Acknowledgements

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The authors also acknowledge the Department of Environment Regulation, Swan River Trust, Department of Health, the mosquito management working group and Mosquito Consulting Services Pty Ltd with the development of the City of South Perth Mosquito Management Plan.

This document was written by officers of the City of South Perth.
**Executive Summary**

This 2017-18 Mosquito Management Plan (MMP) is an update from the original Plan adopted in August 2010. The Plan itself is reviewed every year and updated by the City of South Perth (CoSP) following consultation with stakeholders and using the experience and data collected by the City each year.

The Goals, Aims and Objectives of the Plan have not changed since 2010. The actions and methods have been adjusted in the light of experience gained.

For the 2017-18 mosquito season the Plan proposes the following actions for the control and treatment of mosquito numbers:

1. Aerial treatment with larvicides as soon as larval densities increase;
2. Blower backpack spraying of larvicides covering those areas where aerial treatments have not covered;
3. Barrier treatments with adulticides in public spaces adjacent to residences
4. Fogging with adulticides if excessive numbers of mosquitoes are determined.

The Plan provides for the continued research and learning opportunities for staff integral to this exercise and to educate and effectively communicate with residents and for the assessment on the effectiveness of the Plan against set Key Performance Indicators (KPIs).

Table 1: Action Table for the 2017/18 Mosquito Management Program summarises the principal components of the Plan.

As part of the continuous improvement cycle it is envisaged that at some future date the plan will be subjected to an agreed business review process.
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Introduction

1. The Purpose of this Plan

The City of South Perth (CoSP), Mosquito Management Plan serves as a guiding Operational Program that was initially documented in its current form in August 2010. It is updated annually in order to:

- Give guidance to the City on the control and management of seasonal mosquitoes;
- Create an expectation with residents, particularly within the vicinity of the wetlands along the Canning River, that the City will be taking steps to ensure a reasonable outdoor amenity during the mosquito season; and
- To work with State agencies, particularly the Department Biodiversity, Conservation & Attractions, Swan River Trust, and the Department of Health with regards to the management of mosquitoes within a fragile environment close to residential developments.

As a living document, it is intended that the plan will be subjected to a number of quality initiatives as an annual cycle of continuous improvement. At present the Plan is updated following consultation with a variety of affected stakeholders and using data and experiences gained since 2010. While the present focus of the Plan is to satisfy customer (residents’) needs for mosquito minimization, it is hoped that in future the plan will be subjected to an agreed business review process.

1.1. The Geographical Area affected by this Plan

The City of South Perth, the ‘Peninsular City’, occupies an area of land bordered on three sides by river water. To the north is the Swan River with the wide ‘Perth Water’. The City of Perth lies across the River, with the Narrows Bridge as the link between the two sides, carrying the Kwinana Freeway south.

The Southern boundary of the City, borders the Canning River. Along this boundary is the location of the City’s mosquito breeding grounds. This area comprises of a tidal flood plain along the Salter Point, Waterford and Cygnia Cove foreshore that also incorporates part of Bodkin Park.

This management plan applies to the areas from Salter Point in the West through to the Eastern boundary of Cygnia Cove. The residents of Waterford, (based on the Mosquito Complaint Register and adult mosquito trapping data) predominantly are the most affected by mosquitoes numbers within the City and are therefore the primary target audience for this Mosquito Management Plan.

The Mosquito Breeding sites are shown on Page 11.
Waterford is an established residential area. Waterford is bounded by Manning Road, Conlon Street and McKay Street in the north, Centenary Avenue in the east, the Canning River in the south, and Elderfield Road in the west.

Waterford including Cygnia Cove is a pristine environmental area, surrounded by more than 14 hectares of saltmarsh, mosquito breeding area. Mosquitoes naturally breed on the saltmarsh vegetation, when the weather and tidal conditions are optimum. Summer conditions including humidity, warmth, low rainfall and tidal movements, create a favourable breeding environment on this wetland. There are also areas within the wetland i.e. Sandon Park that are susceptible to breeding freshwater species as well.

1.3. Scope and Limitations of the Plan

The plan has been prepared by the Officers of the CoSP using information available from:

- State and Commonwealth agencies (e.g. Department of Health, CSIRO, Bureau of Meteorology etc.)
- Mosquito Consulting Services Pty Ltd
- Community representatives of the CoSP
- Data accumulated by the CoSP since 2010

This plan has the following limitations in that it does not purport to explain the migration patterns of adult mosquitoes within the affected areas, the most effective way to respond to spikes in mosquito activity, and the breeding sites within the inaccessible wetlands area.

1.4. Why the need for a Plan

Prior to 2009 a Mosquito Management Program had been developed and written by the Environmental Health Officer (EHO) of the CoSP. The two and half page document covered the Aims, Control, Monitoring and the application of treatments. However there was no evidence that the document had been developed through a consultative process. The 2009/10 mosquito season was one of the worst seasons that residents could remember as far as mosquitoes were concerned. The number of complaints from residents, along with bad media exposure on the issue culminated in a public meeting in which residents expressed their frustrations at what was seen as the CoSP not doing enough to address the problem. The outcome of this meeting was the establishment of a Waterford in Action Group to liaise informally with the CoSP Officers in addressing the issue. This resulted in:

- Raising the matter at a formal Council level where resources were directed to addressing the issue
- The development of the first comprehensive Plan for the management of Mosquitoes within the CoSP
The engagement of an External Consultant to advise the CoSP on the robustness of the Plan and to provide advice on whether there was other matters not covered that needed examination.

Following the change in attention, the City adopted a number of recommendations of the External Consultant on mosquito management.

CSIRO studies predict that South Western Australia will have on average higher temperatures and less than average rainfall. This together with global warming effects on sea levels could mean the mosquito vector will be a continuing challenge for local authorities such as the CoSP. In addition cyclic weather systems referred to as ‘El Nino’ and ‘La Nina’ play a major role in determining how severe a mosquito season will be. A ‘La Nina’ episode brings about extremely high tides, higher minimum temperatures and typically establishes conditions that most suit mosquito breeding. La Nina conditions are associated with significant mosquito nuisance and mosquito borne disease outbreaks. The 2011 and 2012 seasons were particularly severe and were influenced by the La Nina episode.

The long-term trend suggests that the mosquito management will continue to be an issue for the CoSP and for other local authorities with similar proximity to wetlands. Therefore, as an evolving document, this Plan does not claim to entirely solve the problems of discomfort and nuisance that residents of Waterford and visitors to the area may face from time to time. Nonetheless the Plan aims to learn from practice and through a continuous cycle of improvement the CoSP is committed to reducing the mosquito nuisance to residents. Also at present there are still a number of unknown factors influencing the breeding rates and the spread of mosquitoes. As a learning document the Plan documents the data and experiences from previous seasons. It is for all these reasons that there continues to be a need for a Plan.

Mosquito management is a complex and often difficult process. The outcomes of mosquito management can be impacted by many variables. Australia wide, mosquito management continues to develop and become more effective however;

“times will still exist when mosquito numbers will exceed desirable levels due to environmental factors and mosquito nuisance will result”.

Therefore this Plan does not claim to entirely solve the problems of discomfort and nuisance that residents of Waterford and visitors to the area may face from time to time. Nonetheless the Plan aims to learn from practice and through a continuous cycle of improvement the CoSP is committed to reducing the mosquito nuisance to residents. This Plan takes its cue from the City's slogan “Working together to create a City for everyone”. Through community consultation it has adopted the following Vision “We belong to an engaged community that is linked by vibrant local centres and shared spaces. We live and travel in ways that nurture our environment; and our housing and amenities meet the diverse needs of a changing society”. In developing this Plan certain principles have been adopted. These call for

- Accountability – accountable to all its ratepayers and stakeholders
- Transparency – the processes used are open to scrutiny
- Involvement – of the residents most affected by this Plan and all other stakeholders
- Professional input – based on outside expertise, literature and best practice

Within the City of South Perth, mosquito management is necessary for three reasons.

- Some species of mosquitoes are transmitters or vectors of disease such as Ross River virus (RRV) disease and Barmah Forest virus (BFV) disease. It is important to note that the incidence of both of these viruses within the City is not high enough to be of a public health concern, and therefore the issues experienced within the City are of a nuisance nature at this point in time.
- Some Mosquito species are aggressive biters, causing discomfort and pain to affected residents, and can impact significantly on lifestyle.
- Residents report effects arising from mosquitoes, including allergic reaction, lack of amenity of parklands and environment that result in reduced outdoor activities.

The operations to monitor and control mosquitoes are a seasonal activity from August to April. However the staffs who are involved in the preparation of the operation undertake activities throughout the year in the planning, liaising, communicating and advancing their knowledge of the latest techniques and research in this area.

2. Statutory & Strategic Implications

2.1 Statutory Management

Department of Health:

*Health (Miscellaneous Provisions) Act 1911*

Department of Water & Environmental Regulation:

*Environmental Protection Act 1986*

Swan River Trust:

*Swan and Canning Rivers Management Act 2006; and*

*Swan and Canning Rivers (Consequential and Transitional Provisions) Act 2006*

City of South Perth:

*Health Act 1911 - City of South Perth - Health Local Laws 2002*
2.2 Strategic Implications

In accordance with the City of South Perth, Strategic Plan 2015 - 2025, “Working together to create a City for Everyone”, this Mosquito Management Plan meets or partially addresses the strategic directions of;

1. Community - Create opportunities for a safe, active and connected community;
2. Environment – Nurture and develop natural spaces and reduce impacts on the environment; and,
3. Places - Plan and develop safe, vibrant and amenable places.

2.3 Mosquito Management Plan: Goal, Aims, and Objectives

Goal: to reduce the numbers of nuisance and disease vector species to a level where the impact on the adjacent human populations is kept to an acceptable level.

Aims:

1. To meet the requirements of Section VII of the Health (Miscellaneous Provisions) Act 1911 with respect to nuisances
2. To meet the requirements of the residents and visitors adjacent to wetlands to have a reasonable quality of outdoor life
3. To protect the environment (natural habitat), whilst prioritising mosquito management.

Objectives:

1. To monitor and treat larval and adult mosquito activity within the CoSP
2. To research and apply other more effective methods for monitoring and treatment of mosquito prone areas
3. To conduct an educational/communication program within the CoSP to manage mosquito infestations
4. To review the effectiveness of this plan and embed a cycle of improvement in the operations of the Mosquito Management Plan
2.4 Yearly Revisions to this Plan – Principal Developments and Lessons Learnt

Since 2012 this Plan has been updated every year following consultation with various stakeholders. In particular the Plan has been updated:

- To include the specific suggestions made by Mosquito Consulting Services Pty Ltd (the Consultant) in their Report (December 2011);
- By using statistical data on trappings and resident complaints; and
- From anecdotal feedback from residents and gathered by the Waterford in Action Group

The general view of the community is that since the 2012/13 season the mosquito problem has abated. Whether this is due to a different set of weather conditions, to the effectiveness of aerial treatments at larval stages or better application of fogging is unknown at this stage.

There was anecdotal evidence that in the 2013/14 season different areas across the Waterford Foreshore experienced different levels of mosquito activity. For instance when the Elderfield Road residents experienced increased activity, the areas around Bodkin and Doneraile Parks appeared relatively free and vice versa. The localized breeding areas and the dispersal of mosquitoes from breeding sites need to be better understood.

The City will also use residual insecticide barrier treatments in suitable public open spaces under the conditions set in the plan. Like fogging barrier treatments use adulticides that kill mosquitoes and other non-target species. However, one advantage of barrier treatments is that the adulticides can be applied to very localized areas while minimizing the effect on pollinating insects. Fogging though mentioned in the Plan will only be used if there are an excessive number of adults found in traps. These changes and priorities are consistent with the recommendations of the Consultant.
Mosquito Breeding Sites

Waterford Foreshore

Salt marsh - tidal flood plain (Mosquito Breeding Ground Map - Waterford)
Size - Approximately 18 Hectares.

Clontarf (Cygnia Cove) Foreshore

Salt marsh - tidal flood plain (Mosquito Breeding Ground Map - Cygnia Cove - adjacent to Clontarf)
Subjected to the CYGNIA COVE ESTATE, WATERFORD - MOSQUITO AND MIDGE MANAGEMENT PLAN.  
Size - Approximately 1.10 Hectares
Mosquito Management

Mosquito Management Program

In order to be effective, this mosquito management program uses an integrated approach, combining different methods of control and treatments to reduce and control the mosquito numbers and therefore reducing the nuisance and the risk of mosquito-borne disease.

**Mosquito monitoring** - determining mosquito numbers and the location of breeding sites.

- **Larval survey**

The sites (tidal wetland, storm water drains and constructed wetlands in Bodkin and Doneraile Parks) will be monitored each month during the mosquito season (August through April) to ascertain the larval activity. The survey involves taking a water sample with a larval dipper to gather information on both the number of larvae per m$^2$, and also what stage the larvae have reached in their life cycle. Water depth and temperature also have a bearing on the frequency of the surveys. Both of these factors influence the numbers of larvae and potentially the number of mosquitoes and how quickly they breed. The findings of these surveys will determine if there is a need for the application of larvicides to minimise mosquito larvae numbers.

- **Adult trapping**

Adult mosquito traps are used to monitor the numbers and types (species) of adult mosquitoes found in certain areas. Traps utilising dry ice (frozen Carbon Dioxide) and light will be used at multiple locations including residences, to trap adult mosquitoes. Trapping is a good indicator for monitoring the increase in mosquito populations. The mosquitoes caught in the traps are counted and identified. The traps are set at least fortnightly during the mosquito season, August to April and monthly, in the off season. The adult traps are used to identify if the species are typically fresh or salt water breeders, allowing officers to direct their attention to the relevant breeding sites. Seasonal trapping results can be viewed on the City's website at; [https://southperth.wa.gov.au/residents/services/mosquitoes](https://southperth.wa.gov.au/residents/services/mosquitoes)

In addition, there is the potential for backyard mosquito breeding to impact on neighbouring residents. The determination of the mosquito species will allow for controls to be directed to where they are needed.

During the 2012/2013 season, the Department of Health undertook a research project to try and understand further the impacts that mosquitoes can have based on distances from a breeding site. This project was based around two main breeding sites: 1 – within the City of Canning and 2 – within the City of Perth (Herrison Island). Mosquitoes were trapped at each site. These mosquitoes were then dyed either red or blue depending from which site they were trapped. These dyed mosquitoes were then released into the environment to study how they travelled from the respective site. Traps were set on a 1km$^2$ grid away from each site, according to the typical wind direction. The City of South Perth assisted the Department of Health with the collection and setting of traps. The aim is to recapture any dyed mosquitoes and understand the distance and direction of travel.
The outcome:

The main implication for mosquito management is that saltmarsh mosquitoes are not the only type of mosquito of significance in the study area. The great number of freshwater and container-breeding mosquito species indicates that local governments and other mosquito managers should broaden surveillance measures and management methods to include the type of habitats occupied by Ae. notoscriptus, Cx. annulirostris and Cx. Quinquefasciatus (Refer to Appendix 4 for further information).

- Land Use

Ideally, residential developments should be located well away from mosquito breeding sites to minimise contact and impacts with mosquitoes and residents. However, in practice different public agencies are involved in residential land use approval which may mean these ideal criteria are not met. The long term effects of such decisions are borne by the local councils who need to address the ensuing problems.

Where development occurs within mosquito dispersal distance from breeding sites, residents are essentially living in a wetland environment and this has the obvious attractions of wetland views, proximity to birdlife and attractive foreshore recreation however, on occasions nuisance insects including mosquitoes will be a disadvantage. The objective is to understand that mosquitoes have an important place within this environment and to maintain an ecological balance.

Ecological Value of Mosquitoes in the Ecosystem

(City Environment Department Comments)

Mosquitoes play an important role in the ecosystem of any wetland. They are a part of the food chain in adult and larval form. They are an important part of aquatic and terrestrial food webs. They serve nutritious prey for a variety of aquatic and terrestrial invertebrates as well as fish, amphibians, turtles, wader birds, waterfowl and bats. They are a food source for bats, turtles, fish, frogs, wader birds and many other predatory animals including dragon flies and spiders. The removal of mosquitoes on any large scale can affect the balance in the ecosystem and may cause predators to starve. Mosquito larvae are not only an important part of the food chain they also have the ability to assist in the recycling of excess nutrient. The nutrients are often present in wetlands caused by human and natural sources. They are effective filter feeders and have the ability to clean polluted waterways in urban areas. Mosquitoes are just one part of the ecosystem needed to maintain a high biodiversity in any wetland.

The City of South Perth is currently implementing various restoration projects that aim to increase the City's biodiversity, with care taken to protect the fragile ecosystem within our wetlands and improve water quality of the City’s waterways. Healthy wetlands sustain natural enemies of mosquitoes. This helps reduce mosquito population by increasing their predatory invertebrates and native fish. In recent years there has been an effort to increase the number of micro-bats within South Perth. This has included the installation and ongoing annual maintenance of ‘Bat Boxes’. These boxes (27 in total) have been partly funded by the City and have helped to increase the amount of dwellings on offer to the micro-bats. On average each box can hold up to 100 micro-bats. Micro-bats have been known to eat up
to 1,000 adult mosquitoes per night. The main aim of the boxes is to increase the habitat for micro-bats. Increasing the population of micro-bats is an opportunity for the City to engage in a safe and suitable form of biological control for mosquitoes.

Western long-neck turtle as hatchlings have been known to eat mosquito larvae. These turtles feature extensively in the wetlands around South Perth. A turtle habitat enhancement program has been proposed which will protect; and increase the number of turtles living in the wetlands surrounding South Perth. By increasing the number of turtles the City will effectively enhance a form of biological control to combat mosquitoes which naturally occurs in wetlands throughout Western Australia.

Annually, the City undertakes water quality monitoring in the City’s managed waterways and waterbodies to identify water quality issues and to determine the causes of poor water quality. Based on the outcomes of the water quality monitoring program, the City designs and implements projects that treat poor water quality in the City’s waterbodies and enhances habitats for mosquito predators that support biological control regimes.

- **Cultural Control**

Cultural control incorporates education to the public to increase awareness of the mosquito problem and identify some simple measures that can be carried out by the individual householder to reduce adult mosquitoes around the home and eliminate backyard breeding sites. Cultural control includes examining best practice with the West Australian Department of Health and other Local Governments with similar programs and issues. Cultural control may include signage, media and other articles, including actively promoting the personal protection message:

- avoid outdoor exposure to mosquitoes from dusk and the first few hours after dark.
- ensure insect screens are installed.
- use a personal repellent containing diethyl toluamide (DEET) or picaridin. The most effective and long-lasting formulations are lotions or gels. Most natural or organic repellents are not as effective as DEET or picaridin.
- wear loose, light-colored protective clothing when outdoors.
- ensure infants and children are protected against mosquito bites, with suitable clothing or other forms of insect screening.

A residual barrier treatment may also be useful around the home. For residents experiencing a pest nuisance, including excessive mosquitoes around the home, the application of a residual barrier treatment by a qualified commercial pest control operator may assist in reducing insect numbers however; non-target species may also be impacted. A residual barrier treatment can be applied externally to buildings as well as to vegetation that can harbor pests using high velocity air streams from motorised mist blowers. Any pests that land on the treated areas will be killed. A residual barrier treatment can last for 3 to 6 months. The City undertakes residual barrier treatments along pathways and around vegetation, known to harbor adult mosquitoes (see appendix 2).
The City of South Perth will record all telephone and written complaints for any given mosquito season. Email complaints can be lodged via the City’s email address: enquiries@southperth.wa.gov.au

**Mosquito Treatments**

- **Chemical control**

  Chemical control is divided into 3 groups.

  1. Larviciding,
  2. Adulticiding, and
  3. Residual Barrier Treatments.

- **Larvicides**

  Larvicides are products used to kill larvae. Larviciding is promoted as the preferred treatment option due to the current available range of larvicides being target specific and environmentally friendly. Larvicides are also a preferred treatment option as they kill and control mosquitoes before they disperse into the environment and pose a health or nuisance risk by biting.

  The larvicides that will be used during a mosquito season in accordance with this management plan; will be *Bacillus thuringiensis israelensis* (Bti), s-methoprene & silicone based liquids.

  **Bti** is a crystalline endotoxin that, once ingested by the larvae, leads to death. Bti kills mosquito within 24 hours. When required, Bti will be applied at the recommended dosage rates.

  **S-methoprene** is an insect growth regulator. S-methoprene is absorbed by the larvae and prevents the larvae from emerging from the pupal stage. The City will apply this product in accordance with the required application rates throughout the mosquito season. This product is available in several different formulations, including the slow-release pellets and briquettes, which ensure ongoing reliance of the larvicide into inundated wetlands, providing ongoing control.

  **Silicone based liquids** for mosquito control are suitable for use in small localised ponds. They are nontoxic liquids that work by forming a very thin film on the water’s surface that restricts mosquito access and destroys the aquatic stages of the mosquito lifecycle.
Aerial Treatments (Helicopter and Drones)

Given the difficulty of accessing all locations within this wetland area for effective treatments, the City will undertake aerial application of larvicides over this wetland area when the larval densities require treatment. Any areas unable to be treated by air will be treated on the ground.

During the 2017/2018 mosquito season, the City will be undertaking Drone treatment trials in conjunction with HeliWest and the Department of Health to allow for the development of this technology with larvicide applications for mosquito control, potentially providing greater treatment options.

This is an evidence based plan and as such, aerial treatments will be based on the larval densities.

Adulticides

Adulticiding (fogging and residual barrier treatments) refers to the killing of adult mosquitoes. This form of control can be very effective in controlling large numbers of adult mosquitoes. Adulticiding is not target specific and works like a large scale insect spray, killing other insects, including predators and beneficial insect species.

Adulticiding (hand-held fogging) is weather dependant and cannot be applied in windy conditions. The City of South Perth has applied to the Swan River Trust and the Department of Environment & Conservation for clarification and approval to fog across the wetland area. The responses have been received (see Appendix 1) by the City and state the following;

“The Waterford foreshore wetlands are classified.... as a high priority wetland management area. It is noted that both control products are highly toxic to fish and aquatic organisms. .......‘fogging’ should not be implemented in areas with exposed surface water; or where there is a possibility of run-off entering waterways to.”

Fogging will only be applied in appropriate wind conditions and based on advice received from the Department of Environment Regulation with reference to the Environmental Protection (Noise) Regulations 1997 fogging cannot occur prior to 7am (Monday to Saturday) and 9am (Sundays and Public Holidays). Although, species such as Aedes vigilax are highly active throughout the day (all day biters) the impact of fogging through the day has significant effects on non-target species and limited effects on mosquito numbers.

Undertaking fogging can also potentially be a nuisance in relation to noise impacts on residential premises (as the City must comply with the relevant noise legislation) and therefore, every attempt will be made to reduce the noise impact of fogging to residential premises.

For fogging to be effective, the wind speed must be between 5-16 km/hr with the wind direction able to carry the fog to areas of mosquito harbourage. Ideally, no rain should be present and for the best results, a temperature inversion must be present. It is accepted that very rarely, all of these conditions will be met and therefore, City officers will make the decision to fog based on the suitability of the onsite
conditions that are present and the average mosquito numbers most recently trapped (Reference MCS 2011).

The City of South Perth acknowledges that currently and historically, there is a low public health risk due to mosquito breeding from this wetland area.

In accordance with the defined threshold, adulticiding will be undertaken where the mosquito numbers are at nuisance levels*.

- The products that will be used by the City in the event of excessive mosquitoes are approved Pyrethrin based fogging chemicals, typically having the active ingredients Pyrethrins & Piperonyl Butoxide.

The chemicals used are safe to large animals including birds, mammals and humans when used in accordance with the label requirements. The chemicals are toxic to fish and insects but are handled in a way that minimizes the risks to non-targets.

*Excessive mosquito numbers are currently set to a threshold of an average of 50 vector mosquitoes over the 3 set traps. It is noted that complaints are typically received by the City from residents when the number of mosquitoes exceeds an average of 200 vector mosquitoes over the 3 set traps.

The City has licenced pest controllers on standby to undertake fogging on days where City staff are unavailable.

- **Residual Insecticide Barrier treatment**

Residual insecticide can be applied to mosquito harborage vegetation at specific human exposure focal locations. It provides effective localised control of adult mosquitoes dispersing from wider environment into the treated location. Existing street landscape features and park landscape provide opportunity for barrier treatment. It moves the focus away from the salt-marsh/marine habitat into less sensitive locations. It can be applied in highly selective situations (say to avoid flowering vegetation and avoiding non-target pollinating insects). Products registered for this use have been approved by Australian Pesticide and Veterinary Medicines Authority with appropriate directions for use. A residual barrier treatment can last for 3 to 6 months. The City undertakes residual barrier treatments along pathways and around vegetation, known to harbor adult mosquitoes in suitable public open spaces and within close proximity to residences. (See Appendix 2).

**Contiguous Local Authorities Group (CLAG) - Swan & Canning Rivers CLAG**

State Government funding of mosquito control activities is available to adjacent local governments to form a CLAG, with the grouping being based on considerations of geography and management of disease vector mosquitoes.
For areas that cannot demonstrate high mosquito-borne disease notifications but still have a mosquito biting nuisance problem, lesser funding arrangements may be available. The general arrangements are:

- Adjoining Local Governments formally enter a CLAG agreement with each other
- Each must have an approved Mosquito Management Plan
- State Govt provides 50% of larvicide cost (50% by CLAG)
- CLAG provides 100% of other costs (aerial application, surveillance etc. to mosquito disease risk areas).

The City has formed a CLAG agreement. The City of Canning, City of Perth and the City of Melville have entered into this agreement with the City with the City of Subiaco and City of Nedlands becoming members this year. With the introduction of an aerial treatment, chemical usage will increase and CLAG funding will offset up to 50% of the chemical cost. The implementation of this Plan is not dependent upon such funding. The City’s attempt to obtain funding is recognition that the mosquito problem is wider than that limited to its boundaries.

**Review**

After each mosquito season is complete, the City of South Perth Mosquito Management Plan will be reviewed with best practice principles applied to continually improve the program and will measure and report on its performance against the agreed objectives and Key Performance Indicators (KPIs) using this information to review the following season’s plan with best practice principles applied to continually improve the program. Such future reviews will involve consultation with a variety of stakeholders, including the representative group of residents affected.

As a living document, it is intended that the plan will be subjected to a number of quality initiatives as an annual cycle of continuous improvement. It is hoped that in future the plan will be subjected to an agreed business review process.

**Performance**

Two of the three aims will be the primary focus for assessing performance against the plan at the end of the mosquito season (Action Table – Objective 4, numbers 1 and 2). However; a number of additional targets which the City will wish to achieve are also set out in the Action Table.

The City will ensure that the whole process is accountable, transparent and auditable within a cycle of continuous improvement.
## Objectives and Actions

1. To monitor and treat the level of larval and adult mosquito activity within the CoSP.

<table>
<thead>
<tr>
<th>No</th>
<th>Action</th>
<th>Method</th>
<th>Frequency</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Larval Inspection of known breeding sites</td>
<td>City officers. Physical inspections</td>
<td>As required.</td>
<td>See map P13 Waterford Foreshore.</td>
</tr>
<tr>
<td>2</td>
<td>Larval Treatment of larvae</td>
<td>Aerial treatments</td>
<td>Once larval densities justify a treatment.</td>
<td>Treatments applied at the next suitable weather conditions, pending availability of helicopter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(The trigger density has not yet been defined) Follow up treatment not less than 28 Days after a treatment.</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Larval Treatment of larvae</td>
<td>Ground based treatments – Localised i.e. Sandon Park</td>
<td>Once larval densities justify only a freshwater treatment. (The trigger density has not yet been defined) Follow up treatments as required.</td>
<td>As required: Treatments applied as soon as is practicable.</td>
</tr>
<tr>
<td>3</td>
<td>Adult Setting mosquito traps during mosquito season</td>
<td>City Officers Rotating trap locations</td>
<td>August to April</td>
<td>Minimum of Fortnightly trapping – Aug – April – Increasing to weekly during peak.</td>
</tr>
<tr>
<td>No</td>
<td>Action</td>
<td>Method</td>
<td>Frequency</td>
<td>Target</td>
</tr>
<tr>
<td>------</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>To undertake CLAG requirements in order to develop and improve mosquito management.</td>
<td>In accordance with the Department of health process for CLAGS</td>
<td>3 meetings August – April.</td>
<td>CLAG meetings.</td>
</tr>
</tbody>
</table>

2. To research and apply other more effective methods for monitoring and treatment of mosquito prone areas.
2 Adults

To publish and analyse mosquito trapping date

City’s web page

After each trapping date

Trapping results published within one week of trapping.

3 Adults

To analyse resident complaints.

City’s web page as part of the review of the MMP

Annually

As part of 4.2 – Review of annual MMP

3. To conduct an educational/communication program within the CoSP to manage mosquito infestations.

<table>
<thead>
<tr>
<th>No</th>
<th>Action</th>
<th>Method</th>
<th>Frequency</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mail out to residents of pending season.</td>
<td>City print/Contractor to deliver.</td>
<td>Once</td>
<td>To be received by residents September</td>
</tr>
<tr>
<td>2</td>
<td>Mail out to residents – update of general information</td>
<td>City print/Contractor to deliver.</td>
<td>Once</td>
<td>To be received by residents November</td>
</tr>
<tr>
<td>3</td>
<td>Mail out to residents – update of season progress.</td>
<td>City print/Contractor to deliver.</td>
<td>Once</td>
<td>January – February.</td>
</tr>
<tr>
<td>4</td>
<td>Follow up on resident complaints in relation to localised complaints.</td>
<td>Setting traps to determine freshwater breeders - surveying latest aerial maps for unmaintained swimming pools.</td>
<td>When deemed necessary by City Officers.</td>
<td>August - April</td>
</tr>
</tbody>
</table>
4. To review the effectiveness of this plan and embed a cycle of improvement in the operations of the MMP.

<table>
<thead>
<tr>
<th>No</th>
<th>Action</th>
<th>Method</th>
<th>Frequency</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To assess whether Aim 1 has been met.</td>
<td>Assess all disease notifications from DoH</td>
<td>Once</td>
<td>May</td>
</tr>
<tr>
<td>2</td>
<td>To review the MMP</td>
<td>City Officers</td>
<td>Once</td>
<td>May – June</td>
</tr>
<tr>
<td>3</td>
<td>To workshop the outcomes and learning's of the completed season with the mosquito working group.</td>
<td>Meeting with Mosquito working group</td>
<td>Minimum once</td>
<td>May – June</td>
</tr>
<tr>
<td>4</td>
<td>To create final updated MMP</td>
<td>Following completion of 4(2) &amp; 4(3).</td>
<td>Once</td>
<td>July.</td>
</tr>
</tbody>
</table>
References


Review City of South Perth Mosquito Management Plan 2011/2012 for City of South Perth by Mosquito Consulting Services Pty Ltd, 6 December 2011

Appendix 1 - Written response from Swan River Trust & Department of Environment & Conservation

Mr Jason Jenke  
Co-ordinator Environmental Health Services  
Cnr Sandgate St & South Tooronga PO Box C120  
SOUTH PERTH WA 6151

Dear Mr Jenke

REQUEST FOR APPROVAL TO UNDERTAKE MOSQUITO FOGGING-WATERFORD FORESHORE - CITY OF SOUTH PERTH

Thank you for providing the Swan River Trust (the Trust) with the opportunity to comment on the above request received on the 8 March 2011.

The request relates to adulticide ‘fogging’ across the Waterford Foreshore. The Trust understands that ‘fogging’ is projected to occur in an wetland area that is part of the Trust’s Development Control Area (DCA) and is classified by the Department of Environment and Conservation (DEC) Wetland Branch as a highest priority wetland management area.

The Trust is sensitive to the current importance surrounding mosquito control within the catchment and in view of current affairs wishes to advice the City of South Perth (CoSP) that there are no objections to the request. However, the Trust is concerned about the lack of environmental scope regarding the impact of the adulticide ‘fogging’ on the wetland. The Trust believes that prior to ‘fogging’ taking place the CoSP should consider possible ecological impacts of adulticide ‘fogging’ within the wetland and include an impact assessment and management statement in the Mosquito Management plan.

It is assumed that the ‘fogging’ will take place in accordance with the relevant environment regulations, chemical data sheets and manufacturer’s instructions.

The Trust understands that the request has been referred to the DEC and expects that their advice be taken into account.

Should there be any queries regarding this matter, please contact Bart Peters, environmental Officer on 92780995.

Yours sincerely

Paul Stephens
Manager Statutory Planning
31 March 2011
Executive Director  
City of South Perth  
South Perth Civic Centre  
Cnr Sandgate Street & South Terrace  
SOUTH PERTH WA 6151

Attn: Mr. Jason Jenke

Dear Sir/Madam

MOSQUITO FOGGING – WATERFORD FORESHORE, CITY OF SOUTH PERTH

I refer to your letter of 16 May 2011 seeking the Department of Environment and Conservation’s (DEC) approval to undertake adulticide ‘fogging’ across the Waterford foreshore wetlands when adult mosquito numbers are excessive.

The Waterford foreshore wetlands are classified by DEC as a high priority wetland management area. DEC would permit the use of adulticide ‘fogging’ using the products listed (Garrads Drift and Py Fog) in accordance with relevant environmental regulations, chemical data sheets and manufacturer’s instructions.

Consideration must be given to the possible ecological impacts of adulticide ‘fogging’ within the wetland area. It is noted that both control products are highly toxic to fish and aquatic organisms. To avoid unintended impacts of adulticide ‘fogging’ within the wetland, ‘fogging’ should not be implemented in areas with exposed surface water, or where there is a possibility of run-off entering waterways to.

Thank you for informing DEC of this operation.

Yours sincerely,

Paul Brown  
REGIONAL MANAGER

30 May 2011
Appendix 2 - Residual Barrier Treatments - Defined areas

New footpath (near Clontarf)
Red Line indicates barrier treatment area.
Green line indicates treatment extent.
**Templemore Gardens Footpath/Nenagh Grove**
Red Line indicates barrier treatment area.  
Green line indicates treatment extent.

**Top of Bodkin Park**
Red Line indicates barrier treatment area.
Elderfield Rd, corner of Fairview Garden
Red Line indicates barrier treatment area.

Doneraile Park
Red Line indicates barrier treatment area.
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Appendix 3

Mosquito General

There are almost 100 species of mosquitoes in Western Australian and many of them can be serious pests, interfering with leisure time and outdoor activities. Mosquito bites cause discomfort and pain, particularly to babies and others with sensitive skin.

Only female mosquitoes bite as they need blood to be able to develop their eggs. While taking blood, infected mosquitoes can pass on disease-causing viruses and parasites. Exposure to large numbers of mosquitoes may increase the chance of being infected with a mosquito-borne disease.

During summer the life cycle from egg to flying adult mosquito takes 7-10 days. In colder months the life cycle may take several weeks.

Mosquito Life Cycle

The general life cycle of a mosquito begins with an adult female laying eggs.

**Egg:** Eggs are laid one at a time and they float on the surface of the water or they are laid on soil or plants. *Culex, Culiseta,* and *Anopheles* lay their eggs on water while *Aedes* lay their eggs on damp soil and on the saltmarsh plant that will be flooded by water. Most eggs hatch into larvae within 48 hours.

**Larva:** The larva (larvae - plural) lives in the water and come to the surface to breathe. They shed their skin four times, growing larger after each molting. Some larvae have siphon tubes for breathing and hang from the water surface. *Anopheles* larvae do not have a siphon and they lay parallel to the water surface. The larva feed on micro-organisms and organic matter in the water. On the fourth molt the larva changes into a pupa.

**Pupa:** The pupal stage is a resting, non-feeding stage. This is the time the mosquito turns into an adult. It takes about two days before the adult is fully developed. When development is complete, the pupal skin splits and the mosquito emerges as an adult.

**Adult:** The newly emerged adult rests on the surface of the water for a short time to allow itself to dry and all its parts to harden. Also, the wings have to spread out and dry properly before it can fly.

**Midge:** Dense swarms of small black non-biting flies, or midges, are one of the more obvious environmental problems associated with urban wetlands in Perth and other regions in Australia. Midges, which belong to the insect family Chironomidae, are often a nuisance in residential areas near wetlands because they are strongly attracted to lights. Some species are so small that they can pass through flyscreens. Unlike mosquitoes, they do not bite, and so are not vectors of disease.
Mosquito Special of Interest

Based on the 2011/2012 season the following species were trapped and identified.

**Anopheles annulipes**

Anopheles annulipes are known to bite humans and other animals. This species tends to bite predominantly at night.

**Aedes vigilax(S)**

*Aedes vigilax* is a salt water breeder that in saline habitats on mudflats usually behind mangroves. Hatching of eggs is usually in response to tidal movements in a salt marsh, although rainfall can initiate hatching and breeding adults are most abundant in summer months. They attack humans and other animals readily and bite during the day in sheltered areas (or full sunlight in larval habitats), but also at evening and night. This species is a known transmitter of vectors of disease such as Ross River virus (RRV) disease and Barmah Forest virus (BFV) disease.

**Culex globocoxitus**

This species is not likely to be an important vector as it rarely bites humans. The larvae are found in swamps and ground pools.
Aedes notoscriptus (f)*

This species tends to breed in clean water situations such as containers, roof gutters and roadside drains. This species is known to be a vicious biter readily attack humans by day in shaded areas but also feeds during the evening, night and early morning. This species is potentially a transmitter of vectors of disease such as Ross River virus (RRV) disease and Barmah Forest virus (BFV) disease.

Aedes camptorhynchus(s)

Adults can be active throughout the year and are associated with rainfall and tidal inundation of a saltmarsh. This species is also thought to breed in some freshwater environments. Aedes can disperse 3-5 Km in search of blood meals; they can be vicious biters readily attacking humans and other animals including birds, and will feed during the day, at dusk and after sunset.

Culex annulirostris(f)*

This species is a fresh water breeder that also breeds in constructed water bodies, drains and swales. Adults readily feed on humans, and most feeding activity occurs from sunset for about 2 hours and again to a lesser degree at dawn; disperses 5-10 km.
**Aedes quinquefasciatus (f)**

This species breeds in polluted fresh water drains, back yard containers and roof gutters. Adults are generally active only during the warmer months; they usually attack humans towards the middle of the night indoors and outdoors.

**Coquilletidia sp. nr linealis (f)**

A mosquito associated with permanent vegetated freshwater. Adults are generally most common from late-spring through summer but periods of peak abundance vary with region; they attack humans readily (as well as other animals), and bite during the day as well as evening and night.

**Aedes alboannulatus (f)**

A commonly collected mosquito particularly early or late in the mosquito season and are not known to transmit viruses.
Culex australicus (f)

This species is a fresh water breeder. Adults are active from spring through autumn in many areas. This species normally does not attack humans.
Appendix 4 – Mossie Bites Research Article June 2014

Mosquito abundance and composition within inner metropolitan local governments of Perth, WA

Ryan Jones, Scientific Officer, Mosquito-Borne Disease Control, Environmental Health Hazards Unit, Department of Health, WA.

A research project, supported by WA Department of Health, to determine the prevalence of disease vectors was conducted throughout the Swan-Canning Rivers system and nearby suburbs in January 2013. The research focused on the Cities of South Perth, Canning and Town of Victoria Park as they are uniquely situated within close proximity to known saltmarsh habitats along the Swan and Canning Rivers.

The study involved 24-hourly collections of mosquitoes over eight days of trapping from 11th to 18th January 2013 and collected more than 50,000 mosquitoes. A total of 53 trap sites were used, spread over the study area in an approximate 1km x 1km grid pattern using EVS CO2 traps, with researchers removing and resetting traps around sunrise each day. Specimens were later identified to species level using Lichten (1991).

A total of 11 mosquito species were collected during the study, with four dominant species across the study area including Aedes vigilax (36%), Culex quinquefasciatus (25%), Culex annulirostris (21%) and Aedes notoscriptus (15%).

The majority of sampled mosquito species were collected at trap locations within 1km of the river systems, even though the majority of mosquito species were typically associated with freshwater. This demonstrates that productive freshwater breeding habitats can be located along the fringes of the rivers but may not necessarily be part of the river system.

Aedes vigilax was the most abundant species within the study area, comprising 36% of the total sample of mosquitoes collected. A significant relationship was found between the mean number of Ae. vigilax mosquitoes collected and proximity to known saltmarsh breeding habitat. Culex annulirostris (third most abundant) was also collected in a similar distribution. This data supports the conclusion that the majority of permanent and semi-permanent naturally occurring mosquito breeding habitats is located in close proximity to the river systems. Specimens of both Ae. vigilax and Cx. annulirostris were collected at further distances but in significantly smaller densities.

The species composition at the centre of the study area comprised mainly Cx. quinquefasciatus (second most abundant species) and Ae. notoscriptus. The relatively ubiquitous distribution through the study area follows the widespread installation of drainage infrastructure and other water-holding containers. Similarly, great variation in mean trap collections of Ae. notoscriptus and Cx quinquefasciatus between...
adjacent traps across the study area, supported the fact that both species have comparatively limited dispersal range.

As all four predominant mosquito species are known for being anthropophilic and with the exception of Cx. quinquefasciatus, are known vectors or implicated in the transmission of mosquito-borne diseases, the impact on local residents can be severe in some years.

The main implication for mosquito management is that saltmarsh mosquitoes are not the only type of mosquito of significance in the study area. The great number of freshwater and container-breeding mosquito species indicates that local governments and other mosquito managers should broaden surveillance measures and management methods to include the type of habitats occupied by Aedes notoscriptus, Cx. annulirostris and Cx. quinquefasciatus.

References:
Figure: Map of overall mosquito species abundance and composition collected during the field study at each trap site in study area. Size of the circular pie chart reflects the overall mean number of mosquitoes collected at each site: smallest circle size represents collections < 50 mosquitoes, increasing gradually to medium circle size representing 50-250 mosquitoes. Largest circles located at northern-most traps and southern-most location represent > 2000 mosquitoes. Main colours of mosquito species are as follows: red (Ae. aegypti), blue (Ae. vigilis), green (Cx. annulirostris), brown (Cx. quinquefasciatus), yellow (Ae. C. punctipennis).