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Environmental Health Services

Mosquito Management Plan

March 2023

Contents

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Foreword

A Mosquito Management Plan (MMP) is triggered by a known or potential risk of mosquito nuisance and/or increased mosquito-borne disease activity.

The issue of mosquito management is complex and requires investigation to establish what the mosquito problem is in an area and determine appropriate management strategies.

This MMP provides guidance on what mosquito management exists within the Shire of Ashburton (the Shire) and prescribes appropriate mosquito management strategies whilst maintaining a surveillance program to inform this plan and decision making.

Guidance Notes

Principles

The principles governing this MMP are:

- Mosquito management incorporates the health, environmental and socio-economic values across the Shire.
- While disease control is the primary focus, reduction of nuisance mosquitoes is a legitimate aspect of improved community well-being.
- Mosquitoes are an important part of the ecosystem, and their treatment may have both positive and negative impacts on the environment; management options will try to minimise negative impacts.
- Effective mosquito management requires the cooperation and coordination of all stakeholders.
- Treatment of mosquito larvae and/or adults is an on-going activity that requires continual surveillance, review, and resourcing.

Scope

The MMP provides site-specific management strategies for all actual and potential mosquito habitats within the Shire area. Background information on a range of aspects of mosquito and mosquito-borne disease management is provided in this plan.

Document control

This plan is Version 2.0 (V2.0) of 2023.

Amendments to the plan may be forwarded to the Environmental Health Team at the Shire via the contact details listed below.

The plan will be reviewed at least annually to allow for the incorporation of seasonal variation and to adjust management strategies as trends emerge.

Environmental Health Team

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Plan Review

The plan will be reviewed at least annually to assess its effectiveness and incorporate new information supplied by stakeholders as required and information derived from seasonal campaigns and field activities.

The MMP is subject to review by the Department of Health every three (3) years to ensure the Shire maintains membership of the Contiguous Local Authorities Group (CLAG) and has access to funding opportunities.

Endorsement

The Shire of Ashburton Mosquito Management Plan was endorsed by Council at Ordinary Meeting of Council on 13 June 2023.

Department of Health WA, review conducted 2023 and found compliant, next review is 2026.

Disclaimer

This Mosquito Management Plan has been produced by the Shire of Ashburton in good faith and is derived from sources believed to be reliable and accurate at the time of publication.

Nevertheless, the reliability and accuracy of the information cannot be guaranteed and the Shire of Ashburton expressly disclaims liability for any act or omission done or not done in reliance on the information and for any consequences, whether direct or indirect arising from such omission

1 Introduction

The Shire covers approximately 105 647 square km of the Pilbara region of northern Western Australia and contains a residential population of over 10,000. There are four (4) main residential centres comprised of Tom Price, Paraburdoo, Onslow, and Pannawonica. There are smaller Aboriginal communities comprising Wakathuni, Bellary, Youngaleena, Bindi Bindi, Jundaru, Wirllilemara and Ngurawanna.

Mosquito management in Pannawonica is the responsibility of Rio Tinto as it is a closed town. Mosquito management within the Aboriginal communities is based on invitation, need and resources.

The Shire is a rural region, with mining, pastoral and tourism industries forming an important part of the local landscape. Management of mosquitoes and mosquito-borne disease is a concern for local authorities and requires site-specific strategic responses that reflects regional mosquito and public health threats.

Mosquitoes are a concern for the community not only due to their potential to transmit debilitating diseases but also due to their nuisance value which can impact on the ability of residents and visitors to enjoy the amenities and natural beauty of the area.

In contradiction to this, while they may be pests, mosquitoes are an important component of the local ecosystem, providing food for birds, bats, amphibians, fish, and insects. The challenge is creating a balance between these factors and implementing a program that has little impact on the environment but reduces the risk of the community being exposed to mosquito borne diseases.

This challenge can be met through an integrated mosquito management program incorporating physical, chemical, cultural and biological control options. Such an approach needs to consider the statutory obligations, policies, guidelines, current practices, the community, and the environment.

By having such an approach to mosquito management, it creates an effective and environmentally sensitive solution that is sustainable. It also provides for avenues that are sometimes less allocated for, being health promotion and chemical resistance management.

This plan is designed to assist the Shire in the management of nuisance-biting and public health risks associated with local mosquito populations with respect to current and future regional environmental and climate factors.

1.1 Shire considerations:

- The Shire provides suitable habitat for mosquitoes that are both nuisance-biting pests and vectors of disease-causing pathogens.
- The major pests are those associated with coastal wetlands and inland regions prone to flooding following wet season rains and tropical cyclones. There will be variation in the abundance of mosquitoes and the environmental drivers between Tom Price, Paraburdoo, Onslow, and Pannawonica townships. Therefore, mosquito surveillance and control strategies may differ between these areas.

- Mosquitoes associated with water-holding containers in residential areas, mining and agriculture developments have the potential to cause nuisance-biting and potential public health risks.
- The abundance of mosquitoes in the Shire and Pilbara more broadly are not as consistently abundant as other regions in WA but maintain the potential, following suitable environmental conditions, to be sufficiently abundant to cause nuisance-biting pest and public health concerns.
- Notwithstanding potentially significant nuisance-biting impacts, disease-causing pathogens such as Ross River Virus (RRV) and Murray Valley Encephalitis Virus (MVEV) are associated with local mosquito populations and wildlife in the Shire and are a concern for the local community. Strategic mosquito control, coupled with surveillance, will assist in reducing disease risks.
- Human disease caused by RRV is an annual threat in the Shire but there is occasional potential for activity of more serious disease risk associated with MVEV following flooding associated with seasonal rainfall and tropical cyclones. Disease caused by RRV peaks at times of tropical cyclone activity. The community must be alert and elevated surveillance of mosquitoes and mosquito-borne pathogens should be considered following such events. "Mosquitoes and cyclones – managing the risk of mosquito-borne disease" *[http://ww2.health.wa.gov.au/Articles/J_M/Mosquitoes-and-cyclones-managing-the-risk-of-mosquito-borne-disease]*
- The Shire supports a growing residential population and transient workforce associated with pastoral, mining, and tourism industries. Cooperation between managing authorities of mining operations in the region and local authorities is critical in ensuring awareness of mosquito risk and exchange of information regarding local mosquito activity. Mosquito-borne disease has been identified in the WA Department of Health's (DoH) "Guidance for mine sites, exploration camps and construction villages" [http://www.dmp.wa.gov.au/Safety/Guidance-for-mine-sites-6988.aspx]
- Future mosquito and mosquito-borne disease risk will be influenced by many factors including climate change, the introduction of exotic mosquito species, increased human population and development close to existing mosquito habitats and the creation and modification of mosquito habitats associated with urban and pastoral water management.

2 Program Objectives

The objectives governing this MMP are:

- Identify breeding and potential breeding locations.
- Provide an easy access document to convey information to future staff.
- Inform, guide, and assist staff, stakeholders, and the community on the Shire's mosquito management activities.
- Strategically guide the financial direction of mosquito management.

3 Strategic Implications

In accordance with the Shire's Strategic Community Plan, under the aspirational theme of Prosperity, our mission is to *"advocate and drive opportunities for the community to be economically desirable, resilient, and prosperous, socially active and connected"*

The MMP strives to address the following under the direction of Prosperity - Section 3.3: Clean, safe, and accessible communities through:

(1). Develop and maintain the Public Health Plan – MMP

(2). Lead, and partner with other agencies on community safety and wellbeing programs – DoH, mining and gas companies, and other identified stakeholders

(4). Work with the community in maintaining safety and amenity in the district – Public Education and Awareness campaigns

Strategic Plans » The Shire

4 Statutory Management

Under provisions within the Local Government Act 1995 (WA), the Shire has adopted measures specific to the prevention and control of mosquito-borne diseases which are contained in the Shire's Health Local Laws 2013

Documents in Local Laws » The Shire

5 Mosquito Control

- It is important that there is consideration given to the most suitable strategy of mosquito control in each of the townships of the Shire well before a decision to implement control is required. During mosquito-borne disease epidemics or in response to climatic events, there may not be sufficient time to review options and decide on a strategy so that effective control can be undertaken to reduce public health risks. Mosquito population surveillance should be a critical component in assessments of any site-specific strategic mosquito control program.
- Given the diverse habitats and highly variable abundance of mosquitoes in the Shire region, routine broadscale mosquito control may not be an effective use of resources. A preferred approach would be the strategic use of larvicides and adulticides to reduce annual site-specific nuisance-biting mosquito populations with an additional view to emergency mosquito control activities triggered by major climatic events (e.g., flooding associated with tropical cyclones), or actual/potential outbreaks of disease as triggered by human disease notifications or detection of mosquito-borne pathogens in surveillance programs.
- Regarding the impacts of estuarine mosquitoes (e.g., *Aedes vigilax*) around the coastal townships of Onslow, any mosquito control activities should be directed towards treatment of estuarine wetlands to reduce productivity of

pest mosquitoes. This is best achieved using *Bacillus thuringiensis israelensis* or *s*-methoprene but given *Aedes vigilax* can disperse long distances from estuarine wetlands, unless there is a broadscale aerial treatment program throughout the season, there may not be a substantial reduction in pest impacts. Controlling these adult populations through fogging or ultra-low volume (ULV) insecticide treatment will be less effective given the wide dispersal of mosquitoes. However, given the relatively small size of the community, such an approach may be useful during periods of higher-than-normal nuisance-biting activity and/or outbreaks of disease caused by RRV. Enhanced mosquito surveillance, including the processing of mosquito specimens for presence of RRV, would greatly enhance the design of any mosquito control activity in addition to providing assessments of efficacy.

- Smaller scale targeted control activities will be most effective for the townships of Tom Price and Paraburdoo where pest mosquito populations will generally be associated with localised habitats. Pannawonica is a closed community serviced by Rio Tinto and mosquito control is managed by Rio Tinto in this instance. While adult mosquitoes may be targeted when pest problems occur, a more effective approach would be to integrate insecticides with source-reduction and modifications of habitats (i.e., specifically those constructed urban stormwater and associated infrastructure) to make them less suitable for mosquitoes (e.g., routine vegetation maintenance, sediment removal). Sustained release larvicides (e.g., s-methoprene) will reduce the productivity of habitats identified as a locally important source of mosquitoes. Vegetation has been removed from open storm water drains throughout the towns of Tom Price and Paraburdoo and areas of the drainage systems that were pooling water after water events have been drained. Onslow central storm water drainage area is currently under redevelopment that will eliminate vegetation in retention basins.
- Routine mosquito management should consist of a program that includes at least annual inspection of actual and potential mosquito habitats associated with permanent and ephemeral water bodies. It is critical that a database be established with mosquito habitats assigned an identifier (also mapped and integrated with the Shire Geographic Information System (GIS) network) with the results of annual inspections, maintenance and control agent applications recorded. Where possible, a considered maintenance program should be implemented that allows for the removal of sediment, debris, rubbish, and invasive vegetation where it may be enhancing conditions for mosquitoes. Where such intervention is not possible, the use of mosquito control agents, such as sustained release briquette or pellet formulations of *s*-methoprene, should be considered. A database identifying these key habitats is critical to ensure surveillance, maintenance and treatment of habitats is effectively tracked.
- Control of adult mosquito populations using thermal fogging or ULV application of insecticides will provide some relief from nuisance-biting impacts and may reduce the risk of pathogen transmission during outbreaks of mosquito-borne disease. Synthetic pyrethroids (e.g., D-phenothrin) are the most appropriate insecticides given their effectiveness and relatively low health risk to people. Alternative products (e.g., Malathion) are malodorous

and may not be considered appropriate by the community. For sustained reduction in mosquito populations, consideration should be given to both the environmental/climatic conditions providing effective control together with a program of community engagement to both allay concerns regarding the risk to human health of the insecticides and encourage the community to embrace source reduction practices around the community and personal protection measures.

- Fixed, as well as flexible, monitoring sites must be established for the assessment of target mosquito population change resulting from mosquito control.
- Annual training of operation staff should be undertaken including a critical review of the previous season's mosquito control activity and predictions of the forthcoming seasonal outlook for mosquito activity.
- Ongoing professional development is essential and there are opportunities for staff to improve and/or update their skills. Western Australia DoH regularly run mosquito management training courses. Training programs dealing with specific aspects of mosquito control are also occasionally conducted by the Mosquito Control Association of Australia. Given the relative isolation of the Shire, consideration should be given to inviting experienced staff from the DoH to visit and present a day-long workshop every 2-3 years to provide an overview of mosquito and mosquito-borne disease risks considering recent surveillance programs, discuss emerging threats and new technologies and update the current trends on mosquito control.

6 Mosquito Biology - Ecology

Mosquitoes go through four (4) development stages - egg, larva, pupa, and adult. This whole cycle from hatching egg to flying adult can take as little as 5-7 days in summer. During colder months the life cycle may take several weeks.

Mosquitoes can breed in any type of standing water. Different species of mosquitoes will breed in different environments, from natural and man-made water bodies to a variety of water-holding containers, and from fresh to brackish or even saltwater.

Some species of adult mosquitoes are known to travel 3km or more from a breeding site in search of a blood meal. As a result, residents living at a distance from the breeding sites (as well as those close by) may be affected.

There are approximately 100 species of mosquitoes in WA and many of them can be serious pests. In addition to being a nuisance, mosquitoes can also pass on viruses when they bite. The main viruses transmitted by mosquitoes in WA are:

· Ross River virus (RRV) - this is the most common virus transmitted by mosquitoes in WA. Symptoms of RRV disease include joint pain and swelling, sore muscles, rash, fever, and fatigue. Symptoms may persist for several weeks to months.

· Barmah Forest virus (BFV) – BFV disease has similar symptoms to RRV disease but is uncommon.

· Murray Valley encephalitis (MVE) virus – MVE is a rare but potentially fatal disease that occurs mainly in the northern two thirds of WA. Symptoms include fever, drowsiness, confusion, headaches and stiff neck, nausea and vomiting, muscle tremors and dizziness. In severe cases brain damage, paralysis or death may result.

· West Nile virus (Kunjin subtype) (WNVKUN) – This has previously been known as Kunjin virus or KUNV. While the symptoms of this rare but serious disease can be like MVE, illness is generally milder and not life threatening.

There are no specific cures or registered vaccines for any of these diseases, so managing mosquitoes and human/mosquito interaction via an integrated mosquito management program is the only way to reduce the risk of mosquito-borne disease transmission.

7 Breeding Sites

Table 1: Common mosquito species associated with estuarine wetlands in the Shire.

Estuarine mosquitoes		
Mosquito species	Habitat associations	Public health risks
Aedes alternans	Tidally influenced saltmarsh but can also be found in freshwater habitats. Larvae are predatory and feed on other mosquito larvae.	Potential nuisance-biting pest but is not considered an important vector of mosquito-borne pathogens.
Aedes vigilax	Tidally influenced estuarine wetlands but also other saline and brackish water habitats.	Severe nuisance biting pest and vector of RRV and BFV. One of the most important pest species in WA.
Culex sitiens	Permanently inundated saline to brackish habitats, including estuarine wetlands and modified habitats.	Widespread in coastal WA but generally not considered a severe nuisance-biting pest as it prefers to bite birds and is not considered an important vector of disease.

Table 2: Common mosquito species associated with ephemeral and permanent freshwater habitats in the Shire.

Freshwater mosquitoes		
Mosquito species	Habitat associations	Public health risks
Anopheles amictus, Anopheles annulipes, Anopheles bancroftii	A wide range of permanent and ephemeral freshwater habitats	Occasionally nuisance-biting pests
Aedes bancroftianus, Aedes eidsvoldensis, Aedes normanensis, *Aedes pseudonormanensis, Aedes sagax* *Aedes* Marks #85	Ephemeral habitats, often associated with creek lines	Nuisance-biting pests, but some species are potentially important vectors of RRV, BFV and MVEV.

Culex annulirostris	Permanent & semi-permanent freshwater habitats	Nuisance-biting pest and important vectors of RRV, BFV, MVEV and WNV_{KUNV}.
Culex quinquefasciatus	Permanent & semi-permanent freshwater habitats, typically with a high organic content or associated with wastewater.	Nuisance-biting pest, often coming indoors, and potential vector of mosquito-borne pathogens.

Commented [NJ1]: More so overseas; not really associated with human pathogens in Australia

Table 3: Common mosquito species associated with water-holding containers in urban and industrial regions of the Shire.

Container-inhabiting mosquitoes		
Mosquito species	Habitat associations	Public health risks
Aedes notoscriptus	Small water holding containers around dwellings such as tins, pots, ornamental ponds, roof guttering bird baths, as well as water holding plants (e.g., bromeliads) and tree holes. Does not travel far from larval habitats.	Severe nuisance-biting pest and vector of RRV and BFV. This is the most important pest mosquito in urban areas across Australia.
Aedes tremulus	Tree-hole and other water holding containers. Generally, not abundant.	Nuisance-biting pest
Culex quinquefasciatus	Permanent and semi-permanent freshwater habitats, typically with a high organic content or associated with wastewater.	Nuisance-biting pest, often coming indoors, and potential vector of mosquito-borne pathogens.

8 Nuisance – Disease Risk

TABLE 4: Mosquito-borne pathogens that may be of concern in the Shire region

Pathogen	Comments
Ross River virus	Annual activity in local region. Symptoms can vary greatly between individuals and may include fever, rash and a condition known as polyarthritis with arthritic pain in the ankles, fingers, knees, and wrists. Generally, the arthritic pain is greater with RRV infection compared to BFV. The primary animal hosts of RRV are macropods (i.e., kangaroos and wallabies).
Barmah Forest virus	Occasional activity in local region. Symptoms can vary greatly between individuals and may include fever, rash and a condition known as polyarthritis with arthritic pain in the ankles, fingers, knees, and wrists. Generally, the rash tends to be more florid with BFV infection, but the arthritic pain is greater with RRV infection. The primary animal hosts of BFV, unconfirmed, but are thought to be birds with mammals also potentially playing an important role.
Murray Valley encephalitis virus	Rarely recorded local activity of this virus but a potential risk. Endemic in nearby Kimberley region. Symptoms include a sudden onset of fever, anorexia and headache, vomiting, nausea, diarrhoea, and dizziness. Drowsiness, confusion, convulsions, and neck stiffness may also be experienced. The disease can be fatal. The primary animal hosts of MVE are thought to be birds. The last case of human MVE infection in the Pilbara was in 2011.
Kunjin virus	Occasional local activity of this virus in local region. Symptoms are like MVE, but no deaths have been reported. The primary animal hosts of KUNV are thought to be birds. The last case of human MVE infection in the Pilbara was in 2017.

Commented [NJ2]: Only the first 4 really

9 Baseline Survey – Existing Data

New data to support this MMP is being collected to establish baseline data to include in this MMP.

Data for the Shire is collated through DoH who put out regular reports based on mosquito trapping and results from the bleeding of the Sentinel Chicken flocks.

9.1 Adult and larval mosquito monitoring

A series of spreadsheets will be utilised to record data relating to:

- Mosquito identification
- Sentinel Chicken flock testing and results
- Control sites with maps /photos

The information will be maintained in the Shire's record keeping system (Altus-Synergy)

9.2 Environmental Data

A series of spreadsheets will be utilised to record data relating to:

- Trapping program
- Use of Larvicides
- Fogging campaign

The information will be maintained in the Shire's record keeping system (Altus-Synergy)

An environmental plan of annual mosquito activity influenced by climate and local environmental conditions is being prepared for inclusion in the MMP

10 Mosquito Management Strategies

There are four (4) mosquito management control strategies involving Physical, Chemical, Cultural and Biological methods. Three are considered in the Shire's integrated MMP.

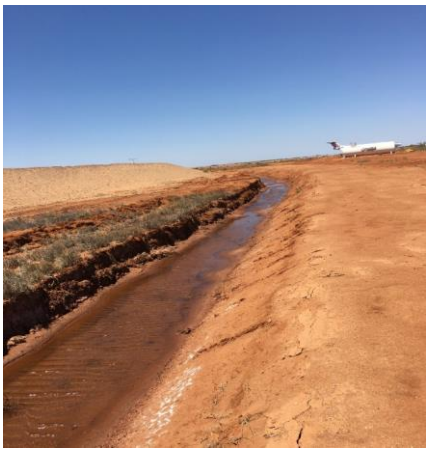
10.1. Physical

Physical control methods are used to reduce the potential for mosquito breeding and harbourage by modifying the natural or built environment. Breeding sites are reduced by decreasing the amount of vegetation within drains, marsh, or other known breeding sites or by filling in low lying land to reduce the impact of flooding/tides.

Habitat modification techniques have shown that the suppression of mosquito populations is possible without reliance on chemical control or jeopardising the flora, fauna, or ecological function of the wetland itself. However, it is important to note that any modification to the environment to reduce 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 are generally directed towards 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. In estuarine wetlands, it is to increase the frequency of tidal flushing, improve the drainage of water and maximise access of fish to wetlands. 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.

This strategy often requires cooperation with local stakeholders that may have responsibility for habitats that could be producing mosquitoes. For example, private or government organisation that manage water bodies, stormwater infrastructure or water-holding container habitats. Communication between local authorities and these stakeholders is critical, particularly where their annual maintenance programs e.g., vegetation maintenance, waste-water treatment and transfer, sediment, and rubbish management, may influence mosquito production.



Drain installed in Onslow near airport to drain swamp created by deposited dredging material

10.2. Chemical

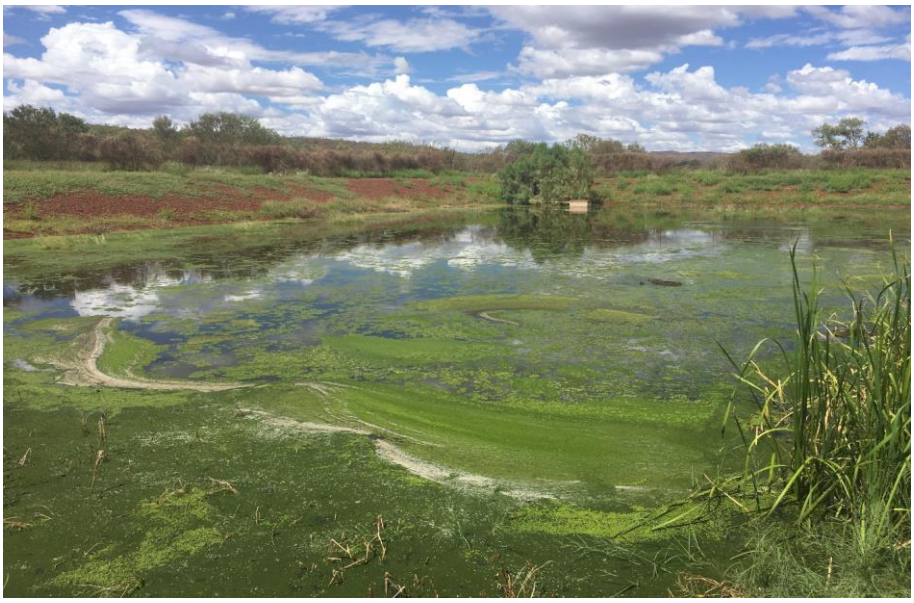
Larvicides

It is more efficient to treat the mosquitoes as larvae, while they are contained within an aquatic environment, rather than as flying adults. Larvicides kill mosquito larvae and/or prevent the larvae developing into adult mosquitoes. They are also target-specific when applied at the label rate, reducing the impact on the environment.

The following larvicides are currently used as part of the Shire's mosquito management program –

S-methoprene is an insect growth regulator that is absorbed by the larvae and prevents the larvae from emerging from the pupal stage. The Shire applies this product in accordance with the required application rates throughout the mosquito season. This product is available in several different formulations, including slow release briquets, which can provide ongoing control for up to 150 days under certain environmental conditions.

Bacillus thuringensis israelensis (Bti) contains spores and endotoxins of naturally occurring bacterium. These spores and endotoxins are ingested by mosquito larvae, resulting in death within 24 hours. Bti is toxic only to the larvae of certain dipteral (true flies). It does not harm other aquatic, marine or terrestrial fauna.



Effluent Pond at Tom Price caravan Park, known breeding ground for *Culex quinpuefasiatus*

Adulticides

Adulticides used in fogging activities are designed to kill adult mosquitoes. However, they will kill other flying insects (e.g., bees, dragon flies etc) and can be lethal to fish. For these reasons, fogging is only used by the Shire when there is an imminent public health risk associated with mosquito-borne disease transmission, often following above average rainfall or flooding.

Fogging activities are planned appropriately to ensure wind conditions are optimal, there is no rain, and the product will not drift over wetlands or water bodies where fish may be present. It should be noted that the environmental impact, particularly on natural wetland/marsh areas can be significant and is undesirable. Fogging is short lived and will only knock down mosquitoes it meets at the time it is applied.

Residual surface treatment chemicals are occasionally used by the Shire. This involves the use of an adulticide, applied to internal and external surface areas at or around known breeding sites/harbourage areas, killing mosquitoes that land on the surface. These treatments can last up to six weeks, but like fogging, they will also have a significant impact on non-target organisms.

The following adulticides are currently used as part of the Shire's mosquito management program:

Pyrethroids – this chemical is used in the thermal fogger and is used as a space spray for the control of adult mosquitoes and flies.

Bifenthrin – this is an insecticide that is used as a barrier treatment. The chemical is sprayed on surfaces such as dense vegetation and walls/fences to kill mosquitoes that land on the surface.

10.3. Cultural

The public are a vital stakeholder for this MMP and have a responsibility in any integrated program to manage mosquitoes on their own private properties. Due to the highly transient residential population in the region, it is important that educational programs are ongoing to ensure information is received by all residents and tourists.

- It is also essential to consider the large number of tourists that visit the region in the dry season months and convey public health messages to these people wherever possible. Circulation of pamphlet information on backyard breeding and personal protective measures should be considered on a regular basis to inform and protect the public."

The Shire is actively involved in promoting the DoHs Fight the Bite campaign

The Biological strategy is managed at a State and or National level.

11 Monitoring Program

Mosquito and mosquito-borne pathogen surveillance forms the basis of local mosquito management strategies in the Shire.

The provision of reliable information on mosquito populations, as well as mosquito-borne disease activity, informs local mosquito management strategies. Without data on changes in mosquito abundance and diversity within and between seasons, strategic cost-effective modifications to mosquito control and surveillance programs are not possible.

Strategic surveillance programs used in the Shire include:

- Monitoring mosquito identity, abundance, and diversity using trapping.

  Monitoring adult mosquito populations provides a quantitative measure of mosquito activity and is a more reliable measure of actual and potential pest impacts, and their associations with prevailing environmental conditions, than nuisance-biting complaints to council.

  Adult populations are most sampled using dry-ice baited Encephalitis Virus Surveillance (EVS) traps. These traps use carbon dioxide (supplied as either block or pellet dry ice or via gas cylinder) to attract host seeking mosquitoes. Female mosquitoes are attracted to the carbon dioxide, thinking the trap may be an animal, a small light serves as a focus and a battery-operated fan blows the incoming mosquitoes into a catch bag. A network of traps is usually set in the late afternoon and collected the following morning.

  Establishing fixed surveillance sites around townships within the Shire will build an understanding of local mosquito populations that will assist assessment of pest and public health risk, the development of mosquito control strategies and aid community engagement and awareness programs.

- Monitor mosquito-borne pathogen activity within Sentinel Chicken flocks.

  Sentinel chicken flocks are in place in Tom Price, Paraburdoo and Onslow in which blood samples are taken from chickens to test for antibodies to flaviviruses. They are generally bled fortnightly, but sampling is generally targeted to the late wet season (Feb-April) when mosquito borne disease risk is considered relatively high.

  These programs are designed to provide information on pathogens in the local area such as MVEV and KUNV whose reservoir hosts are typically birds and are spread by bird-biting mosquitoes.

  Testing is undertaken by the WA DoH.

- Monitoring mosquito-borne pathogen activity within local and district mosquito populations.

  While the risks of MVEV within the Shire are relatively lower than those of the nearby Kimberley district, the use of sentinel chicken flocks to routinely assess activity of this and other mosquito-borne flaviviruses provides important information to local authorities.

  These risks are unlikely to change independently of those driving activity in the Kimberley so elevated surveillance in the region should be informed by

both environmental and climatic factors in addition to the results of surveillance conducted in the Kimberley by WA DoH.

- Monitoring notifications of mosquito-borne disease in the human population.
- Maps of key mosquito "hot spots" across the district are being developed to include I the MMP. This focuses on those habitats that are particularly productive in and around to townships and human settlement. Consideration is given to areas that flood following cyclones.
- Annual Reporting.

  Abundance and diversity of mosquitoes (December through April), combined with environmental data, is presented in an annual report summarising trends in mosquito activity. In subsequent years, an average abundance of mosquitoes for each site can be developed to which current seasonal data can be compared. The benefit is that in educational/public health awareness communications, the Shire can report relative changes in mosquito activity (e.g., "mosquito populations are currently 50% greater than the long-term average for this month") and greatly enhance engagement with community by reinforcing messages around mosquito bite prevention and justifying mosquito control activities.

Commented [NJ3]: This is what we would like to see in the plan; existing data you have and major breeding sites in the Shire

12 Engagement Strategies

Raising awareness of public health risks associated with mosquitoes, together with encouraging behavior that reduces exposure to mosquitoes is critical to mosquito-borne disease management by health authorities across Australia. The following provides guidance on the Shire's approach to engagement and the information it uses to promote awareness.

Stakeholder Engagement

The Shire facilitates a *Mosquito Management Forum* made up of identified stakeholders who meet quarterly to discuss mosquito management issues and control methods. The aim is to coordinate mosquito control strategies and promote collaboration to ensure mosquito management is applied effectively across the Shire for the safety of the community. The existing membership has a representative from each of the following:

1. Shire of Ashburton
2. Rio Tinto
3. Chevron
4. Mineral Resources
5. Onslow Salt
6. East Pilbara Port Authority

The membership may change depending on circumstances

Community Education

Within the Shire, nuisance-biting and public health risks associated with mosquitoes can be reduced by raising awareness of the issues among the community and promoting personal protection measures and source reduction strategies. The strategies the Shire implements include:

- Fight The Bite is a WA DoH program applied locally at various events and times through media (http://healthywa.wa.gov.au/Healthy-living/Prevent-mosquito-bites), its aim is to assist in communicating the risks of mosquito-borne disease and nuisance biting pests, and the use of personal protection strategies that individuals and families can employ to reduce their exposure to mosquitoes.
- Community awareness programs are informed by mosquito and mosquito-borne pathogen surveillance as routine seasonal messaging to further engage the community.

  While human notification is used to trigger public health messages, there may not be sufficient warnings to substantially prevent disease. It is more effective to use surveillance program data to provide an "early warning" of elevated mosquito-borne disease risk.
- Information provided on the Shire's website is reviewed on a regular basis to ensure information is updated based on mosquito surveillance, human disease notifications and recent scientific research. Connecting with regional

stakeholders is important to ensure that these informed public health messages gain maximum reach across the region.

- The Shire has a protocol for dealing with enquiries from the public regarding mosquitoes, mosquito-borne pathogens, disease detection and mosquito control programs. The public can contact the Shire through the health@ashburton.wa.gov.au email address to request information nor advise of mosquito related issues.

  The Environmental Health Team respond to these inquiries as they occur and are familiar with current mosquito issues.

  A database of enquiries/complaints is kept so that over time, any patterns in possible nuisance-biting impacts can be identified. Feedback from the community is considered in future mosquito control plan reviews.

- In conjunction with the WA DoH, the Shire determines a Mosquito Awareness Alert level that are linked to climatic conditions that may cause increases in local mosquito populations, collection of increased mosquito populations in monitoring programs and notifications of mosquito-borne disease.

- The Shire is aware of major events within the local area that may occur during periods of mosquito-borne disease activity. School holiday periods over Christmas and Easter, together with major community events or festivals and determine if specific health warnings or site-specific mosquito control activities may be required.

Personal Protection Information

The use of personal insect repellents is the first line of defense against biting mosquitoes and, consequently, mosquito-borne disease. A wide range of formulations, including aerosols, creams, lotions, pump sprays and sticks. Regardless of the formulation, the most effective products are those that contain DEET (diethyltoluamide or N, N-diethyl-3-methylbenzamide) or Picaridin, two chemicals known to be effective insect repellents and widely available in commercial formulations. Both products have been proven to be effective against a range of Australian mosquitoes and very few adverse health impacts have been reported internationally is used as recommended.

As well as DEET and picaridin, there is another product that may provide effective protection against biting insects. Registered in Australia as "extract of lemon eucalyptus being a modified acid of *Corymbia citriodora*"), PMD is not an essential oil product but rather a chemical derived from the distillation of the lemon eucalyptus plant. In Australia, it is not widely available, but his product has been tested overseas and has been shown to be as effective as low dose DEET or picaridin products.

The decision of which formulation is most appropriate is probably best made by the individual but the key point to remember is that, for complete protection, the entire surface of exposed skin must be covered. For this purpose, sprays are often effective for arms and legs while creams and towelettes are good for the face. Some repellents are available as patches or plastic wrist bands, but these only offer limited and localised protection (i.e., if any protection is provided, it is generally only immediately around the product). However, when used in combination with other

repellents (or long-sleeved shirts), wrist bands may be suitable for those wanting to avoid contact with repellent.

There are many repellents available that contain 'natural' compounds derived from plants, including eucalyptus, tea-tree, catmint, and citronella extracts. While such products are available for individuals wishing to avoid so-called 'chemical' repellents, it should be recognised that they also are chemicals, and some users will find they cause skin irritations. More importantly, however, they generally offer substantially lower protection times when compared to those containing DEET and will therefore need to be reapplied more frequently to provide protection.

In addition to topical mosquito repellents, there is a range of products including coils, sticks and other 'burner' devices that purport to repel mosquitoes. These products are impregnated with an insecticide (usually a pyrethroid) that is released when heated, either by burning (coils and sticks), heated by a small electrical unit (vaporising mat), or dispersed by a battery-operated fan (clip-on devices). These products are generally designed for indoor or sheltered outdoor areas and should be used as directed.

Mosquito repellent wrist bands are promoted as an alternative to the application of topical repellents. However, studies have shown these products do not provide adequate protection against mosquitoes and, if worn on the wrist, will certainly not stop mosquito bites elsewhere on the body. These should not be recommended, even though some products are currently registered with the Australian Pesticides and Veterinary Medicines Authority (APVMA).

While not always common in Australia, products often pop up that purport to use sound to repel mosquitoes. These gadgets can range from key ring sound emitters and plug in "sonic" devices to mobile phone ring tones and smartphone applications. There is no scientific basis to these claims and scientific trials have repeatedly shown that these units are not effective.

13 Urban Planning

Mosquito Risk Assessments can provide valuable information to local authorities on actual and potential mosquito impacts resulting from proposed urban, agricultural, or mining developments. These assessments usually entail an evaluation of the extant of mosquitoes, their habitats and human activity within the vicinity of the site. It often includes the collection and identification of local mosquitoes, detailing the risk each species poses with respect to pest nuisance or disease risk.

Expert consideration of the proposed development with respect to its potential for producing mosquitoes or adding to any local mosquito populations and their associated problems or concerns, and the provision of expert opinion on these risks with recommendations for their minimisation may be required.

For new residential developments, an increasing concern is the proximity of new residents and recreational activity close to productive mosquito habitats. Notwithstanding the environmental impacts of urbanisation, as humans are brought closer to mosquito habitats there is a greater likelihood of nuisance biting occurring and health risks increasing. New residents to these areas may not be aware of the health risks associated with local mosquito populations or the strategies available to protect themselves from mosquito impacts and, may be at a relatively greater risk.

Onsite housing for fly-in/fly-out (FIFO) workforce at isolated mining facilities should also consider mosquito risks. As well as mosquitoes found in nearby natural habitats, water storage, waste-water treatment and stormwater management may all enhance local conditions for mosquitoes and the health risks posed should be considered.

While some mosquito activity should be expected in outdoor areas during warmer months, the entry of mosquitoes into buildings can often have significantly greater nuisance impacts. Insect screens of an appropriate mesh size should be fitted to windows and doors where possible and maintained regularly. Insect screens (made of aluminium, bronze, or fibreglass) of an appropriate mesh size (mesh size of 1.2mm x 1.2mm is generally recommended) should be fitted to windows and doors where possible and maintained regularly (tears and loose-fitting screens will allow mosquitoes entry to buildings).

In situations where there is concern regarding obstruction of views or decreased visual amenity, sash windows can be used where only half the screening is required. There is a wide range of options available for screening doors including sliding, spring loaded and pleated screens for doors and windows. Some retractable structures are available for wide openings with pleated and bi-folding options offering potential coverage of openings over 5m wide and up to 3m high. It should also be ensured that there are no entry points via air conditioning ducts, ventilation structures or other connections between indoor and outdoor areas.

The challenge in providing protection from mosquitoes in outdoor areas close to wetlands is addressing the conflicts between visual amenity and functionality of outdoor areas while minimising contact with mosquitoes. There are an increasing number of options available for providing screening of outdoor settings including insect proof screens. Screening for sun protection (i.e., shade cloth) may also provide

a physical barrier to mosquito movement but mesh sizes of more than 5mm x 5mm are likely to allow entry of mosquitoes. There is a range of options available for retractable and removable screens.

The technologies currently used to provide adjustable shading for restaurants and commercial buildings may be adapted for use with insect screening. For temporary screening, there are a variety of options available to secure the insect screening that include press studs, Velcro, magnets, hooks, and spring clamps. However, loose fitting screening (e.g., no secure attachment to vertical sides) will not provide effective protection from mosquitoes. Any type of screening will pose a physical obstruction to mosquitoes but the more 'complete' the coverage the better protection provided.

Buffer zones between proposed developments and mosquito habitats are often raised as a possible strategy to assist in minimising the impact of nuisance-biting. However, there are no quantitative studies indicating the appropriate size or vegetation composition of effective buffers. Guidelines provided by local authorities elsewhere in Australia can range from 50m to over 1km.

Effective buffer zone distances will be site specific and must be based on the abundance of locally important pest species. For example, buffer zones are not a practical management option for coastal region where *Aedes vigilax* is the key pest mosquito as they disperse, often in great numbers, long distances from wetlands. Where buffer zones are considered appropriate, they should be maintained as clear or sparsely vegetated zones, to not provide continuous harbourage sites for adult mosquitoes and act as a corridor for adult mosquitoes moving between the larval habitat and the human population.

For agricultural, mining, and other major projects, it is not just the impact on local workforce that must be considered but the impact of the proposed development on- and off-site mosquito production. Whether it is the construction or rehabilitation of water bodies on site or shifts to vegetation and hydrology of surrounding environments, developments may enhance local conditions for mosquitoes.

The Shire should consider the following:

- The risk of mosquitoes and their potential health impacts when assessing proposals for residential, industrial, and agricultural developments. These issues may be considered by the Shire's internal Development Control Unit (DCU). The inclusion of mosquito risk in planning instruments allows local authorities to highlight problems of mosquitoes in the local area and provide guidelines for new developments to minimise exposure to mosquito risk and reduce any onsite mosquito production that may result from water sensitive urban design or constructed wetlands.
- Specific attention should apply to those developments within the predetermined mosquito risk zones. Consideration should be given to the overall site plan of the proposed development including buffer zones where appropriate, building design (i.e., screened openings), provision of screened outdoor recreation areas, vegetation plantings, stormwater structures (i.e.,

bioretention swales, wetlands, gross pollutant traps (GPT)) and constructed wetlands.

- For new commercial, industrial, and residential development applications that incorporate constructed wetlands into their design, a specific environmental levee that will provide ongoing funding for wetland maintenance (i.e., vegetation management, sedimentation management, GPT clearance etc) without additional financial burden on Shire resources.
- For new mining developments (including onsite housing), exposure of staff to local mosquito and mosquito-borne disease risks in addition to the potential for such developments to enhance local habitats for mosquito production. Those companies developing such sites should establish communication with council, in addition to state health authorities, to discuss mosquito risk and mitigation of these risks.

14 Procedure Manual

A Procedure Manual for the practical aspects of mosquito management is in development separate to the MMP to guide staff on the required processes for mosquito management. It will include the following information:

- Peak mosquito breeding times.

  While there is an annual risk of nuisance-biting mosquitoes and a potential for mosquito-borne disease (particularly Ross River virus), health risks are greatest following tropical cyclones or other major climatic events that bring substantial rainfall.

- Mosquito Surveillance Framework.

  A surveillance framework to support decision making on local mosquito control based on:

  - Sentinel Chicken program
  - Trapping program in Tom Price, Paraburdoo and Onslow based on at least two trap sites in each location mo0nitored fortnightly between November and April.

    The frequency of larval and adult mosquito sampling should remain flexible enough to respond to unusual climatic events (e.g., exceptional rainfall or tidal inundation of local estuarine wetlands).

    After a 1-2 years of an initial monitoring program, the data can be reviewed to assess whether the geographic distribution of trap sites and frequency of mosquito collections can, or should, be modified.
  - Community monitoring
  - Hot Spot Mapping

    Develop in each township, a risk map for actual and potential mosquito habitats that can be incorporated into council's GIS system. Known sources of mosquito breeding should be identified and a database established that records the frequency of inspection, mosquito species detected, mosquito control agents applied, habitat modification and other noteworthy information that may assist in managing local mosquito production.
  - DoH information
  - Annual reporting

- Chemical management.

  While mosquito control agents targeting immature populations (i.e., *Bti* and s-methoprene) are suitable for use in habitats around the Shire, the use of adulticides (e.g., bioresmethrin) will play a useful role in mosquito control, particularly during periods of peak mosquito activity post substantial rainfall/cyclones and tidal flooding of estuarine wetlands. Given the relatively small communities within the local townships, the use of adulticides may be

a cost-effective alternative to aerial application of larvicides to estuarine wetlands and/or flooded areas around townships.

- Community Engagement.
- Annual Reporting

- Research

  Participate in research into novel and emerging technologies for mosquito and mosquito-borne disease surveillance.

- Professional development

  Undertake professional development in mosquito control through staff attending mosquito management workshops and conferences, arranging visits to other council's undertaking mosquito surveillance and control, and inviting DoH representatives to give presentations/workshops onsite.

Appendix 1 Mosquito control agents

Under the *Pesticides Act 1999*, it is illegal to use a pesticide unless it is registered by the Australian Pesticides and Veterinary Medicines Authority (APVMA) for agricultural and veterinary chemicals or covered by permit issued under the *Commonwealth Agricultural and Veterinary Chemical Code Act 1994*. It is critical that any product used for controlling mosquito populations is used according to the guidelines provided.

Products currently registered for use in Australia for mosquito control include:

- Adulticides. Generally permethrin or synthetic pyrethroid based products (e.g. D-Phenothrin), although organophosphate-based products (e.g. maldison) have also been used, are typically applied as either a "fog" or "mist" via a range of application equipment (e.g. compression sprayers, backpack or vehicle mounted applicators, thermal foggers, ultra-low volume (ULV) generators) delivering very small droplet sizes to kill flying or resting mosquitoes or are applied to the sides of buildings or surround vegetation to form a barrier. These provide rapid knockdown of adult mosquitoes both in flight and taking refuge around built structures and vegetation. They can be relatively expensive, and their effectiveness is dependent on favourable weather and appropriate application equipment (and training of operators on use and maintenance). Multiple treatments are often required, and potential non-target impacts are a concern.
- *Bacillus thuringiensis israelensis* (*Bti*). The naturally occurring soil bacterium produces a protein crystal which contains several microscopic toxins that when ingested can destroy the gut wall and killing mosquito larvae. This is one of the most used larvicides in Australian estuarine and freshwater habitats, no direct or indirect non-target impacts nor resistance in local mosquito populations have been reported. Some drawbacks include no residual control (the product does not remain active in the mosquito habitats for more than 48h) and in heavily polluted environments or those containing a high organic content, efficacy of this product is reduced.
- *Bacillus sphaericus* (*Bs*). Another naturally occurring bacterium with a similar mode of action to *Bti*. However, this product has the potential to replicate in the environment and provide residual mosquito control under suitable conditions. Best suited to highly organic freshwater habitats, particularly polluted urban waterways.
- Methoprene. The insect growth regulator, *s*-methoprene is a synthetic mimic of the juvenile hormone produced by insect endocrine systems and, when absorbed by the larvae, development is interrupted and immature stages fail to successfully develop to adults, usually dying in the pupal stage. This product is commonly used in Australia, particularly in highly organic rich environments (e.g., waste-water treatment ponds, drains, septic tanks) where *B.t.i.* may not be as effective. There is a range of commercial formulations (including liquid, granule, pellet, and briquette) of this product available that provides flexibility in habitat-specific use and, importantly, some formulations provide residual control of mosquitoes for up to three months, making it

useful for providing sustained control following flooding in addition to the potential for “pre-season” treatment of critical mosquito habitats.

- Monomolecular film. A thin film of alcohol or silicone-based product is spread over the water surface and prevents immature mosquitoes emerging as adults. Monomolecular films have only recently been registered for use in Australia and, due to unresolved concerns regarding possible non-target impacts (i.e., macroinvertebrates that use the air-water interface) this product is only registered for use in water holding containers.
- Temephos (GrayBate 10SG) for mosquito and midge

Appendix 2 Advantages - Disadvantages of control strategies

Option	Advantages	Disadvantages
Adulticides (thermal fogging/ULV)	▪ Rapid, flexible, and relatively cost-effective strategy via truck mounted or backpack application ▪ Large areas can be covered by vehicle mounted generators ▪ Useful strategy in emergency response to disease epidemics ▪ Useful for exotic mosquito incursion response	▪ Potentially highly visual activity that may not be considered appropriate by community ▪ Some products have unpleasant smell ▪ Difficult to achieve effective long-term control ▪ Treatments may need to be repeated daily ▪ Effectiveness highly dependent on environmental/climatic conditions ▪ Potentially significant direct non-target impacts
Adulticides (residual insecticides)	▪ Potentially long periods of mosquito control in some situations (e.g., domestic settings) ▪ Useful in emergency response to disease epidemics ▪ Useful for exotic mosquito incursion response	▪ Potentially significant direct non-target impacts ▪ Generally, not appropriate close to aquatic ecosystems ▪ Time consuming over large areas ▪ Potential development of insecticide resistance
Larval control (s-methoprene)	▪ Proven effective for mosquito control ▪ Minimal direct non-target impacts ▪ Sustained release formulations provide residual efficacy (i.e., reapplication frequency reduced) ▪ Larvae are retained in ecosystem for longer periods to provide food mosquito predators	▪ Time consuming to apply sustained release formulations (i.e., briquettes must be tethered to stakes to prevent 'encapsulation' by sediments) ▪ No opportunity for reapplication if treatment fails ▪ Relatively expensive

Option	Advantages	Disadvantages
Habitat modification (wetlands)	▪ Potential long-term solution without reliance on routine application of control agents ▪ May assist the rehabilitation of degraded wetlands (e.g., restore tidal flushing)	▪ May not significantly reduce mosquito populations over large wetland areas ▪ May adversely impact local wetland/environment if planning not suitably assessed ▪ May require regular maintenance to remain effective
Habitat modification (stormwater)	▪ Routine removal of sediment and vegetation may improve functioning of stormwater systems	▪ Routine maintenance is required ▪ Major works may be expensive
Larval control (*Bti*)	▪ Proven effective for mosquito control in estuarine and freshwater habitats ▪ Relatively cost effective ▪ Minimal direct non-target impacts ▪ Simple to assess treatment success and reapplication possible if treatment fails	▪ Reapplication regularly required; no residual control provided ▪ Requires accurate mapping of larval mosquito habitats and monitoring larval populations ▪ Reduced efficacy in heavily polluted habitats or those containing high levels of organic material
Larval control (*Bs*)	▪ Proven effective for mosquito control ▪ Provides sustained control in some situations ▪ Well suited to polluted habitats	▪ Requires good surveillance as established larval mosquito populations must be present prior to treatment to maintain sustained control
Larval control (Monomolecular film)	▪ Highly effective against pupae ▪ Sustained control in water holding containers	▪ Not to be used in natural water bodies ▪ Potential non-target impacts of water surface dwelling insects
Larval control (s-methoprene)	▪ Proven effective for mosquito control ▪ Minimal direct non-target impacts ▪ Sustained release formulations provide	▪ Time consuming to apply sustained release formulations (i.e., briquettes must be tethered to stakes to prevent 'encapsulation' by sediments)

	residual efficacy (i.e., reapplication frequency reduced) ▪ Larvae are retained in ecosystem for longer periods to provide food mosquito predators	▪ No opportunity for reapplication if treatment fails ▪ Relatively expensive
Option	Advantages	Disadvantages
Habitat modification (wetlands)	▪ Potential long-term solution without reliance on routine application of control agents ▪ May assist the rehabilitation of degraded wetlands (e.g., restore tidal flushing)	▪ May not significantly reduce mosquito populations over large wetland areas ▪ May adversely impact local wetland/environment if planning not suitably assessed ▪ May require regular maintenance to remain effective
Habitat modification (stormwater)	▪ Routine removal of sediment and vegetation may improve functioning of stormwater systems	▪ Routine maintenance is required ▪ Major works may be expensive
Personal protection strategies (repellents, source reduction, education)	▪ Change to human behaviour and insect repellent use acts is first line of defence against mosquitoes ▪ Increases awareness of mosquitoes and mosquito-borne disease in local area ▪ May assist reduction of populations of pest mosquitoes associated with backyard habitats ▪ May reduce the need for undertaking other management options	▪ Difficult to assess success of strategy ▪ Requires continuing awareness program ▪ Accurate information is required to avoid uptake of ineffective personal protection strategies (e.g., blue light insect traps, sonic buzzer repellents)

Appendix 3 Onslow Mosquito Management Sub-plan

The Shire is divided into two main areas with one being the Inland area comprising Tom Price and Paraburdoo and the Coastal area comprising Onslow. The following is a sub-plan for mosquito management in Onslow.

Onslow is mostly surrounded by salt marsh environments where the mosquito *Aedes vigilax* breeds prolifically. *Aedes vigilax* are aggressive biters and are known vectors of the mosquito borne, Barmah Forrest and Ross River viruses. The mosquito can travel up to 70 kilometres. Murray Valley Encephalitis and Kunjin viruses are from time to time present in the Onslow mosquito population.

A dredging operation that deposited sand and water residue to an area off McAully road near the Airport has created a wet land between the sand bank created by the dredging and the roadside. This wetland has created an ideal habitat for the breeding of mosquito larva. The site has been periodically drained but frequently refills after rainfall.

The determination of the prevalence of mosquito around Onslow requires Monitoring of larvae, this is achieved by the dipping of all known breeding locations in waterways in the township zone and the water area at the dredge spoil deposit area. Detection of lava in the water bodies will require the application of larvicide as required.

Given the large areas of salt marsh within 10km of Onslow, mosquitos and midge will always be present. Mosquito numbers may be controlled through the implementation of mosquito control strategies documented in the Shires Mosquito Management Plan (MMP).

Community mosquito complaints have highlighted the need to adjust the Onslow ULV misting program to include more regular ULV misting to provide assurance to the community that our mosquito control program is being implemented.

PURPOSE

To reduce the numbers of biting mosquitos within the immediate confines of town to provide relief to the community from mosquito nuisance.

IMPLEMENTATION

Mosquito Fogging/misting in Onslow will be carried out on a more regular basis to:

1. Reduce adult mosquito numbers in town during peak breeding times
2. Provide a visual indicator to the community that the Shire's mosquito management plan is being implemented

RESPONSIBLE PERSONS

The Environmental Health Officer (EHO) has

- Overall responsibility for ULV misting and thermal fogging.

- Responsible for training and managing other staff who assist

TRIGGERS

The triggers to initiate a mosquito control response in Onslow, include but are not limited to:

1. Community complaints of mosquito activity are received that indicate an increase in mosquito activity.
2. Fifty (450) or more mosquitos trapped in a 24-hour period
3. Significant rainfall (>25mmin a 24-hour period) is received within 10km of Onslow

The EHO will

a. Investigate mosquito complaints to understand scale of the issue
b. Determine the strategy and resources required to manage the issue
c. Facilitate the mosquito control strategy
d. Ensure larvicides are deployed at appropriate locations and time
e. Commence ULV misting/thermal fogging as required if required
f. Monitor mosquito trapping sites

WEATHER CONDITIONS

Weather conditions are an important factor for successful misting operations. Strong wind reduces the mosquito knockdown effectiveness. Light wind (under 10km/hr) is acceptable for ULV misting.

During the aftermath of significant rain – the mosquito breeding areas in and around Onslow town increases significantly and so the numbers of biting mosquitos increase.

CHEMICAL MANAGEMENT

The regular application of mosquito larvicide is a key mosquito control strategy for the shire. Routine larviciding of water retention basins, drains, sumps etc. has a big impact on the reduction of mosquito populations.

Appendix 4 Communication Strategy

Goal	Objectives	Key actions	Target audience	Control measures	Resourcing / timeframes
Manage mosquito disease related education and media issues	Conduct basic community education campaign	1. Once a year conduct a mail drop of the 'Fight the Bight' (FTB) home brochure to the residents of each town. 2. Promote the FTB education campaign at events during peak risk biting times. 3. Deliver FTB message through knowledge of the sentinel chicken surveillance programs and through mosquito life cycle education/trapping programs to schools in the Shire.	All residents within Shire Event participants Schools	Manager Regulatory Services to approve	November
	Respond to positive sero-conversions of the sentinel chicken surveillance program by preparation of relevant media releases for distribution	1. DoH prepares media release for the public 2. Shire prepares a media release based on DoH brief, and distributes, once approved to: • Pilbara ABC regional news • Shire CEO, Councillors, Executive Leadership Team (ELT) &	All residents within Shire relevant networks	Shire CEO and Media only to approve media release	As required

Commented [PK4]: What are the acronyms used here in Red?

		Middle Management Group (MMG) • Shire web & Facebook page • Community notice boards • Shire Intranet • Emergency service networks • Other non-government health and wellbeing organisations as required			
	Respond to notified human cases of mosquito borne disease through preparation of relevant media releases for distribution	1. DoH prepares media release for the public 2. Shire prepares a media release based on DoH brief, and distributes, once approved to: • Pilbara ABC regional news • Shire CEO, Councillors, Executive Leadership Team (ELT) & Middle Management Group (MMG) • Shire web & Facebook page • Community notice boards • Shire Intranet • Emergency service networks	All residents within Shire relevant networks	Shire CEO and Media only to approve media release	As required

Commented [PK5]: What are the acronyms used here in Red?

		Other non-government health and wellbeing organisations as required			
	Respond to quarterly mosquito surveillance data reports	Distribute to: • Environmental Health Officer • Approved stakeholders • CEO, ELT, MMG and Councillors as required and Councillor email network	Non-public Only	Manager Regulatory Services	As required

Appendix 5 Community Notice - Media Release Examples

Appendix 6 Annual Activity Program (Section 9: Mosquito Management Strategies).

Strategy	Objectives	Key actions	Stakeholders	Reporting
Mosquito and mosquito-borne pathogen surveillance	Provision of reliable information on mosquito abundance and diversity	Engage in mosquito trapping program in Onslow, Tom Price & Paraburdoo Record activity using the App for the Atlas of Environmental Health	Shire - Environmental Health Officer (EHO) & Environmental Health Support Officer (EHSO) Rangers	Number of times fogging is carried out due to increase of mosquito populations
	Quantitative measurements of mosquito activity to determine actual and potential pest impacts, and their associations with prevailing environmental conditions			
	Record number of nuisance biting complaints to the Shire	Respond to CARs related to mosquito complaints. Create duplicate record in Atlas of Environmental Health	Shire - EHO and EHSO	Respond to complaints as required
	Use of sentinel chicken flocks to routinely assess activity of mosquito-borne flaviviruses	Conduct fortnightly bleed of all chicken flocks and maintain chicken infrastructure	Shire - EHO & EHSO DoH	Chicken coups maintained by Shire in partnership with DoH as per Poultry WA Code of Practice (COP)
	The elevation of MVE and	Disseminate quarterly report	DoH Entomology	Ongoing data monitoring

Commented [NJ6]: This app will provide specific details on mosquito composition in the area

	mosquito-borne flaviviruses surveillance to be informed by both environmental and climactic factors in addition to results of surveillance conducted in the Kimberley region	of case surveillance data Quarterly report of monitoring data Conduct case follow up when required Work with DOH	Section and Population Health unit (PHU)	Reports distributed quarterly Support PHU with response to disease clusters and individual case notifications
Strategy	Objectives	Key actions	Stakeholders	Reporting
Mosquito and mosquito-borne pathogen surveillance	Support monitoring methods for pathogens in the environment	Support DoH Implement monitoring programs	DoH Shire - EHO & EHSO	Maintenance and service records held
Mosquito control	Respond to major climactic events e.g., cyclones	Respond to cyclone & flood events: Activation of Shire Local Emergency Management plans Review plans annually	Shire	Response provided Relevant plans reviewed
	Develop a larviciding program for outside of town boundaries	Develop operational plan for each town using the App for the Atlas of Environmental Health Utilise	Shire - EHO & EHSO	Plans developed and implemented Inspect drains one week after heavy rain event
	Control mosquito habitats within town sites	Map breeding locations using the App for the Atlas of Environmental Health	Shire - EHO & EHSO Infrastructure Services	Plans developed and budget allocated

		Collaborate with infrastructure to develop identified high risk habitat modification plan Promote capital expenditure works program to remove mosquito habitats		
	Maintain a database of key habitats	Utilise DoH mosquito monitoring app.	DoH Shire - EHO & EHSO	Records of key habitats filed

Strategy	Objectives	Key actions	Stakeholders	Reporting
Mosquito control	Effective mosquito control using an integrated approach	Review fogging information to the public to ensure it is relevant for each town	DoH Shire - EHO & EHSO	Information reviewed Information recorded
	Ensure that all mosquito control equipment is operational	Maintain equipment according to manufacturer instructions. Conduct quarterly stocktake of consumables	Shire - EHO & EHSO	Equipment maintenance and servicing records held Stock takes carried out
	Undertake assessments of target mosquito population change resulting from mosquito control	Conduct adult mosquito fogging of all towns as required.	Shire - EHO & EHSO	Records of fogging activities maintained
	Annually conduct a review of the previous season's mosquito control activity and predictions of the forthcoming seasonal outlook	Update this plan annually	Shire - EHO & EHSO	Plan updated
Community Awareness	Facilitate community awareness and education on nuisance-biting and public health risks associated with mosquitoes and the use of personal protection measures and source reduction.	Utilise DoH FTB Campaign Participate in public events Review Shire website annually	DoH Shire - EHO & EHSO Shire Media	Resources provided to public Promotional activities undertaken

Strategy	Objectives	Key actions	Stakeholders	Reporting
Community Awareness	Media campaign	Action media plan as required	Shire - Media	Media plan implemented
	Complaints	Respond to mosquito related complaints	Shire - EHO & EHSO	Record of complaints responded to Report distributed
Urban Planning	Consider the mosquito risk and potential health impacts when assessing residential, industrial, and agricultural developments	EHO to provide comments on relevant development application (DA)	Shire - EHO & EHSO Shire Planning	Number of DAs commented on
Staff training	Staff in charge of the mosquito management program are to be trained in mosquito management, chemical handling, and fogging machine operation.	Staff to have completed: 1. Annual DoH mosquito control training course 2.Basic chemical handling course 3. Completed internal training on machine use	Shire - EHO & EHSO	Planning and budgeting considerations done Records of training attended
Annual review and report	Maintain records that inform the annual review and maintenance of the MMP and reporting to ensure the retention of knowledge within the organisation.	1. Maintain records electronically 2. Review the mosquito management program 3. Review MMP 4. Annual report	Shire - EHO & EHSO	1. Records maintained 2. Report on annual mosquito management program 3. Review MMP

Note:

The activities undertaken within this MMP is subject to the availability of:

- Funding both internal and external to the Shire
- Resources including chemicals and promotional material availability
- Qualified staff to implement the activities of the MMP