typically not conducted when people are on the streets or around the structures being treated.

Meteorological parameters also influence mosquito activity and to some extent black fly activity and timing of the application. Some trends are:

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Increased humidity = increased activity*
- *Increased temperature = increased activity (to a limit above which activity decreases)*
- *Increase wind = decreased activity*
- *Lunar illuminations = increased activity and an extended activity period for mosquitoes*

Timing of residual spraying is not nearly as critical as the timing of space spraying. Residual spraying targets the mosquito in harbourage at rest on vegetation or other surfaces. An effective residual spray uniformly coats a target surface with an insecticide that will last an appreciable length of time. Applications should be conducted when conditions are conducive to provide the best coverage. Timing is not critical in relation to mosquito behaviour and/or black fly; instead, applications must be made to achieve the best deposit. Winds should be low or favourable to the direction of the target related to the sprayer. Conditions should be dry since while most compounds are considered rain-fast, they need time to dry.

Choosing the Chemical

Once the application type has been determined, the chemical to be applied and the dose rate must be selected. This decision is dictated in part by the size of the application area. For example, large area spraying with some compounds can be cost prohibitive. The habitat can also have some influence. For example, the use of some chemicals may have to be restricted around waterways. The species that is being targeted also may affect the choice of compound. The comparative efficacy of one compound over another is disputable, but one thing that is known is the effect that mosquito species and black fly, habitat preference, and behaviour has on ease of control.

Adulticides

Pesticides kill or alter an organism by disrupting some vital physiological function. The method by which this occurs is called the pesticide's mode of action. The most typical mode of action involves disruption of the insect's nervous system. The most common compounds used for adult mosquito and adult black fly control in Australia are the Pyrethroids.

Pyrethroids are synthetic chemicals whose structures mimic the natural insecticide pyrethrum. Pyrethrins are found in the flower heads of some plants belonging to the family Asteracae (e.g., chrysanthemums). These insecticides have the ability to knockdown insects quickly. Pyrethrums can be degraded very easily by ultraviolet light which oxidizes the compounds. In general, this phenomenon leads to lower environmental risk. Pyrethroids can pose significant hazards to aquatic organisms, and the potential for build up within sediment is a concern. Pyrethroids are highly toxic to insect pests at very low rates. Synthetic pyrethroids have been chemically altered to make them more stable and safer to mammals. Pyrethroids are axonic poisons; they poison the nerve fibre by binding to a protein in nerves called the voltage-gated sodium channel. Normally, this protein opens causing stimulation of the nerve and closes to terminate the nerve signal. Pyrethroids bind to this gate and prevent it from closing normally which results in continuous nerve stimulation. Control of the nervous system is lost, producing uncoordinated movement and ultimately mortality.

Products typically used for adult mosquito and/or adult black fly control include:

- *Aqua K-othrine® from Bayer Environmental Science is a space spray concentrate containing 2% deltamethrin. Deltamethrin is a highly active pyrethroid insecticide which will effectively flush insects out of their hiding places and kill through direct contact. Due to the high activity of deltamethrin Aqua K-Othrine® can be applied at extremely low dose rates of 0.5 - 1.0 g/ha of active ingredient to control public health insect pests including vectors of disease as well as nuisance flies and mosquitoes.*
- *Baytex® 550 from Bayer CropScience is a residual spray concentrate containing 550g/l of fenthion. Its use on the outside of buildings, where treated surfaces are not exposed directly to rain ensures control of flies for up to eight (8) weeks and longer for mosquitoes.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Biflex® Aqua Max from FMC Australia Pty Ltd is a residual spray concentrate containing 100g/L Bifenthrin. It is a powerful knockdown and residual pesticide. Mosquitoes and flies are controlled by direct contact with the spray and also by residual action as they come into contact with the treated surfaces.*
- *Garrards Pyrethrin Drift from Garrards Pty Ltd is pyrethrin based with 4g/L of pyrethrins, 24g/L piperonyl butoxide and utilises a liquid hydrocarbon solvent. The product is applied through misting or fogging equipment and is registered for the control of mosquitoes, midges and flies in outdoor situations and flies in indoor areas.*
- *Perigen ® Defence from Bayer Environmental Services is a residual insecticide containing 500g/L of permethrin 25:72 and utilises a liquid hydrocarbon solvent. Mosquitoes and files are controlled by direct contact with the spray and also by residual action as they come into contact with treated surfaces.*
- *Pyrocide® Mosquito Adulticide ULV Extra Strength Concentrate from MGK Asia-Pacific Pty Ltd is a space spray containing a 118g/L pyrethrins, 592 g/L piperonyl butoxide and utilises a liquid hydrocarbon solvent. The formulation that is designed for larger programs, particularly those that use modern truck mounted application equipment. Pyrocide is available in 5 Litre bottles, and using an oil-based diluent, operators can adjust the spray mix to a wide range of concentrations to suit all situtations. The Natural Pyrethrins give excellent flushing and knock-down characteristics, short persistence, and rapid breakdown in sunlight.*
  'Note'*: Currently Pyrocide is only suitable for mosquito treatment.*
- *Reslin® from Bayer CropScience is a space spray concentrate containing 50g/L bioresmethrin 400g/L piperonyl butoxide and utilises a liquid hydrocarbon solvent. Reslin should be diluted with a suitable volume of water, oil or kerosene. It can be used for indoor and outdoor control of both mosquitoes and flies. **
  'Note'*: Reslin may not be available in the future.*
- *Twilight™ ULV Mosquito Adulticide Concentrate from Pacific Biologics Pty Ltd is a space spray containing 89g/L phenothrin, 89g/L piperonyl butoxide and utilises a liquid hydrocarbon solvent. It is a highly concentrated formulation that has extremely low mammalian toxicity. It is designed for outdoor control of mosquitoes.*
- **'Note' :** *Currently Twlight is only suitable for mosquito treatment.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 3 – Surveillance Methods – Container/Urban Breeding Mosquitoes

The reasons for undertaking surveillance and the record keeping requirements are similar to those required for groundwater/freshwater/polluted water breeding; therefore that information will not be rehashed. The methods or surveillance differ and will be covered in this section.

Surveillance activities are designed to:

- *Detect the relevant abundance of Aedes aegypti;*
- *identify the types and availability of breeding sites; and*
- *potentially provide an early warning system for the possible importation of Aedes albopictus.*

Most surveillance will require entry onto private property, therefore the occupiers consent will be required unless entry is conducted under an 'Approved Inspection Program' under the *Local Government Act 2009,* or an 'Authorised Prevention and Control Program' under the *Public Health Act 2005.* There are two main differences between these programs: the 'Approved Inspection Program' can be approved by Council and treatment **cannot** be undertaken without owner/occupier consent; the 'Authorised Prevention and Control Program' must be approved by Queensland Health and treatment **can** be undertaken without owner/occupier consent.

Routine surveillance can be undertaken at locations that represent a high risk:

- *Premises where Aedes aegypti has been identified,*
- *backpackers/hostels/guest houses,*
- *hospitals,*
- *major truck/vehicle stops,*
- *farms, mining operations or businesses that use transient labour (in close proximity to urban areas),*
- *tyre dealers,*
- *schools, and*
- *travel transit centres.*

The type of sampling undertaken will be determined after conducting a risk analysis, identifying available resources and in most cases advice from the entomologist/specialist from Queensland Health who is responsible for this area.

3.1 Identifying species and density of vectors in the area

There are three sampling techniques that can be used for determining species and density of the vector:

- *Ovi/egg sampling;*
- *Larval sampling; and*
- *Adult sampling.*

In many cases the same equipment can be used for more than one type of sampling.

3.2 Ovi/egg Sampling

The ovitrap is useful for collecting information on container breeding mosquitoes. Counting the number of eggs on the substrate can estimate the number of container mosquitoes that may hatch following the next rain, as well as the number of adult females present within the sampling area. It is also possible to rear the eggs from this trap to either larval or adult stage for identification purposes.

3.2.1 Equipment required for ovi/egg sampling

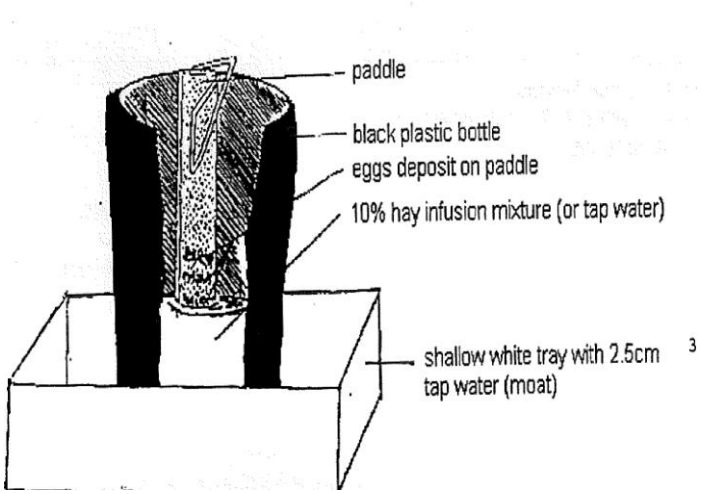
- *Black divot buckets (1.2L),*
- *Masonite paddle or tongue depressor,*
- *Distilled water or tap water infused with a Lucerne pellet,*
- *Warning labels,*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Moat and tap water (if required to stop ants eating the eggs),*
- *Sealed containers for transport of water and paddle from ovi trap,*
- *Rearing jar/tray/container – only required is the intention is to rear to larval or adult stage,*
- *Ground fish food – feed for larvae is breeding out.*

3.2.2 Sampling Method

- *Use a black container (golf divot buckets are suitable), it is important is the container has not been used before that it is seasoned first. This is achieved by placing water in the black container and part of a Lucerne pellet, place the container outside in the sun for approximately a week;*
- *Ensure the bucket has the appropriate identifying sticker i.e. Monitoring site only;*
- *Prepare a paddle by cutting a Masonite sheet (2cm W x 12cm L) or alternatively use a wooden tongue depressor roughened with sandpaper;*
- *If ants are a problem place the bucket in a white plastic shallow tray filled with about 2.5cm tap water;*
- *Set each ovitrap in an area protected from the weather (e.g. under steps, house eaves, or under house), out of direct sunlight but visible to the mosquitoes. Preferably near vegetation and protected from rain and disturbance from animals. They also need to be adjacent to areas where there is regular human activity;*
- *Add appropriate level of distilled water or tap water and Lucerne pellets (x 2, or @ 0.5g). Water depth should be approximately 10cm;*
- *Place the numbered paddle into the bucket;*
- *There is no limit on the number of traps that can be placed on a property. When monitoring a town area set between 10 to 20 traps with one trap per property;*
- *Collect paddles in a marked container or bag, and if rearing to larval or adult stage place in a rearing jar or suitable container (e.g. clear plastic takeaway container large enough to allow the paddle to be submerged and ensure there are small pinholes to allow for airflow);*
- *Wipe out the bucket with paper towel and refill with water (as above) and place a new paddle in the bucket; Label transport container with Date and Location and place for record keeping;*
- *Return paddles or rearing trays to depot/office for counting or rearing;*
- *If rearing for larval identification fourth Instar larvae can be identified using a microscope;*
- *Keep accurate records of locations and properties with ovitraps.*



Ovi/egg trap Construction

3.2.3 Larval or Adult Rearing

- *Larval rearing should be carried out in an area that is not air-conditioned with natural light (where possible);*

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Each larval rearing jar should be monitored for at least three (3) weeks;*
- *If larvae are present but growth is slow the temperature may need to be increased;*
- *Hatched larvae need to be reared under hygienic conditions;*
- *Larvae should be feed on ground fish food (tropical fish food is satisfactory). The ground fish flakes need to be soaked in water for one hour before the suspension is added to the rearing jar. A pipette should be used to place the fish food suspension below the water surface to reduce bacterial problems on the water surface;*
- *Food should be added at Day one (1) of the rearing process to aid hatching. Do not add too much food or put fingers into the water as this can promote bacterial growth (evident by the presence of white scum on the surface of the water);*
- *Larvae can be Identified under a microscope once they reach the fourth (4^{th}) instar, alternatively they can be reared until they become adults. If rearing to the adult stage it is advisable to use a container designed for this purpose;*
- *Once the adults have emerged that can be placed into a freezer for 24hours (to kill them – my experience has shown that is you leave for less than 12 hours the mosquitoes will awaken and be able to fly off). Once the mosquitoes are dead they can be identified under a microscope.*

Adult Rearing Jar

Used paddles can be disposed of paddles in to a waste bin. If using Masonite they can be left to dry for one week, then scrubbed clean to remove any old unhatched eggs and scum sterilised in boiling water and dried. Wash buckets in hot/boiling water to remove any extra eggs and organic matter.

3.3 Larval Sampling

There are two (2) methods that are routinely used for larval sampling:

- *Ovi/egg traps – with eggs reared to larval stage; and*
- *House to house surveys*

'Note': *Refer to the previous section on ovi/egg sampling and Appendix 4 sections 3.2.and 3.3 in this Part for details on conducting larval sampling*.

House to house surveys although extremely labour intensive, provide direct access to the owner/occupier. This face to face contact can be used to educate the community about steps they can take to prevent mosquito breeding. House to house surveys also identify the specific types of containers within the community that have the potential for breeding and/or are breeding mosquitoes. This information can then be used during media campaigns.

3.4 Adult Sampling

Traditionally container/urban mosquito surveillance involved inspecting commercial and domestic yards and premises for mosquito breeding containers. However, recent research has led to the introduction of alternate methods for sampling and controlling container breeding mosquitoes.

There are three methods that can be used for adult sampling:

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *BGS traps;*
- *Gravid Aedes Traps (GATs); and*
- *Sticky ovitraps*.

3.4.1 BGS Traps

These traps require a power source to operate and an attractant can be added to increase the mosquito activity.

Placement Rules

- *The trap needs to be set up in a position out of the wind, rain and direct sunlight;*
- *The trap should not be placed under any structures/objects where there is less than 1m gap above the trap;*
- *Do not set the trap in any location where the top of the trap is over 1.5m off the ground, the closer to the ground the more effective the trap;*
- *Traps can be placed either in door or outdoors and should always be placed in areas where human activity is high;*
- *Running the trap on mains power is preferred over battery operation. If the trap is to function correctly, then the battery must be 12V with a maximum 24Ah output. Batteries last approximately 26 hours.*

Trap Construction

- *Gently pull the trap into the upright position;*
- *Slot the mounting poles into the gaps at the base of the trap, ensuring that the groove in the base of the pole is aligned over the bottom frame wire, very gently bend the pole until you are able to slot the top of the pole around the top frame wire;*
- *Gently push the pole so that it sits against the side of the trap – see Figure 1*

BGS Trap Figure 1

- *Ensure that the suction tube is fully expanded and the fan is not damaged;*
- *Add the white gauze cover - ensure that the lead has not pulled the fan to one side of the trap. The cover must sit neatly over the trap with no gaps around the outside of the suction tube. - see Figure 2*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

BGS Trap Figure 2

- *The funnel net needs to sit high on the catch pipe (over the top of the groove on the catch pipe) - see Figure 3 - to allow mosquitoes uninterrupted access to the catch bag. Once the funnel net is in place, the catch bag is placed over the funnel net- see Figure 4*

BGS Trap Figure 3

BGS Trap Figure 4

- *Check that there are no holes or tears in the catch bag. The stitching of the catch bag must be on the outside of the bag to avoid mosquitoes becoming caught in the stitching and not being removed for identification. The catch bag requires regular inspection to avoid escapees (bag material is easily torn);*
- *Ensure there is a gap between the bottom of the funnel net and the catch bag. Tighten the toggle on the catch bag until the bag is firm around the funnel net and catch pipe;*
- *Place the catch bag in the suction tube, the BG trap is now ready to run – see Figure 5*

BGS Trap Figure 5

- *Once the trap is running check the sound of the fan to ensure the fan is working and that the catch bag is not touching the fan. The sound of the fan will change if the catch bag, or part of the suction tube, is interfering with the airflow.*

Collection of the Catch Bag

- *The fan must be running when the catch bag is collected to prevent mosquito escapees;*
- *Run you hand around the inside of the catch pipe and rattle the catch pipe to ensure that all the mosquitoes are inside the catch bag;*
- *Carefully lift the catch pipe until the toggle of the catch bag is visible above the rim of the suction tube;*
- *Loosed the toggle until the catch pipe and funnel net can be removed from the catch bag;*
- *Leaving the catch bag within the suction tube, tighten the toggle until firm and there is no gap in the top of the catch bag;*
- *Attach label with trapping details to the elastic of the catch bag.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Transportation of the Collection Catch Bag

- *The label (collection details) for the catch bag should be attached to the elastic of the bag, preventing the label from falling off or damaging the collected mosquitoes;*
- *Ideally, the collected mosquitoes will be transported within an esky to keep them alive and in good condition. A piece of dowel wedged in the esky, from which the catch bag can be hung, prevents the mosquitoes being squashed or badly rubbed during transport.*

Maintenance

White Gauze Cover

The cover needs to be inspected regularly as they are prone to elastic degradation and can easily be torn. The cover requires washing (in warm soapy water) on a regular basis to keep it white and prevent dust interfering with air flow.

Funnel Net

The funnel net requires washing (in warm soapy water) on a regular basis to keep it clean and prevent dust interfering with the airflow. The elastic in the funnel net is also prone to degradation.

Catch Bag

Each time the catch is returned to the lab for the collection to be identified it MUST be carefully checked for holes, especially around the edges. The catch bags also require regular washing to keep them clean and the airflow unhindered.

The manufacturers recommend that the catch bag be exchanged/replaced every three (3) – four (4) days, of operation, to maintain quality of the mosquito specimens. After this time the damage to the caught mosquitoes increases and identification becomes more difficult. If the trap is not working check the connecting plugs as sometimes the wire becomes loose and the power doesn't reach the fan. CO_2 gas can be added to the trap increase the catch of *Aedes aegypti*, as well as other mosquito species. The gas is added from the bottom of the trap, escaping upward. BG Lure Attractant can also be added to the trap to increase the chances of catching target mosquitoes such as *Aedes aegypti*. A small net pocket is located inside the trap on the outside wall of the suction tube for the attractant to be placed. Ants can become a problem with long term surveillance trapping locations. Move the BG trap to a different location within the trapping property to deter the ants or treat the ground around the BG with surface spray (remove the BG trap from the area first and allow any excess chemical to dissipate before returning the trap). At no time should any part of the BG trap be treated with chemical. The trap will work effectively without the funnel net, which is only required to assist in the prevention of insect escape if the power is interrupted. On return to depot/office plug in the battery charger and recharge the batteries so they are ready for use.

3.4.2 Gravid Aedes Traps (GATS)

These traps can be used instead of undertaking a house to house survey. If surveillance is only being undertaken on one property multiple traps should be deployed. The number will only be limited by the availability of traps and the number of suitable locations. If surveillance is for a street or town, at least two traps should be placed within one property and if possible traps should be placed in every second or third property.

Equipment Required

- *Clear ten (10) L bucket("**base**") with overflow hole drilled in the side;*
- *Clear container/bucket with circular section removed from base & with interior roughened/scratched ("**central chamber**");*
- *Circular mesh cut out approx. 43cm diameter (1mm aperture) "**gauze**";*
- *Cylindrical black "**funnel**";*
- *Lucerne pellets;*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Residual insecticide- "Mortein Outdoor Surface Spray" (0.3 g/kg imiprothrin and 0.6 g/kg deltamethrin);*
- *Tap Water;*
- *Talcum Powder (optional);*
- *Saucer (optional – big enough to hold base of 10L bucket);*
- *Labels/pens;*
- *Sample Jars; and*
- *Tray/Large Container.*

Trap Preparation

- *Pre-treatment of mesh and central chamber should be conducted* ***≥ 24hrs prior to deployment;***
- *Using disposable gloves, spray the inside surface of the central chamber with the surface spray (1-2 second burst);*
- *Still wearing gloves, spray the central area of the gauze (approximately an area the diameter of the central chamber opening). It may be a good idea to place the gauze on a piece of scrap cardboard to catch the overspray;*
- *The surface spray should last one (1) month but respray central chamber and gauze prior to each deployment.*

Field Collection

- *Holding the gauze and central chamber together, remove from base bucket (note that the mosquitoes will be held on the gauze so care must be taken to prevent them falling into the water, also if the female was carrying eggs she may have discharged them just before dying so check the water for signs of larvae);*
- *Transfer/tip mosquitoes into tray or large container before placing into sample jar;*
- *Be sure to* ***label*** *sample jar with corresponding details of GAT trap.*

3.4.3 Stick Ovitrap

Provide a relatively new method to measure the relative abundance of egg-laying female container/urban mosquitoes. Sticky Ovi traps are useful for gauging the prevalence of *Aedes aegypti* mosquitoes and the risk of dengue transmission. Access to the glue required to create the trap is limited and currently the only known supplier is in the USA. The cost for the glue may make the production of this trap cost prohibitive.

Construction

- *Cover a bench top with protective sheeting. Wear disposable gloves whenever appropriate;*
- *Ensure the bucket has the appropriate identifying sticker (no reference to bifenthrin);*
- *Drill two overflow holes (6mm diam) 50mm from bucket brim and on opposite sides of bucket (to prevent glue strips being submerged in water);*
- *Cut glue sheet into strips Dengue Action Response Team {(DART) prefer 5cm W x 15cm L} by starting from the edge of the glue sheet (where the glue is closest to the edge) and cutting at every eight (8th) corrugation. The narrow piece can be discarded (Figure 1A);*

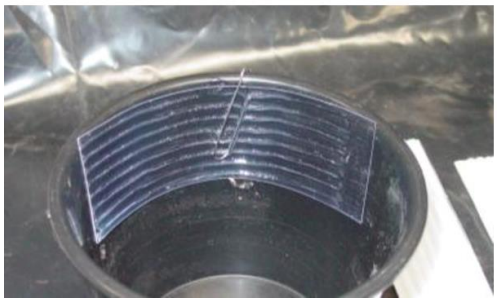
Sticky Ovitrap Figure 1

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Cut each strip into half to complete sticky trap panel (Figure 1B). Two panels are required for each bucket;*

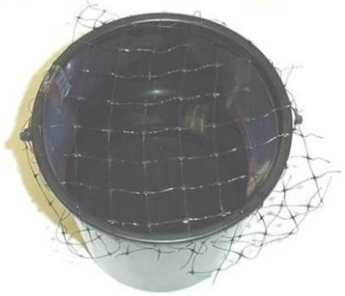
Sticky Ovitrap Figure 1B

- *Attach panels to the bucket with paper clips or a folding clip (Figure 2). Paper clips need to be pressed down firmly to prevent the panel slipping;*



Sticky Ovitrap Figure 2 – Panels attached with a giant paperclip of fold back clip

- *Fit mesh over top of bucket, using a rubber band to complete the Sticky Trap (Figure 3);*



Sticky Ovitrap Figure 3 - Fully assembled

Components

- *Anti-bird mesh;*
- *Divot Buckets (1.2L);*
- *Material Grade Cutter or scissors;*
- *Glue Panels;*
- *Rubber bands - size 64;*
- *Giant paper clips or 32mm fold back clips;*
- *Distilled Water or Tap Water and Lucerne Pellets;*
- *S-methoprene Pellet; and*
- *Warning Labels.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Trap Deployment

- *Set each ovitrap in an area protected from the weather (eg. under steps, house eaves, or under house), out of direct sunlight but visible to the mosquitoes;*
- *Add appropriate level of distilled water or tap water and Lucerne pellets (x 2,or @ 0.5g);*
- *Add Prolink pellet (s-methoprene) to water to prevent mosquito breeding In the traps;*
- *There is no limit on the number of traps that can be placed on a property;*
- *Place traps in the field for 2 to 4 weeks, can be checked weekly for water top up. Keep accurate records of locations and properties with ovitraps.*

Retrieval

- *Retrieve traps after one (1) to two (2) week/s;*
- *Adult ID may be possible in the field using a hand held magnifying glass;*
- *Egg number assessment is best done at the depot/office;*
- *Label both glue strips with Date and Location and place in a plastic bag for transport.*

Clean Up

- *Dispose of used glue panels and paper clips into waste bin;*
- *Wash buckets in hot water to remove any extra eggs and organic matter. Avoid harsh scrubbing of buckets to ensure mosquitoes lay eggs on ovistrips.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 4 – Response – Container/Urban Breeding Mosquitoes

4.1 Source Reduction/Larval Control

Source reduction can be achieved at the house hold level when individuals comply with legislation by screening tanks, removing and/or regularly cleaning artificial containers. House to house surveys and the use of any of the above detailed surveillance traps will also assist with source reduction.

4.2 Chemical Control

Controlling adult container/urban breeding mosquitoes can be achieved by using a 'lure and kill' (Lethal ovitrap) trap or interior residual spraying.

4.2.1 Lethal Ovitraps

Lethal ovitraps employs a "lure and kill" strategy: egg bearing females are lured onto the bucket by the water, then killed when they contact the flannelette strip whilst laying their eggs. These traps provide a 'green' alternative to adult mosquito control due to the minimal use of pesticides, minimal contact with non-target insects/animals/humans, an minimal chemical exposure of health workers to pesticides.

Preparing Flannelette

- *Using Bifenthrin; mix the chemical at the initial mosquito control application rate into a ten (10)L plastic bucket. Ensure there is sufficient room for the flannelette strips to be added to the bucket without allowing the chemical emulsion to overflow;*
- *Cut flannelette into strips (15cm W x 200cm L);*
- *Add flannelette strips/sheet to bucket, completely submerge and soak (two [2] minutes per strip);*
- *Without wringing flannelette, spread strips/sheet on a plastic 'drying sheet' where strips can dry undisturbed, out of sunlight.*

Please note this must be done is a secure area to prevent chemical contamination.

Lethal Ovistrips treated strips drying on plastic

- *Label Drying Sheet with information of each batch (Date of treatment, Batch No &*
- *Signed);*
- *Allow 24hrs for flannelette to dry completely. A fan can be used to speed up the drying process;*
- *Cut flannelette strips to size (5cm W x 15cm L);*
- *Keep three random strips form each sheet for efficacy testing. Store in Labelled plastic bag (Batch Number and Date) then put in freezer (in door pocket);*
- *Store 100 treated strips in a container out of sunlight (e.g. brown paper bag, cardboard box). With batch Number, Date and your Initials; Affix "warning label"*

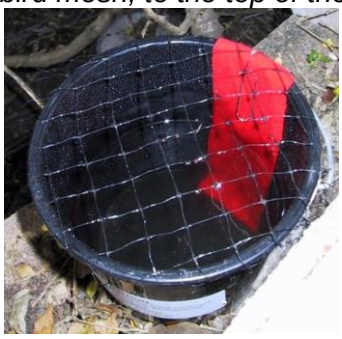
Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

'Note': *The DART team may be able to provide the lethal strips - contact either the DART team leader or the QLD Health Entomologist/specialist for our region*.

Trap Construction

- *Ensure that bucket has the appropriate identifying sticker (reference to bifenthrin);*
- *Drill two holes (8mm diameter) opposite each other just under the top rim (approximately 15mm down);*
- *Use gloves to affix one treated strip per bucket with a giant paper clip/fold back clip. (Ensure treated strip is in date and use oldest stock first);*
- *Use a rubber band to attach anti-bird mesh, to the top of the black bucket;*



Lethal ovitrap ready for deployment

- *Record the Batch No. and Date for the treated strips;*
- *Lethal Ovitraps should be deployed as soon as possible.*

Components

- *Anti-bird mesh;*
- *Divot Buckets (1.2L);*
- *Material Grade Cutter or scissors;*
- *Treated Flannelette strips;*
- *Rubber bands - size 64;*
- *Giant paper clips or 32mm fold back clips;*
- *Distilled Water or Tap Water and Lucerne Pellets; and*
- *Warning Labels.*

Chemical Application Equipment

- *Bucket (10L);*
- *Bifenthrin insecticide (suitable for mosquito treatment);*
- *Container to store treated strips in (eg brown paper bag);*
- *Disposable Gloves;*
- *Drying Plastic;*
- *PPE for Chemical use; and*
- *Red Flannelette.*

Deployment

- *Set each ovitrap in an area protected from the weather (eg. under steps, house eaves, or under house), out of direct sunlight but visible to the mosquitoes;*
- *Add appropriate level of distilled water or tap water and Lucerne pellets (x 2, or @ 0.5g). Ensure that the flannelette strip is touching the water. A damp strip will be more effective (better dispersal of chemical to adult mosquito) than a dry strip;*
- *Maximum of four lethal ovitraps per property; and*
- *Place traps in the field for two (2) to four (4) weeks, should be checked weekly for water top up. Keep accurate records of locations and properties with ovitraps.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Retrieval

- *Retrieve traps after three (3) to four (4) weeks. Adult identification may be possible in the field using a hand lens. Egg number assessment is best done in the depot/office;*
- *Place the flannelette strip in a container to prevent chemical contamination of the microscope when counting eggs;*
- *Label container with Date and Location and place for transport and Record Keeping; and*
- *Keep lethal ovitrap mesh separate form any other mesh to avoid contamination.*

Clean Up

- *Dispose of paper clips and damaged flannelette strip into waste bin;*
- *Rinse out intact flannelette strips in hot soapy water and store at depot for future chemical treatment and reuse, as necessary; and*
- *Wash buckets in hot water to remove any extra eggs and organic matter. Avoid harsh scrubbing of buckets to ensure mosquitoes lay eggs on ovistrips.*

The low dose of insecticide in Lethal Ovitraps ensures that the trap is safe to humans and pets.

4.2.2 Residual Spraying

An effective way to kill adult mosquitoes is to apply a residual insecticide onto the areas where they prefer to rest. Most container/urban breeding mosquitoes prefer to rest in dark areas around houses and other occupied buildings. Residual insecticide can be applied by a Licensed Pest Management Technician (PMT) as a surface spray in and around premises. If domestic insecticides are used around the house by residents they must be used as directed on the label. Although external truck-based 'fogging' or 'misting' is highly visible and can be used for groundwater breeding mosquitoes, it is not effective against container/urban breeding mosquitoes.

4.3 Approved Inspection Program

The legislative power for an Approved Inspection Program's is found in the *Local Government Act 2009.* Mosquitoes are designated pests under the *Public Health Act 2005*. Programs must be run in accordance with all legislative requirements

Sections 133 and134 of the *Local Government Act 2009*, deal with Approved Inspection Programs. The program must first be approved at a Council Meeting, generally by resolution. The resolution must state the following:

- *the purpose of the program;*
- *when the program starts; and*
- *the period (not more than three [3] months) over which the program will operate; and*
- *for a systematic program:- the type of property that will be entered; or*
- *for a selective program - the criteria for selecting the properties*.

The program can be either systematic or selective (refer to Local Government Act for terminology). BSC must give a written notice to the occupier of a property (this can be in the form of a letter drop in the letterbox of a property). The Notice must state the following:

- *Local Government's intention to enter the property; and*
- *The reason for entering the property; and*
- *An estimation of when the property will be entered.*

BSC must notify the public of the program approval, at least 14 days, but not more than 28 days, before the program commences. The notice must be published in the local newspaper and on Council's website. The Notice must state the following information:

- *Banana Shire Council is operating the program;*
- *Purpose and scope of the program, in general terms;*
- *Start date for the program;*

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Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *How long the program will last;*
- *That the public may inspect a copy of the resolution at Council's office until the end of the program;*
- *That the public may purchase of copy of the resolution;*
- *The cost of purchasing a copy of the resolution;*
- *The cost of the copy is no more than the cost to BSC for making the copy available;*
- *For the entire time that the program is running the public may view of purchase a copy of the resolution from Council's public office/s; and*
- *An authorised person may enter a property (but not a home) without the permission of the occupier of the property, at any reasonable time of the day or night, under an Approved Inspection Program*.

The authorised person on entering a property must attempt to inform any occupier of the property; the reason for entering; and that the authorised person is authorised under the Local Government Act to enter without their permission.

4.3.1 Survey Preparation

- *Determine the number of properties to be inspected;*
- *Identify the number of staff available. A team of two (2) people should not be allocated more than 30 properties a day. (Teams generally manage 15 to 20 properties in a day);*
- *If treatment is to be undertaken ensure that at least one member of each team has a Pest Management Technician Licence;*
- *Group properties together for inspection and produce maps/create spreadsheet for each group;*
- *Ensure sufficient equipment is available for each team;*
- *Provide educational material and Pest Advice documentation to each team/ licensed operator;*
- *Ensure accurate records are maintained. Use of QLD Health tablets or paper copies of larval survey forms; and*
- *Ensure each team has a mobile phone and contact numbers for all relevant staff.*

4.3.2 Equipment & Documentation

- *Authorised Officer ID;*
- *Pest Management Technician Licence (if applicable);*
- *Insect Repellent and sunscreen;*
- *Suitable clothing including Hat, sunglasses etc.;*
- *Dipper;*
- *White/clear plastic dish;*
- *Pipettes;*
- *Turkey baster;*
- *Sample bottles/tubes/vials*
- *Labels, pens, notebook, survey form, map/spreadsheet;*
- *Pest Advice;*
- *Carry bag;*
- *Ladder/extended mirror for rainwater tank or gutter inspection;*
- *Esky (where necessary);*
- *Mobile phone; and*
- *s-methoprene (sand, pellets, briquettes).*

4.3.3 Method

- *Check for locked gates or dogs (if access is not possible leave a letter in the letterbox requesting that occupier contact Council to arrange a suitable inspection time;*
- *Enter the property and try and locate occupier and advise of reason for entry;*
- *Work your way around the property and look for containers that are holding water or have the potential to hold water. All containers are to be recorded;*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Small containers holding water - empty the entire contents into the white/clear plastic dish. If larvae are present take a minimum of six larvae (when available) and place in a sample bottle. Ensure the bottle is appropriately labelled or if using QLD Health tablet scan the bar code;*
- *Large containers holding water that can be emptied - tap container to force any larvae to the bottom and then tip off most of the water. Pour the remaining water into the white/clear plastic dish. If larvae are present take a minimum of six larvae and place in a sample bottle. Ensure the bottle is appropriately labelled or if using QLD Health tablet scan the bar code;*
- *Large container holding water that cannot be emptied - approach without casting a shadow. Look for larvae on the surface; if present use a turkey baster to take samples. If larvae are present take a minimum of six larvae and place in a sample bottle. Ensure the bottle is appropriately labelled or if using QLD Health tablet scan the bar code;*
- *If breeding is found and the water source cannot be removed request permission from the occupier to treat the water source. Treatment should not occur without occupiers approval;*
- *If treatment occurs provide the occupier with a pest advice;*
- *If no one is home leave a door hanger and where necessary an information brochure. If treatment is required leave a request for the owner to contact Council at their earliest convenience;*
- *All larvae to be identified by a suitably competent person and records kept;*
- *If larvae are not to be identified that day preserve larvae in ethanol or methylated spirits (ethanol preserves for longer and is the preferred medium);*
- *If using QLD Health Tablet ensure the larvae details are entered and then sync the system*.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 5- Management of a Dengue Outbreak

5.1 Dengue Fever and the *Aedes aegypti* mosquito

Dengue Fever is an acute febrile disease which is transmitted by the bite of an infected *Aedes aegypti* mosquito. The organism occurs in a number of serotypes and it is now believed the re-infection of a sufferer with a different serotype can lead to development of the potentially fatal hemorrhagic form (Severe Dengue)of the disease. Control of the mosquito is the only viable form of control of the disease.

5.1.1 Surveys

To detect and eliminate the breeding of *Aedes aegypti* mosquitoes, house to house surveys or GAT trap deployment may be conducted following:-

- *The direct import of a Dengue Virus sufferer to an area.*
- *The presence of a suspected locally acquired case of Dengue.*
- *The presence of a confirmed locally acquired case of Dengue.*
- *A general (epidemic) outbreak of Dengue.*

It is generally accepted that the *Aedes aegypti* mosquito will travel up to a maximum of 400m from its breeding site in search of a blood meal. In an attempt to limit the spread of the mosquito/eliminate secondary infections of dengue, the following inspection distances will be adopted.

House to house inspections, after the initial identification of breeding will only be undertaken as per advice from Queensland Health (QLD Health) entomologist. With the recent introduction of the GAT traps for *Aedes aegypti* surveillance, their use may be more appropriate as the man power and time required to deploy and retrieve these traps is substantially less than undertaking a house to house survey. Inspections and/or deployment of GAT traps will be conducted within every premise in a radius zone of 100m to 200m of the sufferer's home. All breeding found is to be recorded on inspection sheets or within (Vector-borne Disease Early Detection and Surveillance) VEDS. Information highlighting control options for the *Aedes aegypti* mosquito will be provided to the effected residences. QLD Health may provide the necessary Officers to inspect the 0 to 100m zone. In the instance of an outbreak, QLD Health can treat the inside of dwellings with a surface spray to eliminate harbouring adult mosquitoes.

In an epidemic, these distances may be reduced due to human resource shortages when multiple suburbs are affected.

5.1.2 Notification

Notification of the presence of a case of Dengue Fever is currently received from the Central Queensland Public Health Unit. Following notification, Banana Shire Council will make contact with the QLD Health entomologist to discuss the appropriate actions and determine what type of survey should take place. The following actions may be required:

- *Conduct a thorough house to house survey and or deploy GAT traps within the 100m to 200m zone in accordance with the principles outlined below.*
- *Note on the maps the location of each premises surveyed, the location of breeding detected and the location of premises treated.*
- *If necessary, seek the assistance of from QLD Health to expedite the conduct of the survey and treatment*

5.1.3 Survey Equipment – House to House Surveys

It is recommended the following survey equipment be available for use in house to house surveys:

- *Suitable identification for the officer.*
- *Maps, survey forms, tablets (if available for data collection), information resources and 'Health Warning' door hangers.*

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *A suitable carrying container holding:-*
  - *A container of suitable larvicide;*
  - *A turkey baster to collect large samples;*
  - *A white bowl to collect larval samples;*
  - *A pipette to collect individual specimens;*
  - *Vials for transport of larvae for subsequent identification;*
  - *Insect repellent;*
  - *Sun screen; and*
  - *Water.*

5.1.4 Survey Equipment – GAT trap Deployment and Retrieval

It is recommended the following survey equipment be available for use during GAT deployment and retrieval:

- *Suitable identification for the officer.*
- *Maps, survey forms, tablets (if available for data collection), information resources and 'Health Warning' door hangers.*
- *GAT traps either assembled or pre-treated with assembly on site;*
- *A suitable carrying container holding:-*
  - *Lucerne pellets*
  - *Tap Water;*
  - *Talcum Powder (optional);*
  - *Saucer (optional);*
  - *Tray or Large Container;*
  - *Sample Jars*
  - *Labels/Pens;*
  - *Insect repellent;*
  - *Sun screen; and*
  - *Water.*

5.1.5 Conduct of House-to-House Surveys

The conduct of house to house surveys involves several steps:

Pre survey meetings

- *Confirm the location/case information.*
- *Hold meeting with all Officers involved.*
- *Brief staff on all details.*
- *Assign inspection teams and ensure team communications.*
- *Ensure all inspection bags are fully stocked with equipment.*

Face to Face Communication

- *Introduce yourself and explain the purpose of your visit.*
- *Deliver Information Materials.*
- *Explain the dangers of Dengue Fever and Severe Dengue and the role of the mosquito including its life cycle and flight range. Correct any long-held misconceptions.*
- *Explain the mechanisms of Aedes aegypti control (Tip 'em out, Store 'em dry, Throw 'em out).*
- *Thank the occupier for letting you check the premises and give them contact numbers for further information if required.*

Source Reduction

- *If it can be emptied,* ***empty it***
- *If it can't be emptied or moved,* ***treat it****.*
- *If it is required, have the occupier* ***clean it, dry it and store it*** *in a dry place.*
- *If it is not required, have the occupier* ***throw it out*** *or do it for them.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *If larvae are located, **show them to the occupier**, explain their legal responsibilities.*
- *Check inside the house if the occupier advises they have indoor plants or cut flowers (only required if Dengue Fever inspection).*
- *Ask if there is a **disused septic tank or well** on the property.*
- *Check tree holes.*
- *Check **toilets** especially disused ones.*

REMEMBER – It only takes one breeding container in twenty houses to sustain an outbreak. Get it right the first time.

If owner or occupier is not home

In accordance with legislation, Council Officers cannot enter premises without the permission of the occupier, unless they are operating under an Approved Inspection Program or an Authorised |Prevention and Control Program. In order to gain access at a later time:

- *Leave the usual information materials in the letterbox.*
- *Hang a 'Health Warning' card on the doorknob, making sure the identifier for the correct contact number is marked or highlighted.*
- ***Re-inspect** as soon as possible after the occupier makes contact.*

5.1.6 Conduct a GAT Trap Deployment and Retrieval

'Refer to Appendix 3 Section 3.4.1 Gravid *Aedes* Traps for deployment and retrieval; and the previous Section - Conduct of House to house Surveys. From the previous Section the following actions remain the same:

- *Pre survey meeting.*
- *Face to face communication, and*
- *If the occupier is not home.*

Records

Accurate records of the investigation of an *Aedes aegypti* /Dengue Case are vital.

- *Maps should be made as described above.*
- *Survey forms (available from QLD Health) have been standardized and must be completed.*

5.1.7 Public Relations – Media

Media releases may be required throughout dengue instances. The level of public relations response is dependent on the number and location of these cases. The purpose of the release is threefold:

- *Ensures the public is made aware of a potential serious public health issue.*
- *Provides an opportunity for additional and widespread public education messages.*
- *Facilitates the house to house inspection or GAT trap deployment process by making the public aware of Council inspection activities.*

For the purpose of media activities, dengue cases can be grouped under the broad headings – Imported Cases and Local Transmission Cases.

5.1.8 Imported Cases

Within Individual Council Boundaries

Where imported dengue cases occur solely within the jurisdiction of a Council area, i.e. Greater than 1.0km from a common boundary, the following procedures apply:

- *The responsible Council is to deal with media responses and releases according to set policies.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- *Information and briefing notes will be provided by the investigating Officers to management and public relations section for media dissemination.*
- *Information will be limited to the number of cases, inspections conducted, general health advice and protection measures, and generalized location of cases* ***by suburb only.***

Border cases

Where an imported dengue case occurs close to the border of adjoining Council areas, inspections are required in both areas.

Council's Health & Environment section incorporating Environmental Health Officers responsible for mosquito control will liaise and share all information and jointly prepare proposed media briefs. Council will present media releases, separately or jointly as deemed appropriate.

5.1.9 Local Transmission Cases

Where local transmission of dengue exists, the above protocol (focusing upon cooperation and sharing of information) for both case scenarios will be followed. In addition to this, Council's Health & Environment section will liaise closely with QLD Health.

Council may wish to present additional media releases, separately or jointly as deemed appropriate.

'Note': *The majority of the information in this Appendix was sourced from Queensland Dengue Management Plan (DMP) 2010 > 2015 produced by the Queensland Government.*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 6 - Mosquito & Black Fly Control during an Emergency or Disaster Situation

Mosquitoes and Black Fly numbers can rapidly develop into plague proportions in an uncontrolled environment following/during a disaster or emergency. Mosquitoes have the potential to transmit disease and cause a nuisance. Black Flies can cause severe skin irritation and/or a nuisance. The impact these insects have on the community can be influenced by:

- *Excessive rain; Flood waters;*
- *Existing seasonal abundance;*
- *Unprotected community due to damaged infrastructure;*
- *Confinement of displaced persons into temporary facilities; and*
- *Lack of personal protection supplies.*

Disasters do not generate 'new diseases', however, by altering the environment, they may increase transmission of diseases that already exist in a region through:

- *Direct effect of the physical event itself, such as faecal contamination;*
- *Indirect effects which may result in such conditions as overcrowding and poor sanitation;*
- *Promoting or causing increase in the movement of populations;*
- *Disrupting routine mosquito and black fly management programs; or*
- *Altering the distribution of vector and nuisance species.*

During a disaster or emergency the Environmental Health Section should:

- *coordinate pest control services;*
- *follow Council's Mosquito & Black Fly Management Plan and extend where necessary extend the program to include habitable areas created by the disaster,*
- *follow the Queensland Health – Guidelines for Controlling Public Health Risks relating to Mosquitoes, Flies and Black flies in a Flood Event; and*
- *monitor waste management.*

Information on waste management; mosquito control and surveillance; and personal protection should be distributed throughout the community via all media outlets and the use of signage in prominent locations and areas where people are congregating e.g. schools, shopping centres, evacuation centres, and council offices.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 7 – Resources

7.1 Personnel

BSC currently has access one (1) full time, one (1) part time and one (1) Cadet Environmental Health Officers (EHOs) to assist with implementing the Mosquito & Black Fly Management Program.

7.2 Equipment

The following equipment is currently available for mosquito and black fly management:

- *1 x ULV*
- *3 x 4WD vehicles with spray units*
- *2 x ATVs*
- *1 x Spray units on trailer*
- *2 x Hand held foggers*
- *1 x Microscope*
- *4 x Light traps*
- *6 x GAT traps*
- *4 x Batteries*
- *1 x Battery charger*
- *Ladles for larval surveillance*

7.3 Chemicals

The control program utilises specialist chemicals to maintain effective control of vectors and nuisance pests.

- *s-Methoprene (ProLink briquets and sand)*
- *Twlight*
- *Reslin*

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 8 – Survey Forms and Spreadsheets

8.1 Container/Urban Breeding Mosquito - Survey Sheet

Council:			**Date:**		**Residential – R** **Commercial - C**
Officer:			**Inspection Type**: Routine / AIP / Other		
Address	**Inspected Y / N**	**Premise Type**	**Type of Container**	**Sample No.**	**Other information**

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.2 Alternate Container/Urban Breeding Mosquito Survey Sheet

Container/Urban Breeding Mosquito Survey

Council:	**Date:**	**Residential**	**Commercial**	**Industrial**

Premise Address	Not Inspected	Inspected	Outdoors	Indoors	Type of Container	Dry	Wet	Wet with Larvae	Action Taken	Larval |Identification

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

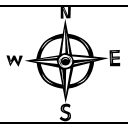
8.3 Advice/Record of a Pest Control Activity (example)

Banana SHIRE SHIRE OF OPPORTUNITY	*Biloela Administration Office* *62 Valentine Plains Road* *Biloela QLD 4715* *Telephone Number: 07 4992 9500* *Email: enquiries@banana.qld.gov.au*

Advice / Record of a Pest Control Activity
Sections 13 and *14 Pest Management Regulation 2003*

DATE	**START TIME**	**FINISH TIME**	
PMT Name		PMT Licence No.	
PMT Name		PMT Licence No.	
Vehicle Registration No.			
Address where activity carried out			
Owner/Occupier Name		Telephone No.	

TYPE OF PREMISES: **Residential (single)** **Commercial** **Hotel/Motel**
Residential (Multi level) **Other (specify)----------**

Pesticide	**Active Constitute**	**Rate**		**Quantity Used**	
DILUTANT:	**Water**	**Hydrocarbon**	**Nil**	**Other:**	
EQUIPMENT USED:	**Fogger**	**ULV**	**Spray Tank**	**Hand Rega**	**Spreader**
AREA TREATED:	**Dense**	**Scattered**	**Sparse**	**Plants/trees**	**Regrowth**
	Grass	**Water**	**Rock Wall**	**River bank**	**Structure**
METHOD OF APPLICATION	**High Volume**	**Low Volume**	**Long Hose**	**Boom**	**Fogger**
	ULV	**Aerial**	**Hand**	**Other**	
WIND SPEED	**0 - 10km/hr**	**11 – 20km/hr**	**21 – 30km/hr**	**WIND DIRECTION (indicate on diagram)**	
WEATHER CONDITIONS	**Fine**	**Showers**	**Humid**	**Overcast**	**Cool**
	Warm	**Hot**	**Other:**		
PURPOSE	**Mosquito Control**		**Black Fly Control**		
SIGNATURE (Licensed PMT)			***SIGNATURE (Licensed PMT)***		

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.4 Larval Collection Sheet

DATA SHEET – LARVAL COLLECTION											
Date:	**Time:**			**Collector:**							
Site No.:	**GPS:**			**Rain (mm)**				**High Tides**			
Street:	**Map Ref:**			**Previous 24hrs:**				**Previous 24hrs:**			
Photograph:				**Previous week:**				**Previous week:**			
Breeding Site characteristics (circle the relevant descriptors):											
Site type	Size class	Water		Vegetation	**Bottom**			**Shade**			
Swamp	< 5m^2	Fresh		Fringing	Organis			Exposed			
Marsh	>5 – 10m^2	Saline		Emergent	Mud			½ Shade			
Permanent pond	>10 – 20m^2	Running		Floating	Sand			Deep shade			
Temporary pool/depression	>20-50m^2	Stagnant		Algal mat	Rocks						
Natural/semi natural drain	>50-100m^2	Clear		Other	Concrete						
Artificial drain	>100-200m^2	Turbid			Other						
Tyre track	>200-500m^2	Foul									
Container	>500-1000m^2										
Other (specify)	>1000-5000m^2										
	>0.5-1ha										
	>1ha										
	Other										
Surrounding vegetation, within 50M (circle the relevant description)											
Protective foliage cover of tallest stratum											
Tallest stratum	Dense (70-100%)	Mid dense (30 – 70 %)			Sparse (10 – 30 %)			Very sparse (<10%)			
Trees >30m	Tall closed forest	Tall open forest			Tall woodland			Tall open woodland			
Trees 10–30m	Closed forest	Open forest			Woodlland			Open woodland			
Trees 5-10m	Low closed forest	Low open forest			Low woodland			Low open woodland			
Shrubs 2-8m	Closed scrub	Open scrub			Low scrubland			Low open scrubland			
Shurbs <2m	Closed hearth	Open hearth			Low shrubland			Low open shrubland			
Herbs/grasses (<2m)	Closed grassland	Grassland			Open grassland			Low open grassland			
Larval collections:											
Dip	No.	Instar	Pupae	Dip	No.	Instar	Pupae	Dip	No.	Instar	Pupae
1				6				11			
2				7				12			
3				8				13			
4				9				14			
5				10				15			
Species											
Sketch map of site on back of sheet											

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.5 Adult Trapping Excel Spreadsheet (example)

Adult Trapping Data																	
Trap No.	Location: Date: Time Out: Time In:	*Aedes aegypti*	*Aedes alternans*	*Aedes vittiger*	*Anopheles annulipes*	*Culex annulirostris*	*Coquillettidia xanthogaster*	*Mansonia uniformis*	*Ochlerotatus notoscriptus*	*Culex halifaxii*	*Culex quinuefasciatus/fatigans*	*Mimomyia elegans*	*Toxorhynchites*	Damaged	Male	Total Number per Trap	Comments
1																	
2																	
3																	
4																	
5																	
6																	
Weekly Total:																	

Weather Conditions					
	Fine	Scattered Cloud	Overcast	Light Rain	
	Temperature	Min:	Max:	Wind Speed:	Wind Direction:
	Tides	Low:	High:		Overnight Rainfall:
	Moon Phase:		Humidity:		Weekly Rainfall:

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.6 Ovi/Egg Collection Excel Spreadsheet (example)

Ovi/Egg Collection Data										
Trap No.	Location: Date/Date Range	*Aedes aegypti*	*Toxorhynchites*	*Culex annulirostris*	*Culex quinuefasciatus/fatigans*	*Culex halifaxii*	*Ochlerotatus notoscriptus*	*Tripteroides sp.*	*Totals*	Comments:
1										
2										
3										
4										
5										
6										
Totals:										

Weather Conditions				
	Temperature:	Min:	Max:	
	Weekly Rainfall:			
	Fine	Scattered Cloud	Overcast	
	Light Rain	Heavy Rain		

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.7 Mosquito/Black Fly Treatment Register (example)

Mosquito & Black Fly Treatment Register							
Date	**Target Pest**	**Suburb**	**Treatment Source** (e.g. pool, dam, fence)	**Treatment Type** (e.g s-Methoprene)	**Amount**	**Time Taken**	**Comments** (e.g. PMT name, reason for treatment)

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

8.8 Risk Assessment Guide

Risk Assessment Table

Risk outcome:_____

Location/Town	*Aedes. aegypti* present	*Aedes. aegypti* infestation	*Culex annulirostris* present	Other:	Human population size	# DENV importations	#CHIKV importations	Industry traffic/conduit to industry	Location of major transport route	Tourist destination	Proximity to transient workers	Prevalence of other key factors	Latitude/longitude	Human density/urbanisation	Proximity to known breeding ground

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Appendix 9 - Letter Templates and Fact Sheets

9.1 Generic Complaint Response

Re: Mosquito Prevalence

Council is in receipt of your concerns raised regarding the number of mosquitoes in and around your home. An Environmental Health Officer will be investigating the matter further by setting a Mosquito Light Trap in your area; this will give an indication into the numbers and species of mosquitoes around your community. Further surveillance will then be carried out pending the results from the trap. Council will contact you should they require any further information with regards to this matter.

You are advised that mosquitoes live and breed in a diverse array of environments and have very specific requirements in order to breed effectively. Some live and breed in containers holding water around your house and yard; while others are found in salt marshes or freshwater pools in the natural environment. Some species can actually travel up to 50 kilometres from their breeding site. The presence of ponding water alone is not necessarily an indicator of mosquito breeding. The water depth, flow rate, temperature and the presence of food for the mosquito larvae are far more important factors as to why a female mosquito chooses to lay her eggs in a particular body of water. Furthermore, only certain mosquitoes can spread disease to humans and animals; most mosquito species are merely a nuisance.

You can manage mosquito breeding on your property. A product called “Nomozz” can be used for treatment of any ponding water around the home to prevent any mosquito larvae emerging into adults. You can also arrange to have a Licensed Pest Management Technician treat any garden foliage, walls and fences with mosquito barrier products to deter mosquitoes from harbouring in and around your home.

It is also recommended that you always use personal protection against mosquitoes. Including the use of suitable insect repellents and wearing long, loose, light-coloured clothing when in areas where mosquitoes are present. Ensuring that all windows and doors are fitted with insect screens will also reduce the impact on your family.

If you require any further information, please contact Council’s Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.2 Domestic Mosquito Breeding

Re: Mosquito Breeding

Banana Shire Council have been undertaking routine mosquito surveillance in your area and have recently noticed an increase in the number of domestic container breeding mosquitoes being captured in the traps.

OR

Banana Shire Council has received complaints regarding the number of mosquitoes in your area. Subsequent monitoring has revealed that the type of mosquitoes being captured are predominately those that breed in domestic containers in and around the home.

There are a number of things residents can do to reduce the number of mosquitoes breeding on their property. The first is to remove all containers holding water, as little as 100ml is enough for over 400 adult mosquitoes to develop, in a week. If the container cannot be removed it should be emptied, dried and wiped out once a week so as to prevent mosquito breeding.

Please find attached an information brochure ‘Mozzies and You” that provides some important information regarding these types of mosquitoes.

If you require any further information, please contact Council’s Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.3 Ponding Water Alleged Offender – Public Health Act – Public Health Risk

Re: ***PUBLIC HEALTH ACT 2005***
PUBLIC HEALTH RISK - PONDING OF WATER ON LAND WHICH IS LIKELY TO BECOME A BREEDING GROUND FOR MOSQUITOS – PROPERTY LOCATED AT *insert address*.

Council's Health & Environment Section has recently received advice regarding water ponding *(insert exact location on the land)* at the abovementioned property. Subsequently, Council Environmental Health Officers have investigated the matter and found that due to the amount and longevity that the water remains in the area, it is likely to become a breeding ground for mosquitoes if it is not drained or filled in.

You are therefore required to remove the public health risk by ensuring the following work is carried out **within thirty (30) days**:

1 Ensure that all drains are at all times maintained and kept free from obstructions;

AND

2 Maintain the surface of the land at appropriate levels so that at all times water or other liquid does not accumulate on any portion of private property.

If the remedial action results in a change in level of your land, you may be required to make a development application for operational works before commencement of any work. For enquiries in this respect please contact Council's Infrastructure & Planning Section on 1300 883 699.

A reinspection will be carried out on or after the specified time to ensure compliance with the *Public Health Act 2005*. Failure to comply with the requirements of this correspondence may result in the issuing of a public health order.

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.4 Rainwater Tank Potential Breeding – Public Health Act - Public Health Risk

Re: ***PUBLIC HEALTH ACT 2005***
PUBLIC HEALTH RISK – RAINWATER TANK WHICH IS LIKELY TO BECOME A BREEDING GROUND FOR MOSQUITOS – PROPERTY LOCATED AT. ***insert address***

An officer from Council's Health & Environment Section has observed a rainwater tank (*relevant tank*) located at the abovementioned property which is likely to become a breeding ground for mosquitoes. The relevant tank is therefore considered to be a public health risk and is in breach of the *Public Health Act 2005*.

You are therefore required to remove or reduce the public health risk by undertaking the following work **within fourteen (14) days**:

1 Repair or replace all mosquito-proof screens and/or flap valve to the relevant tank to ensure that every opening of the tank prevents the ingress of mosquitoes into the tank.

2 Mosquito proof screens and flap valves are to comply with the provisions of PART 1A Division 2 of the *Public Health Regulation 2005,* as follows:

a Mosquito-proof screens that-
- i are made of brass, copper, aluminium or stainless steel gauze; and
- ii have a mesh size of not more than 1mm; and
- iii are installed in a way that does not cause or accelerate corrosion; and
- iv stop mosquitoes passing through the openings; or

b flap valves that when closed, stop mosquitoes passing through the openings.

A reinspection will be carried out on or after the specified time to ensure compliance with the *Public Health Act 2005*. Failure to comply with the requirements of this correspondence may result in the issuing of a public health order.

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.5 Receptacle/Guttering Potential Breeding – Public Health Act - Public Health Risk

Re: ***PUBLIC HEALTH ACT 2005***
PUBLIC HEALTH RISK – RECEPTACLE/ GUTTERING *(cross out whichever is not applicable)* **WHICH IS LIKELY TO BECOME A BREEDING GROUND FOR MOSQUITOS – PROPERTY LOCATED AT** ***insert address***

Council's Health & Environment Section recently received advice regarding receptacle/guttering *(cross out whichever is not applicable)* located at the abovementioned property which is likely to become a breeding ground for mosquitoes. Subsequently, Council's Environmental Health Officer has investigated the matter and has confirmed that the water located in the .*(state whether receptacle or roof guttering etc.)*. is a public health risk and is in breach of the *Public Health Act 2005*.

You are therefore required to remove the public health risk by undertaking the following **within seven (7) days**:

Completely empty all water from every .*(state whether a bowl, bucket, flowerpot, tyres etc.)*.. or other receptacle kept on the property so that the water is not, or is not likely to become, a breeding ground for mosquitoes.

Clean out and remove from all roof guttering, any obstruction including leaves, vegetation or other debris, to ensure all water drains away and is not, or is not likely to become, a breeding ground for mosquitoes.

A reinspection will be carried out on or after the specified time to ensure compliance with the *Public Health Act 2005*. Failure to comply with the requirements of this correspondence may result in the issuing of a public health order.

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.6 Swimming Pool Alleged Offender Letter – Public Health Act – Public Health Risk

Re: ***PUBLIC HEALTH ACT 2005***
PUBLIC HEALTH RISK – SWIMMING POOL WHICH IS LIKELY TO BECOME A BREEDING GROUND FOR MOSQUITOS – PROPERTY LOCATED AT *insert address*

Council's Health & Environment Section recently received advice regarding a swimming pool located at the abovementioned property which is likely to become a breeding ground for mosquitoes. Subsequently, Council Environmental Health Officers have investigated the matter and confirmed that the swimming pool is a potential public health risk and is in breach of the *Public Health Act 2005*.

You are therefore required to remove the public health risk by undertaking one (1) or more of the following actions **within fourteen (14) days**:

1 Clean the pool (including the pool pump and equipment); and maintain as such so that the water quality is kept at a suitable level for swimming. Water in private swimming pools should have a free range chlorine content of between 0.25ppm and 0.75ppm and a pH range of 7.5 – 8.0;
2 Take measures to prevent the accumulation of stagnant water and organic material in the pool;
3 Ensure that the pool, if in use, is filled to the appropriate level, filtered and treated using commercial preparations to control the algae and ensure that mosquitoes can not breed; OR
4 Keep the water stocked with mosquito-larvae-destroying fish.

A reinspection will be carried out on or after the specified time to ensure compliance with the *Public Health Act 2005*. Failure to comply with the requirements of this correspondence may result in the issuing of a public health order.

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.7 Public Health Order – Generic

PUBLIC HEALTH ORDER

Public Health Act 2005
Section 23

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Public Health Order* is hereby issued to you <<offenders name>> as being responsible for a *public health risk* existing at the place described as <<real property description>> and situated at <<street address>>.

The nature of the *public health risk* identified at the place is (provide details of public health risk) .

This is considered to be a *public health risk* by virtue of Section 11(1)((insert subsection)) of the Act.

In order to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring, you are required to take the following action:

1 Provide detailed specification of works.

DUE DATE FOR COMPLIANCE WITH THIS ORDER IS (DAY), (DATE) (YEAR)

Under Section 387 of the Act, an authorised person may, at reasonable times, enter the place to check whether this Order has been complied with. Procedures for entry of the place are set out under Section 392 of the Act.

As the recipient of a *Public Health Order* it is an offence not to comply with the Order, unless you have a reasonable excuse. This is punishable upon conviction with a fine not exceeding 200 penalty units (insert current $ value). Alternatively you may be issued with a penalty infringement notice of 5 penalty units (insert current $ value) for an individual, or 25 penalty units (insert current $ value) for a corporation.

Notwithstanding any action that may be taken as described above, should you fail to comply with the requirements of this *Public Health Order* by the due date, one or more of the following courses of action may be taken to ensure compliance with the requirements of this *Public Health Order*:

- Under Section 24 of the Act, Council may make application to a magistrate's court for an *enforcement order*.

- Under Section 388 of the Act, Council by its employees or agents may at reasonable times, enter the place to take steps stated in this Order. Procedures for entry of the place are set out under Section 393 of the Act. Any costs and expenses incurred, including interest accrued in exercising these powers, is recoverable from you as a debt or a charge over the land the subject of this Order. [Include this section only when the Order is issued to the owner of the subject land]

Further, in relation to a corporation, Section 448 of the Act provides that the executive officers of the corporation must ensure that it complies with the Act. If a corporation commits an offence against the Act, each of the corporation's executive officers also commits an offence, namely the offence of failing to ensure the corporation complies with the Act, and is subject upon conviction to a penalty not exceeding 200 penalty units (insert current $ value).
[Include this paragraph when the Order is issued to a Corporate entity including a Body Corporate]

If you require any further information, please contact Council's Health & Environment Section.

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.8 Public Health Order - Ponding Water

PUBLIC HEALTH ORDER

Public Health Act 2005
Section 23

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Public Health Order* is hereby issued to you **<<insert offenders name>>** as being responsible for a *public health risk* existing at the place described as **<<insert real property description>>** and situated at **<<insert street address>>.**

The nature of the *public health risk* identified at the place is that water is ponding on the land that is a breeding ground for designated pests, namely mosquitoes.

This is considered to be a *public health risk* by virtue of Section 11(1)(a)(i) of the Act.

In order to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring, you are required to take the following action:

3 Ensure that all drains are at all times maintained and kept free from obstructions; and

4 Maintain the surface of the land at appropriate levels so that at all time's water or other liquid does not accumulate on any portion of private property.

If the remedial action results in a change in level of your land, you may be required to make a development application for operational works before commencement of any work. For enquiries in this respect please contact Council's Planning Section on insert telephone number.

DUE DATE FOR COMPLIANCE WITH THIS ORDER IS (DAY), (DATE) (YEAR)

Under Section 387 of the Act, an authorised person may, at reasonable times, enter the place to check whether this Order has been complied with. Procedures for entry of the place are set out under Section 392 of the Act.

As the recipient of a *Public Health Order* it is an offence not to comply with the Order, unless you have a reasonable excuse. This is punishable upon conviction with a fine not exceeding 200 penalty units (insert current $ value). Alternatively you may be issued with a penalty infringement notice of 5 penalty units (insert current $ value) for an individual, or 25 penalty units (insert current $ value) for a corporation.

Notwithstanding any action that may be taken as described above, should you fail to comply with the requirements of this *Public Health Order* by the due date, one or more of the following courses of action may be taken to ensure compliance with the requirements of this *Public Health Order*:

- Under Section 24 of the Act, Council may make application to a magistrate's court for an *enforcement order*.

- Under Section 388 of the Act, Council by its employees or agents may at reasonable times, enter the place to take steps stated in this Order. Procedures for entry of the place are set out under Section 393 of the Act. Any costs and expenses incurred, including interest accrued in exercising these powers, is recoverable from you as a debt or a charge over the land. [Include this section only when the Order is issued to the owner of the subject land]

Further, in relation to a corporation, Section 448 of the Act provides that the executive officers of the corporation must ensure that it complies with the Act. If a corporation commits an offence against the Act, each of the corporation's executive officers also commits an offence, namely the offence of failing to ensure the corporation complies with the Act, and is subject upon conviction to a penalty not exceeding 200 penalty units (insert current $ value).
[Include this paragraph when the Order is issued to a corporate entity including a Body Corporate]
If you require any further information, please contact Council's Health & Environment Section.

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.9 Public Health Order – Pool

PUBLIC HEALTH ORDER

Public Health Act 2005
Section 23

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Public Health Order* is hereby issued to you <<insert offenders name>> as being responsible for a *public health risk* existing at the place described as <<enter real property description>> and situated at <<insert street address>>.

The nature of the *public health risk* identified at the place is water located in the swimming pool is a breeding ground for designated pests, namely mosquitos. This is considered to be a *public health risk* by virtue of Section 11(1)(a)(i) of the Act.

In order to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring, you are required to take the following action:

5 Clean the pool (including the pool pump and equipment); and maintain as such so that the water quality is kept at a suitable level for swimming. Water in private swimming pools should have a free range chlorine content of between 0.25ppm and 0.75ppm and a pH range of 7.5 – 8.0;
6 Take measures to prevent the accumulation of stagnant water and organic material in the pool;
7 Ensure that the pool, if in use, is filled to the appropriate level, filtered and treated using commercial preparations to control the algae and ensure that mosquitoes cannot breed; OR
8 Keep the water stocked with mosquito-larvae-destroying fish.

DUE DATE FOR COMPLIANCE WITH THIS ORDER IS (DAY), (DATE) (YEAR)

Under Section 387 of the Act, an authorised person may, at reasonable times, enter the place to check whether this Order has been complied with. Procedures for entry of the place are set out under Section 392 of the Act.

As the recipient of a *Public Health Order* it is an offence not to comply with the Order, unless you have a reasonable excuse. This is punishable upon conviction with a fine not exceeding 200 penalty units (insert current & value). Alternatively you may be issued with a penalty infringement notice of 5 penalty units (insert current $ value) for an individual, or 25 penalty units (insert current $ value) for a corporation.

Notwithstanding any action that may be taken as described above, should you fail to comply with the requirements of this *Public Health Order* by the due date, one or more of the following courses of action may be taken to ensure compliance with the requirements of this *Public Health Order*:

- Under Section 24 of the Act, Council may make application to a magistrates court for an *enforcement order*

- Under Section 388 of the Act, Council by its employees or agents may at reasonable times, enter the place to take steps stated in this Order. Procedures for entry of the place are set out under Section 393 of the Act. Any costs and expenses incurred, including interest accrued in exercising these powers, is recoverable from you as a debt or a charge over the land the subject of this Order. [Include this section only when the Order is issued to the owner of the subject land]

Further, in relation to a corporation, Section 448 of the Act provides that the executive officers of the corporation must ensure that it complies with the Act. If a corporation commits an offence against the Act, each of the corporation's executive officers also commits an offence, namely the offence of failing to ensure the corporation complies with the Act, and is subject upon conviction to a penalty not exceeding 200 penalty units (insert current $ value).

[Include this paragraph when the Order is issued to a Corporate entity including a Body Corporate]

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.10 Public Health Order – Rainwater Tank

PUBLIC HEALTH ORDER

Public Health Act 2005
Section 23

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Public Health Order* is hereby issued to you <<insert offenders name>> as being responsible for a *public health risk* existing at the place described as <<insert real property description>> and situated at <<insert street address>>.

The nature of the *public health risk* identified at the place is that the mosquito-proof screens and/or flap valve to the rainwater tank are defective, which is a breeding ground for mosquitoes.

This is considered to be a *public health risk* by virtue of Section 11(1)(a)(i) of the Act.

In order to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring, you are required to take the following action:

1 Repair or replace all mosquito-proof screens and/or flap valve to the relevant tank to ensure that every opening of the tank prevents the ingress of mosquitoes into the tank.

2 Mosquito proof screens and flap valves are to comply with the provisions of PART 1A Division 3 of the *Public Health Regulation 2005,* as follows:

a Mosquito-proof screens that -

i are made of brass, copper, aluminium or stainless steel gauze; and

ii have a mesh size of not more than 1mm; and

iii are installed in a way that does not cause or accelerate corrosion; and

iv stop mosquitoes passing through the openings; or

b flap valves that when closed, stop mosquitoes passing through the openings.

DUE DATE FOR COMPLIANCE WITH THIS ORDER IS DAY DATE YEAR

Under Section 387 of the Act, an authorised person may, at reasonable times, enter the place to check whether this Order has been complied with. Procedures for entry of the place are set out under Section 392 of the Act.

As the recipient of a *Public Health Order* it is an offence not to comply with the Order, unless you have a reasonable excuse. This is punishable upon conviction with a fine not exceeding 200 penalty units (insert current $ value). Alternatively you may be issued with a penalty infringement notice of five (5) penalty units (insert current $ value) for an individual, or 25 penalty units (insert current $ value) for a corporation.

Notwithstanding any action that may be taken as described above, should you fail to comply with the requirements of this *Public Health Order* by the due date, one or more of the following courses of action may be taken to ensure compliance with the requirements of this *Public Health Order*:

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- Under Section 24 of the Act, Council may make application to a magistrate's court for an *enforcement order*.
- Under Section 388 of the Act, Council by its employees or agents may at reasonable times, enter the place to take steps stated in this Order. Procedures for entry of the place are set out under Section 393 of the Act. Any costs and expenses incurred, including interest accrued in exercising these powers, is recoverable from you as a debt or a charge over the land the subject of this Order. [Include this section only when the Order is issued to the owner of the subject land]

Further, in relation to a corporation, Section 448 of the Act provides that the executive officers of the corporation must ensure that it complies with the Act. If a corporation commits an offence against the Act, each of the corporation's executive officers also commits an offence, namely the offence of failing to ensure the corporation complies with the Act, and is subject upon conviction to a penalty not exceeding 200 penalty units (insert current $ value).

[Include this paragraph when the Order is issued to a Corporate entity including a Body Corporate]

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.11 Public Health Order – Receptacle/ Guttering

PUBLIC HEALTH ORDER

Public Health Act 2005
Section 23

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Public Health Order* is hereby issued to you <<offenders name>> as being responsible for a *public health risk* existing at the place described as <<insert real property description>> and situated at <<insert street address>>.

The nature of the *public health risk* identified at the place is <<deleting as required>>

- Receptacles are being kept at the place, namely *(state whether a bowl, bucket, flowerpot, tyres etc.)* which area breeding ground for designated pests, namely mosquitoes.
- Roof guttering at the place is ponding water which is a breeding ground for designated pests, namely mosquitoes.

This is considered to be a *public health risk* by virtue of Section 11(1)(a)(i) of the Act.

In order to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring, you are required to take the following action:

- Empty and dispose of any receptacle holding water if the item is no longer required;
- Completely empty all water from every *state whether a bowl, bucket, flowerpot, tyres etc.)* or other receptacle kept at the place so that the water is not a breeding ground for mosquitoes. The receptacle should also be wiped clean to remove any mosquito eggs;
- Clean out and remove from all roof guttering, any obstruction including leaves, vegetation or other debris, to ensure all water drains away and is not a breeding ground for mosquitoes.

DUE DATE FOR COMPLIANCE WITH THIS ORDER IS (DAY) , (DATE) (YEAR)

Under Section 387 of the Act, an authorised person may, at reasonable times, enter the place to check whether this Order has been complied with. Procedures for entry of the place are set out under Section 392 of the Act.

As the recipient of a *Public Health Order* it is an offence not to comply with the Order, unless you have a reasonable excuse. This is punishable upon conviction with a fine not exceeding 200 penalty units (insert current $ value). Alternatively you may be issued with a penalty infringement notice of 5 penalty units (insert current $ value) for an individual, or 25 penalty units (insert current $ value) for a corporation.

Notwithstanding any action that may be taken as described above, should you fail to comply with the requirements of this *Public Health Order* by the due date, one or more of the following courses of action may be taken to ensure compliance with the requirements of this *Public Health Order*:

- Under Section 24 of the Act, Council may make application to a magistrate's court for an *enforcement order*.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

- Under Section 388 of the Act, Council by its employees or agents may at reasonable times, enter the place to take steps stated in this Order. Procedures for entry of the place are set out under Section 393 of the Act. Any costs and expenses incurred, including interest accrued in exercising these powers, is recoverable from you as a debt or a charge over the land the subject of this Order. [Include this section only when the Order is issued to the owner of the subject land]

Further, in relation to a corporation, Section 448 of the Act provides that the executive officers of the corporation must ensure that it complies with the Act. If a corporation commits an offence against the Act, each of the corporation's executive officers also commits an offence, namely the offence of failing to ensure the corporation complies with the Act, and is subject upon conviction to a penalty not exceeding 200 penalty units (insert current $ value).

[Include this paragraph when the Order is issued to a corporate entity including a Body Corporate]

If you require any further information, please contact Council's Health & Environment Section.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.12 Public Health Act – Notice of Entry

NOTICE OF ENTRY

Public Health Act 2005
Sections 392(5) and 393(7)

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Notice of Entry* is hereby issued to you (insert name of person PHO is being issued to) in relation to the issuing of a *Public Health Order on* .(insert order date) for a *public health risk* at the place described as (insert real property description) and situated at (insert street address).

While exercising powers under the Act you were unable to be located, and entry to the above place was gained by an authorised person to take steps required under the *Public Health Order,* namely*:*

- *(Provide details of steps taken to reduce public health risk – should be the same as wording stated in 'Notice of Intention to Enter a Place')*

The time and date of entry was (enter date and time).

If you require any further information, please contact Council's Health & Environment Section.

9.13 Public Health Act - Notice Intention to Enter

NOTICE OF INTENTION TO ENTER A PLACE

Public Health Act 2005
Sections 393(2) and 393(3)

TAKE NOTICE that under the provisions of the *Public Health Act 2005* a *Notice of Intention to Enter a Place* is hereby issued to you (insert owner/occupiers name - notice to be issued to both, unless the occupier is the owner) in relation to the issuing of a *Public Health Order* for a *public health risk* at the place described as (insert real property description) and situated at (insert street address). The *Public Health Order* was issued by Council on (insert order date), a copy of which is attached to this Notice. ***(attach copy of Order)***

The *public health order* required .(insert the name of the person who the Order was issued to) to take steps at the place to remove or reduce the risk to public health from the *public health risk*, or prevent the risk to public health from recurring. It is evident that the requirements of the *Public Health Order* have not been complied with, in that a *public health risk* still exists at the place.

FURTHER TAKE NOTICE that the Council, by its employees or agents, intends to enter the place to take the following steps, as required under the *Public Health Order:*

- Treat the water contained in the in-ground swimming pool with an approved mosquito larvicide, namely *Prolink XR* Residual Briquets. Three (3) briquets will be placed into the in-ground swimming pool. This treatment is intended to control mosquito growth for up to six (6) months.

It is intended that entry to the place will be carried out on .(insert date) at .(insert time).

If you require any further information, please contact Council's Health & Environment Section

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.14 Letter Container/Urban Mosquito Breeding Monitoring Site

Re: Mosquito Surveillance

As part of Banana Shire Council's commitment to supporting preventative public health programs; we are endeavouring to set up mosquito monitoring sites around our region in order to minimize the community exposure to potential health risks

With this in mind, we are requesting your assistance in allowing us to place mosquito monitoring equipment on your property. This will be monitored by an officer of Council every (insert number of days) days depending on the season. The officer will simply collect the water/mosquitoes from the trap and take the sample/s away for further identification of mosquito breeding. We ask that the trap not be disturbed and for permission to access the monitoring equipment in your absence (consent form to be signed).

If you require any further information, please contact Council's Environmental Health Officers

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

9.15 Common Mosquito Species in Central Queensland (including Coastal Species)

9.15.1 Freshwater Species

Species	Vector of	Breeding Habitat	Other
Aedemoyia catasticta		Semi & Permanent Pools	
Aedes aculeatus		shallow depressions in moist peaty soil	Large and bites humans
Aedes alboannulatus		Bushland Ground Pools	Minor pest
Aedes australis		Rock pools above high tide	
Aedes bancroftianus		Roadside ditches ground pools	Nuisance after extensive rain
Aedes Burpengaryensis		Coastal Regions and Tablelands	Day biting
Aedes clelandi		Ground pools with and without vegetation	Can be nuisance in tea tree scrub
Aedes imperfectus		Shaded grasses, groundpools filled with floodwater	Bite humans
Aedes lineotopennis		Temporary Grass Pools	Vicious biter of humans
Aedes normanensis	Ross River & MVE	Casual groundpools, sunlit	
Aedes rubrithorax		Usually shaded areas	Nuisance pest
Aedes rupestris		Rockpools in bushland	Nuisance pest
Aedes vittiger		Grassed sunlit temporary ground pools – irrigation areas	Major pest
Anopheles amictus		Semi & permanent pools	Host for malaria
Anopheles annulipes		Various	Host for malaria
Anopheles bancrofti		Common in Hyacinth Swamps	Host for malaria
Culex annulirostris	Ross Rive, MVE	Freshwater swamps	Dog heart worm
Culex australicus		Groundpools	
Culex bitaeniorhynchus	unclear	Semi permanent lagoons	MVEV overseas
Culex cubiculi		Farmland freshwater	
Culex orbostiensis		Vegetated ground pools	Bites humans

Mosquito & Black Fly Management Plan

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Culex gelidus	JEV overseas	Freshwater groundpools	Bites humans
Culex globocoxitus		Swamps and small ground pools	
Culex halifaxii		Polluted Domestic Sites	
Culex hilli		Shallow swampy pools melaleuca canopies	
Culex pullus		Various freshwater	Carries Kunjin disease but rarely bites humans
Culex quinquefasciatus		Polluted Water	Major pest
Coqillettidia linealis	Potential Ross River	Vegetated permanent ground pools	Nuisance pest
Coqillettidia xanthogaster		Swamps, lagoons, creeks	Major pest
Mansonia uniformis		Associated with water plants	Major pest
Mimomyia elegans		Freshwater	
Mimomyia		Freshwater	
Verallina Marks No 52	Not known	Coastal Semi-permanent Ground Pools	
Uranoaenia pygmaea		Groundpools	

9.15.2 Salt Water Species

Species	**Vector of**	**Breeding Habitat**	**Other**
Aedes alternans	Possible Ross River from Laboratory Tests	Brackish & fresh pools	Nuisance pest
Aedes procax	Possible Ross River	Casual groundpools	Minor pest
Aedes vigilax	Ross River	Brackish water high tides	Major pest & can transmit dog heart worm
Culex sitiens		Coastal brackish water	Major pest
Verallina funereus	Potential for Ross River	Well shaded groundpools slightly brackish to fresh water – tidal areas	Major pest in tea tree swamps etc

Mosquito & Black Fly Management Plan

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9.15.3 Container/Urban Species

Species	**Vector of**	**Breeding Habitat**	**Other**
Aedes aegypti	Dengue Fever	Containers	
Aedes kochi		Leaf axils of plants	Potential for dog heartworm
Aedes tremulus		Tree holes and containers	Nuisance pest
Ochlerotatus notoscriptus	Possible Ross River from Laboratory Tests	Container breeder and plants	Major pest, heart worm
Toxorhynchites		Containers	Larval predator
Tripteroides Sp		Natural environments	Nuisance pest

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

PART F ACTION PROGRAMS

Action 1 – Operations

Scope	Inclusions	Present	Actions
Control Methods	Ground based applications for Groundwater/freshwater/polluted water mosquito breeding	The majority of the proposed program will involve this depending on seasonal demands. Larviciding is recognised as the most efficient method of control. It is envisaged that a pre-treatment program of s-Methoprene briquettes, pellets or sand distribution will be applied in areas that may be affected by rainfall.	➢ Identify breeding sites. ➢ Identify resting sites. ➢ Initiate and review ground based control methods. ➢ Identify treatment areas. ➢ Initiate and review all ground based activities. ➢ Mosquito Task Calendar to be developed and implemented.
	Ground based applications for container/urban mosquito breeding	Undertaken as part of the current surveillance program to establish and identify the presence of container breeding mosquitoes such as *Aedes aegypti.* Review the benefits of the program as required.	➢ Ovi trapping is a suitable option for dengue response and for the program in general. ➢ Investigate the need for a routine monitoring sites over the summer months using either BGs or GAT traps ➢ Identify suitable methods for surveillance, response and control

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Scope	Inclusions	Present	Actions
Control Methods Cont.	Aerial applications	Have it set up as an alternative should the need to utilize such an application be required.	➢ Aerial application for mosquito control is an expensive exercise however it is often recognised as an essential part of a treatment program and is known to produce significant results. ➢ Council would have to establish a good working relationship with the helicopter/light plane operator/company to establish possible treatment methods and knowledge of the processes and outcome. ➢ Identify loading sites for the aircraft.
	Adulticiding – Space Sprays	Adult mosquito and black fly control would most likely be achieved through the use fogger or ULVs applications. Adulticiding for mosquitoes and Black Flies would generally be carried out early morning or late afternoon with low winds in densely vegetated known harbourage sites. Usually undertaken during the late spring and Summer months or when infestations occur. It should be noted that this type of treatment will have some impact on non-target species.	➢ Identify suitable areas for adulticiding treatments. ➢ Monitor light trap numbers to identify adult mosquito activity. ➢ Monitor black fly numbers and activity.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Scope	Inclusions	Present	Actions
Control Methods Cont.	Adulticiding – Residual/Barrier Treatments	This treatment can be used to reduce the impact of both mosquito and black fly. Treatment should only be undertaken where there is a suitable barrier. It should be noted that this type of treatment will have some impact on non-target species.	➢ Identify possible locations where barrier treatments may be effective against mosquito and/or black fly. ➢ Determine the most efficient method of providing this service on both Council, State and private land. ➢ Investigate suitable locations for the introduction of barriers.
	Light trapping - Mosquitoes	Allows Council to identify mosquito numbers and species found within the region?	➢ Initiate light trapping program. ➢ Identify routine trapping locations. ➢ Ensure target areas are monitored as required. ➢ Determine frequency and duration of trapping program. ➢ Integrate data into a treatment program.
	Pre/post dipping	Pre/post dipping is an important part of the treatment program to assist in determining mortality rate/efficacy.	➢ Collect and record data to determine appropriate response.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Action 2 – Data Collection

Scope	Inclusions	Present	Actions
Site Identification and characteristics	Breeding Site Identification and characteristics	The mosquito & Black Fly breeding areas of the region are numerous and varied. Mosquito breeding occurs in temporary ground pools and permanent water bodies. Black Fly breeding occurs in running water.	➢ Site identification process to be initiated. ➢ Site identification to be incorporated with the mapping of the breeding sites.
GIS integration	Mapping Known Breeding Sites	Breeding sites and treatment areas are yet to be loaded onto Council's mapping system.	➢ Creation of a layer in Councils mapping system for mosquito and black fly related information. ➢ Incorporate treatment data into the mapping system e.g. Pre-treatments, aerial treatments.
Records	Surveillance, Response and Treatment data	Identify necessary data for recording e.g. chemical application, Complaints, Meteorological Bureau data and how the information will be recorded. A simple system that is easy to access and maintain should be implemented.	➢ Implement data recording systems.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Annual Reports	All details relating to the Mosquito & Black Fly Management Program	Identify what information is needed and how it should be presented.	➢ Identify any season highlights. ➢ Provide an overview of climate and rainfall data. ➢ Larval Monitoring and Treatment. ➢ Adult Monitoring and Light Traps. ➢ Complaint Monitoring. ➢ Specific Township Activities. ➢ Mosquito Breeding Areas. ➢ Black Fly Breeding and Resting areas. ➢ Mosquito & Black Fly Management Plan. ➢ Future Opportunities. ➢ Community Awareness and Community Satisfaction.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Action 3 – Competencies

Scope	Inclusions	Present	Actions
Staff training	Mosquito Training	Identify staff needs and available training.	➢ Ensure relevant staff can access ID and mosquito management courses e.g. MOZ01 course. ➢ Ensure that all staff undertaking treatment are appropriately licensed. ➢ Ensure all staff is provided with in-house training on mosquito management aspects where practicable.
	First Aid	Identify training as determined by program requirements.	➢ Ensure all staff has access to first aid training.
	Vehicle/Driver Safety Courses	Identify staff needs and availability training as determined by program requirements.	➢ Ensure staff have access to 4WD ➢ Quad bike training. ➢ Ensure staff has access to driver safety courses.
	Other Licenses and Permits	Identify if Staff are required to hold any license, permit or authority to safely undertake their duties.	➢ Ensure staff have access to required training e.g. Manual handling, Forklift licence etc ➢ Identify and develop further training requirements
Pest Management Technician Licenses	Pest Management Technician Licenses	Relevant staff are required to hold a current Pest Management Technician License.	➢ Ensure all relevant staff have current Pest Management Technicians Licenses.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Action 4 – Program Performance Review

Scope	Inclusions	Present	Actions
Legislative compliance	LGAQ – Mosquito Management Code of Practice Pest Management Technician Licenses *Public Health Act 2005*	Continue to evolve the Mosquito & Black Fly Management Plan to ensure compliance with relevant legislation.	➢ Operate under the principles outlined in the Mosquito & Black Fly Management Plan. ➢ Produce and operate in accordance with - Work Procedures and Instructions and the Mosquito & Black Fly Management Plan. ➢ Comply with relevant statutory legislation. ➢ Produce and comply with a Public Health Act Enforcement Strategy.
Budget controls	Plant and equipment	Identify plant needs. Identify sections that have suitable plant and determine if these can be used by the Mosquito & Black Fly Control Unit. Future budgets to include provisions for suitable plant.	➢ Ensure continued review of plant adequacy. Specific plant and equipment to be replaced regularly. ➢ Ensure laboratory instruments are adequately maintained e.g. Microscopes, microscope camera. ➢ Undertake an annual plant review.
	Larviciding Program	Undertake larviciding treatments as required.	➢ Utilise larviciding as an integral part of the mosquito program where necessary.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Budget Controls Cont.	Pesticides	Pesticides are provided for the treatment program within current resources.	➢ Identify chemical stock needs and quantities to be held and acquire as necessary to deal with routine and emergency situations. ➢ Identify areas of improvement within the program including operational efficiencies. ➢ Addition of further treatment sites will demand more pesticides.
	Promotional Brochures	Continue to develop information brochures on numerous topics including Mosquito Management, dengue awareness and Black Fly responsiveness.	➢ Provide information brochures on Council's Mosquito control program. ➢ Develop additional information as the need is identified. ➢ Review information, including documents sourced from Queensland Health prior to each season. ➢ Provision of ongoing funding, within the sections awareness program.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Action 5 – Community Awareness

Scope	Inclusions	Present	Actions
Awareness and Education	Website	Council's website contains only a minimum amount of information relating to Mosquitoes & Black Fly Management.	➢ Environmental Health section continue to try and increase public awareness by making information readily available via the BSC website and social media.
	Promotional Material	Council provides promotional material in several formats including brochures/handouts and on their website and other social media forums.	➢ Continue to provide promotional material in all formats. ➢ Increase public awareness of personal responsibilities.
Paid media advertising	Paid Media advertising.	Undertaken as the need arises, in response to disaster or weather conditions.	➢ Further develop Banana Shire Council's proactive mosquito awareness campaign e.g. TV/radio advertising, promotional materials etc.
Media Releases	Media releases through all relevant local press outlets	Undertaken In response to events.	➢ Ensure a number of media releases occur each year.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Action 6 – Stakeholders

Scope	Inclusions	Present	Actions
Local Government Authorities	Central Highlands Regional Council Gladstone Regional Council Maranoa Regional Council North Burnett Regional Council Rockhampton Regional Council Western Downs Regional Council	Council is a members of the Central Queensland Mosquito Management Group (CQMMG) which meets quarterly. Information and resources are shared between these Councils and State Government. Listed Council's share a boundary with BSC.	➢ Maintain communication and relationship with CQMMG. ➢ Establish communication and formalise relationship with Councils that share a boundary but are not members of the CQMMG. ➢ Liaise with other Council department e.g. Engineering and Natural Resources

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Scope	Inclusions	Present	Actions
Mining Operations	Anglo American Metallurgical Coal (Callide, Boundary Hill & Dawson) Newcrest Mining (Cracow Gold) Baralaba Wonbind Pty Ltd (Cockatoo Coal) Vale Australia (Belvedere Coal start 2019) Cockatoo Coal & Mitsui (Taroom Coal start 2018) Westside Corp (Energy – LNG) Santos (GLNG Project Biloela & Moura) Arrow Energy (LNG Pipeline) Australia Pacific (LNG Pipeline) Queensland Zeolite Ltd (Willows Zeolite) Central QLD Quarries (Avoca Sand, Castle Creek Basalt, Fairway Quarry Banana) Kianga Quarry Ltd (Quarry Banana) Hanson Construction (Yalkara Quarry)	Council is involved with Development applications.	➢ Establish communication and formalise relationship. ➢ Determine if employees/vehicles travel from areas where Dengue Fever is prevalent. ➢ Identify if surveillance and/or treatment can be undertaken on site.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department

Scope	Inclusions	Present	Actions
Other Organisations	Sunwater Main Roads Regional Environmental or Catchment Care Groups Dawson Valley Cotton Growers Association Cotton Australia Wheat Growers Sorghum Growers Wheat Storage (Silo Operations)	Sunwater provides irrigation throughout the region Road side drainage issues	➢ Establish communication; and formalise a relationship with Sunwater. Investigate research breeding in Sunwater irrigation channels. ➢ Establish communication channels with Main Roads. ➢ Establish communication with local environmental/catchment care groups. ➢ Establish communications with grain and cotton industries to determine if transport or employees travel to areas where Dengue Fever cases occur. ➢ Identify if surveillance and/or treatment can be undertaken within farms and/or storage areas.
State & Federal Bodies	Department of Environment & Heritage Protection (EHP) Queensland Health	No formal lines of communication QLD Health is a member of the CQMMG and a good working relationship has been fostered.	➢ Establish communication and formalise relationships with EHP. ➢ Maintain communication and relationship with QLD Health.

Information has been sourced from World Health Organisation; Queensland Health; New South Wales Health; and University of Sydney Medical Entomology Department