FLORIDA KEYS MOSQUITO CONTROL DISTRICT REVIEW FINAL REPORT

September 2023

Prepared for

The Florida Legislature

Prepared by

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Executive Summary

Although the Florida Keys Mosquito Control District (Florida Keys MCD) encompasses all of Monroe County, the district operates only on the island chain of the Florida Keys. The district does not service the mainland peninsula body of the county as few persons inhabit the area. The district's service area is 123.4 square miles and is divided into five districts along the island chain. Florida Keys MCD has unique operational circumstances including its island geography, demography of heavy tourism and spread-out population, extensive environmentally sensitive lands, federally regulated properties, and unique arthropod populations. Each of these elements complicates Florida Keys MCD's operations.

About 90,000 households paid ad valorem taxes to support Florida Keys MCD operations in Fiscal Year (FY) 2021-22 (October 1, 2021 through September 30, 2022). The most recent budget year included about $36 billion in taxable value for real property, plus an additional $688 million from about 15,000 tangible personal property accounts that are subject to district millage. Florida Keys MCD operates with about 80 employees; extreme increases in local housing costs in recent years have proven challenging for employee recruitment and retention.

Florida Keys MCD was established in 1949 with an elected board of five commissioners. The Board is actively engaged in review of operational success, financial stewardship, and efficiency. Operations largely focus on prevention of mosquito infestation via surveillance, monitoring, larvicide, and targeted adulticide, along with operational research to improve the effectiveness and efficiency of Florida Keys MCD activities. Florida Keys MCD has managed several externally induced issues in recent years including a dengue outbreak with almost 70 human cases; this locally acquired outbreak caused over $1 million in unbudgeted treatment costs. Because no public health emergency was declared, Florida Keys MCD had to absorb the costs with local taxpayer funds.

The Balmoral Group worked in consultation with a mosquito control expert in the course of this review and found that Florida Keys MCD follows industry standards for Integrated Pest Management and provides an array of mosquito control services consistent with the district's charter and statute. Other local government entities located wholly or partially within the district do not provide similar mosquito control services and, as such, consolidation with another local government entity is not possible. The district is managing its resources in an efficient and effective manner to achieve its goals and objectives and has clearly defined goals and objectives that adequately address its statutory purpose. It tracks and measures its performance, and analysis finds that the district is upholding its performance standards.

SCOPE

Section 189.0695, *Florida Statutes,* requires the conduct of performance reviews of Independent Mosquito Control Districts. The Balmoral Group was selected by the Office of Program Policy Analysis and Government Accountability to perform the review, which evaluates the district's programs, activities, and functions, including

- evaluating the district board's primary function and governance;
- assessing service delivery and comparing similar services provided by municipal or county governments located within the district's boundaries;
- describing district purpose, goals, objectives, performance measures, and performance standards and evaluating the extent to which they are achieved;
- analyzing resources, revenues, and costs of programs and activities; and
- providing recommendations for statutory or budgetary changes to improve the special district's program operations, reduce costs, or reduce duplication.

Based on its review, The Balmoral Group presents the following recommendations for the improvement of mosquito control services in the Florida Keys MCD:

- The Legislature could consider amending section 403.709(1), *Florida Statutes*, to require a portion of the funds currently administered by DEP for solid waste activities to be allocated to waste tire abatement activities by MCDs.
- The Legislature could consider directing DACS to allocate a portion of the funding under s. 388.261, *Florida Statutes,* for emergency mosquito-borne disease outbreaks that do not occur as part of a state of emergency.
- The Legislature could consider modifying Section 420.50871, *Florida Statutes*, to include affordable housing projects for Florida Keys MCD workers among the projects eligible for state development funding to increase affordable housing options in the area to retain district workers.
- The district could formalize additional performance measures and standards that would allow the district to monitor and track progress toward all its goals and objectives. Such performance information would facilitate the district in consistently monitoring its progress.
- The Legislature could consider amending s. 388.46*, Florida Statutes*, to direct the Florida Coordinating Council on Mosquito Control to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.

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1. Background

District Description

District Purpose

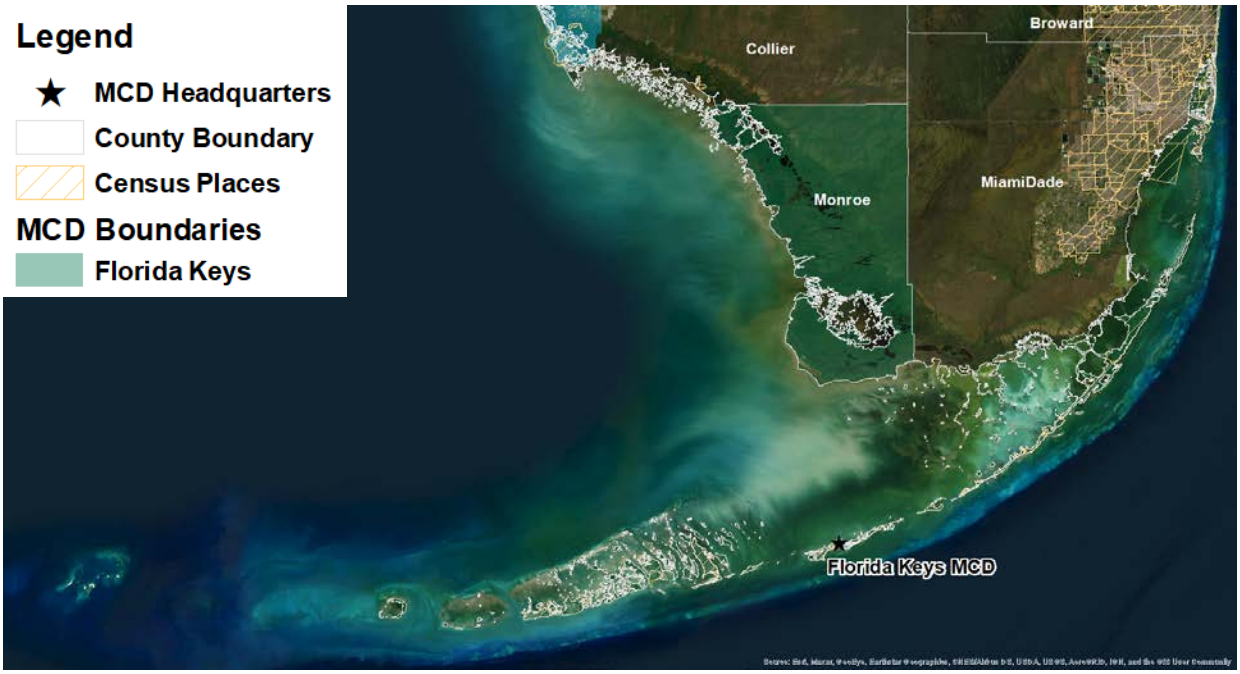
The purpose of the Florida Keys Mosquito Control District (Florida Keys MCD) is "[t]he abatement and control of mosquitoes and other arthropods within Monroe County [as] is advisable and necessary for the maintenance and improvement of the health, comfort, welfare, and prosperity of the people thereof . . . ." The adopted mission of the Florida Keys MCD is "to protect the public from health threats and nuisance issues that impact the local economy by utilizing control methods that are efficient, effective and environmentally sensitive." [1]

Service Area

Florida Keys MCD encompasses all territory in Monroe County; however, the district operates only on the islands of the Keys. Service is not provided on the mainland peninsula body of Monroe County where the majority of the landmass lies, as few persons inhabit that region and the majority of those lands are protected national park lands. The district's service area is 123.4 square miles and is divided into five districts along the island chain.

Florida Keys MCD's headquarters is located at 503 107th Street, Marathon, Florida 33050. **Figure 1** shows a map of Florida Keys MCD boundary, with the county boundary and Florida Keys MCD headquarters marked.

Figure 1. Florida Keys MCD Map



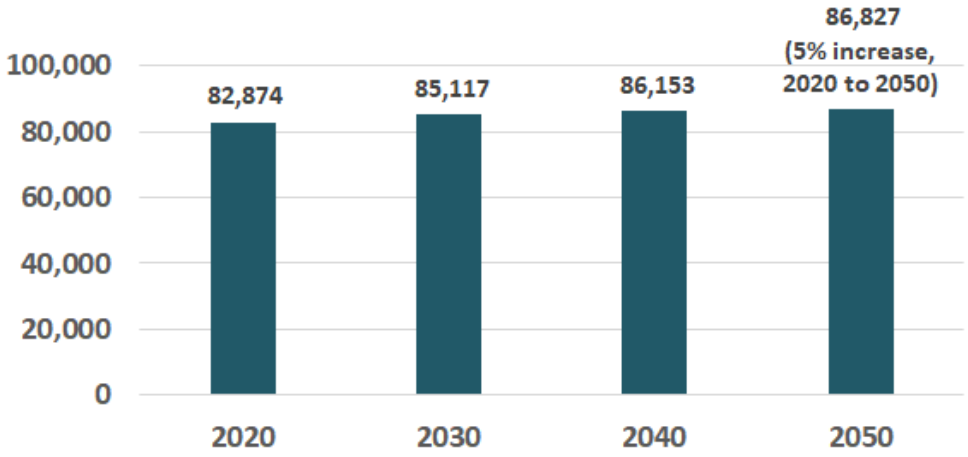
Source: TBG Work Product, ESRI, US Census, MCDs.

[1] Chapter 2002-346, s. 16, *Laws of Florida*, as amended by Chapters 2002-346, 2003-387, 2019-171, and 2020-195, *Laws of Florida.*

Population

The population of Monroe County was 81,708 in 2022 according to the U.S. Census.[2] The area covered by the Florida Keys MCD has just short of that total, with only a few people residing outside of service area. The Florida Legislature's Office of Economic and Demographic Research (EDR) projects Monroe County's population to increase by 5% through 2050 to 86,827 residents compared to a 2020 baseline. [3] **Figure 2** shows Monroe County's projected population estimates calculated by EDR.

Figure 2. Monroe Population Projection



Source: TBG Work Product, EDR.

District Characteristics

The area serviced by Florida Keys MCD consists of the islands of the Florida Keys at the southern end of the Florida peninsula. The Florida Keys are a chain of limestone islands that extend for a distance of approximately 220 miles from the Florida mainland to the Dry Tortugas to the southwest. They have a tropical climate and received just under 40 inches of rain in 2022, with an average temperature of 79 degrees Fahrenheit.

Several environmental and geographic characteristics affect the types of mosquito control services needed in the district. The islands in the Florida Keys have unique features compared to mainland Florida, which in many cases require more sophisticated approaches to mosquito control than those used in other areas of the state. The island geography is dependent on one main thoroughfare. This reduces economies of scale that other districts may enjoy with fleets, maintenance servicing and so forth, since central hub approaches are not as efficient given the long distances workers would have to travel. The island geography also results in a very spread out population, with clusters of settlements throughout the islands, interspersed with environmentally sensitive lands and federally regulated properties. The Florida Keys contain several state parks and national wildlife refuges, sanctuaries, and parks, including John Pennekamp Coral Reef State Park, Crocodile Lake National Wildlife Refuge, Key Largo National Marine Sanctuary, Biscayne National Park, and others. Federally regulated properties require extensive coordination and advance approval to allow mosquito treatment, if allowed at all, while residential areas where treatment is appropriate may be immediately adjacent. In addition, because of the areal extent of the Keys and

[2] Population Estimates, July 1, 2022 retrieved from U.S. Census Bureau QuickFacts: United States.

[3] Based on 2021 Estimates, Population: 1970-2050, County projections retrieved from Population and Demographic Data - Florida Products (state.fl.us).

tropical wind and climate influences, the Florida Keys MCD has unique arthropod populations. Florida Keys MCD has over 45 different species of mosquitoes to contend with, which introduces a more complex operating environment than most other MCDs. The Keys host millions of visitors and thousands of refugees each year, many from countries with prevalent dengue fever that can quickly be introduced to the local population.

Meteorology is the primary driving force for producing mosquitoes with heavy rainfall events creating standing pools of water that serve as larval habitat for mosquito species capable of transmitting several arboviruses. Changing water levels through tidal events can also produce such pools. Humans contribute to the problem by allowing water to stand in waste containers, garden pots, tires, and other vessels. The very unique geographic and natural characteristics of the district's chain of islands surrounded by shallow aquatic areas, with its tropical climate and meteorological conditions described above, create an environment conducive to extensive mosquito habitats that require constant mosquito control. The services needed to control mosquitoes include routine surveillance of mosquito-producing habitats, source reduction through elimination of mosquito habitats, aerial and ground applications of pesticides to treat areas with large mosquito populations, and testing of mosquito collections when disease incidence is prevalent.

Real Property Data

Florida Keys MCD receives ad valorem taxes to fund district operations. The total taxable value of properties within Florida Keys MCD was almost $37 billion in FY 2022-23 under a millage rate of 0.4565 (**Table 1**). Real property parcels subject to district millage exceeded 89,000 parcels in FY 2022-23. Taxable value of real property parcels increased 30% in FY 2022-23 compared to FY 2019-20, following changes in property values despite little change in the number of taxable parcels over the years (**Table 2**).

Table 1. Millage Rates and Total Taxable Value of Properties Subject to Florida Keys MCD Millage

Florida Keys MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Millage Rate	0.4508	0.4508	0.4648	0.4565
Taxable Value of Parcels ($Bil.)	$27.83	$29.43	$31.04	$36.15
Taxable Value of Accounts ($Bil.)	$0.575	$0.614	$0.634	$0.688
Taxable Value of Centrally Assessed Property ($Mil.)[1]	$0	$0	$0	$0
Total Taxable Value ($Mil.)	**$28,408**	**$30,046**	**$31,679**	**$36,836**

Source: Florida Department of Revenue (FDOR).
[1] Centrally assessed property includes railroad and private carline company assessments as defined in Rule 12D-2.011, *F.A.C.*

Table 2. Real Property Parcels Subject to Florida Keys MCD Millage

Florida Keys MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Just Value of Parcels ($Mil.)	$38,655	$40,137	$41,640	$55,086
Real Property Parcels Subject to Millage	89,958	89,840	89,849	89,993
Taxable Value of Parcels ($Mil.)	$27,834	$29,432	$31,045	$36,148

Source: FDOR.

Tangible Personal Property Data

In addition to real property, tangible personal property accounts subject to district millage total 15,269 accounts in FY 2022-23, down 7% since FY 2019-20 (**Table 3**). Despite this, the taxable value of tangible personal property accounts increased in FY 2022-23 by almost 20% compared to FY 2019-20 due to higher asset values.

Table 3. Tangible Personal Property Accounts Subject to Florida Keys MCD Millage

Florida Keys MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Just Value of Accounts ($Mil.)	$820	$855	$905	$957
Tangible Personal Property Accounts Subject to Millage	16,335	15,789	15,374	15,269
Taxable Value of Accounts ($Mil.)	$575	$614	$634	$688

Source: FDOR.

History and Composition

Florida Keys MCD (formerly the Monroe County Anti-Mosquito District) was formed in 1949 by an act of the Legislature, which was approved by the voters through a public referendum. [4] The district currently operates pursuant to Chapter 2002-346, *Laws of Florida* (as amended), and is also subject to Chapter 189, *Florida Statutes*, given its status as an independent special district; Chapter 388, *Florida Statutes*, setting forth the requirements for creating and operating MCDs in this state; and Chapter 5E-13, *Florida Administrative Code*, setting forth rules adopted by the Department of Agriculture and Consumer Services (DACS) for mosquito control program administration. [5]

The district is governed by a board of commissioners comprised of five elected members, with one member from each of the five districts that make up the service area. The positions include a chairperson, vice chairperson, and secretary/treasurer. Members of the board must be residents and registered electors of the area from which they are elected and represent. Members serve four-year terms that, as of 2018, are prospectively subject to 12-year term limits.[6] As of the date of this report, there are no vacancies on the board.

Pursuant to section Chapter 388, *Florida Statutes*, and the district's chapter law, the powers and duties of the board of commissioners include:

- Performing all duties necessary for the control and elimination of mosquitoes and other arthropods of public health importance.
- Being authorized to provide for the construction of canals, ditches, drains, dikes, fills, and other necessary works, and to install and maintain pumps, excavators, and other machinery and equipment.
- Preparing and adopting a district budget.
- Being authorized to hold, control, and acquire by gift or purchase for district use any real or personal property.

[4] Chapter 26042, *Laws of Florida* (1949).
[5] *See* Footnote 1.
[6] Chapter 2018-171, s. 1, *Laws of Florida.*

- Being authorized to condemn any land or easements needed for the purposes of the district.
- Having all the powers of a body corporate, including the power to contract; to employ a director, employees, and others; to borrow money; and to participate with employees in a group hospitalization insurance plan providing the entire cost of such a plan.

As required by s. 388.151, *Florida Statutes,* the board of commissioners has met at least monthly during the current FY and past three FYs, with the number of meetings and special meetings shown in **Table 4.**

Table 4. Florida Keys MCD Commissioner Meeting Counts

Commissioner Meetings	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Monthly Meetings	12	12	12	7
Special Meetings[1]	20	21	22	22

Source: TBG Work Product, MCD.
[1] Special meetings included Budget Public Hearings, Retiree Healthcare, Audit Committee, and Investment Review Committee Meetings, as well as for budget, performance review, benefits, *Aedes Aegypti* mosquito control, and strategic plan workshops.
[2] 2023 YTD through April.

The board's meetings are open to the public and noticed and conducted in accordance with s. 189.015, *Florida Statutes*.

Intergovernmental Interactions

Florida Keys MCD interacts with several government entities at the federal, state, and local levels. At the federal level, Florida Keys MCD has an ongoing contract for mosquito control services and received funding from the U.S. Navy and Balfour Beatty in FYs 2021-22 and 2020-21 to conduct spraying operations on the US Naval Base and naval housing in Key West. Florida Keys MCD also coordinates with the Department of Homeland Security, National Parks Service, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Authority (EPA) for the use of certain chemicals in certain areas and treatments in areas under their jurisdictions. Furthermore, the Florida Keys MCD partners with the National Marine Sanctuary in research projects on mosquito control operations within the National Marine Sanctuary while also being a member of the Water Quality Protection Program Steering Committee.

At the state level, Florida Keys MCD works with the Florida Department of Health (DOH) in tracking cases of mosquito-borne diseases that often originate abroad and are brought into the Keys by travelers. The Florida Keys MCD also works with the DACS for reporting and updating to the public, as well as the Florida Wildlife Conservation Commission to monitor and treat state-managed environmentally sensitive and biologically highly productive areas throughout the Keys. At the state and local levels, the district coordinates with the Florida Department of Environmental Protection (DEP), Department of Transportation, Monroe County Emergency Management, Monroe County, and Monroe County School Board to utilize landing zones throughout the county for the MCD's aerial operations throughout the Keys.

Resources for Fiscal Year 2021-22

The published FY 2021-22 millage rate established by Florida Keys MCD was 0.4648. The district received $15 million in revenues and spent about $14 million in FY 2021-22. The district had 79 paid staff (72 full-time

employees, 5 commissioners, and 2 part-time or seasonal positions) and owned or leased 89 vehicles, 3 facilities, and 6 buildings in FY 2021-22 (**Table 5**).

Table 5. Florida Keys MCD Resources for FY 2021-22

Resource Item	FY 2021-22 Amount
Millage Rate	0.4648
FY 2021-22 Revenues	$15.00 million
FY 2021-22 Expenditures	$13.83 million
Number of Paid Staff	79
Vehicles	2 airplanes, 4 helicopters, 4 boats, 76 trucks, and 3 utility vehicles
Equipment	Field equipment: 143 Lab equipment: 18 Office equipment: 54 Surveillance equipment: 133 traps, no sentinel chicken program
Facilities	3 facilities, 6 buildings

Source: TBG Work Product, Florida Keys MCD.

2. Findings

Service Delivery

Florida Keys MCD follows industry standards for Integrated Pest Management and provides an array of mosquito control services consistent with the district's charter and statute; other local government entities located wholly or partially within Florida Keys MCD do not provide similar mosquito control services.

To assess the delivery of services in the district, The Balmoral Group (TBG) requested information on the geographic characteristics of the district; other local governments to which the district provides services or with which it coordinates efforts; the services provided by the district; similar services provided by other entities; district studies or evaluations of alternative service delivery methods including consolidation of services with other government entities; unique contributions from the district relative to the county or municipalities; and local stakeholder perceptions of the relative value of the district's services. In addition, TBG requested information from representatives of the Board of County Commissioners, local health department, and local parks and recreation department on their perceptions of the district's service delivery and efficiency.

Overview of Services

Most mosquito control programs use an Integrated Pest Management (IPM) approach to control mosquito populations, which targets the different stages of a mosquito's life cycle with various prevention and control measures. IPM addresses eight areas. Surveillance of mosquito populations is an essential component of all IPM programs with chemical treatments based on the surveillance findings. IPM can also include source reduction (e.g., container disposal, water/impoundment management), larviciding and adulticiding (using ground and/or aerial treatments), biological and alternative control, and disease surveillance. Research and education are also

important components of IPM programs. See attachment titled, “Integrated Pest Management” for more information. Florida Keys MCD conducts activities in each of the eight areas of IPM.

TBG reviewed documentation, interviewed staff and management, and inspected field facilities to assess delivery of services.

Florida Keys MCD’s surveillance services include conducting ground and aerial surveillance to pinpoint areas of concern and conducting daylight inspections using rotary wing aircraft. Inspectors monitor over 300 sites daily for landing rates, rain gauges, and traps. Inspectors check for larvae, enter data via phone with GPS and real-time data that allows for immediate processing of appropriate mission responses within appropriate time periods depending on the results.

Florida Keys MCD also uses innovative techniques to improve efficiency, such as using trailcams to track tidal inundation. In areas where tidal inundation floods lands, the resulting standing water creates ideal larval habitat for mosquitoes. Typically, these are remote areas that are labor- and time-intensive to visit and inspect. Using trailcams allows for internet monitoring of areas that may require treatment. Florida Keys MCD was in the process of developing a drone program to gain access for inspecting remote areas typically only accessible by foot and administering larvicide as needed, prior to legislative changes prohibiting the use of drones from unapproved manufacturers. Based on the new legislation, Florida Keys MCD halted program development, and instead entered into a contract for up to five days of drone-administered larvicide treatment. Florida Keys MCD also developed, in partnership with private manufacturers, automated field traps to detect landing rates remotely, allowing for desktop monitoring via satellite signal and further reducing manual inspection costs.

Florida Keys MCD’s source reduction activities include ground crews that visit house-to-house throughout the Keys and frequently inspect known hotspot areas to identify locations of standing water, inspecting storm drains, tidal pools, and household containers such as bird baths, abandoned spas, and plant holders that can house larvae. The district also collects waste tires, which create problematic mosquito-producing habitats that are difficult to manage through routine chemical applications but can be managed through proper disposal. District staff reported that the district has collected approximately 493 tires per year on average in the current and prior three fiscal years and has spent an average of approximately $1,651 each year for waste tire disposal. The district reported that it applied for and received funds from DEP in FY 2022-23 that reimbursed the district for costs related to a tire amnesty event during which residents could bring tires for disposal free of charge. The grant reimbursement was $6,433 and covered the costs of tire disposal and advertising for the event. Florida Keys MCD also deploys mosquito fish to reduce mosquito populations.

Florida Keys MCD’s larviciding activities include application of granular and liquid material targeting mosquito larvae. Larvicide is applied when ground crew detect larvae, identify areas with a high potential for standing water such as rain-filled lots, and prioritize treatment areas based on development phase.

Florida Keys MCD’s adulticiding activities include nighttime truck adulticiding and early morning aerial adulticiding using the fixed wing and rotary wing aircraft platforms to deliver ULV sprays in accordance with EPA-approved labels, when adult mosquitoes are most active. Florida Keys MCD follows strict protocols for application in accordance with IPM best practice.

The district conducts disease surveillance through mosquito collections when disease has been detected in coordination with the state DOH. As described above, the district conducts surveillance using a variety of

techniques including remote sensing trail cams and automated traps. The district submits samples of mosquitoes collected from mosquito pools to the DOH laboratory in Tampa for testing when disease presence has been confirmed. The Monroe County DOH office notifies the district immediately if cases of disease are suspected and their location within the district, after which the district will elevate treatment in the area where disease is detected.

Florida Keys MCD's biological and alternative control activities include the use of the sterile insect technique (SIT) and similar technologies. Florida Keys MCD is currently using a technique in which male mosquitoes that are genetically modified to be sterile are deployed into the environment where they will mate with female mosquitoes whose female offspring will fail to emerge as adults. The district partners with Oxitec, a private firm that develops and deploys the genetically modified mosquitoes used in their SIT approach, which was recently approved by the U.S. EPA and DACS under an experimental use permit. Most of the cost and labor associated with this project is covered by Oxitec, with the Florida Keys MCD providing some facilities and small amount of labor to support these activities. The district also participates in ongoing SIT-related research activities using other approaches using incompatible insects, and its scientists are credited authors on a number of peer-reviewed scientific articles about testing and refining methods of biological mosquito control.

Florida Keys MCD's outreach and education activities include educating and informing the public through school-based education programs to teach Florida Keys students about mosquitoes and mosquito control, as well as public communication through guest lectures to local civic groups, social media posts, weekly radio interviews on a local news program, dissemination of educational materials, and direct contact lines of phone, email, and a dedicated app.

A summary of the eight areas of IPM in which Florida Keys MCD conducts activities is set forth in **Table 6**.

Table 6. Florida Keys MCD Services Overview

Integrated Pest Management Service	Florida Keys MCD Services Provided
Mosquito Surveillance	Daily ground and aerial surveillance using trap collection and analysis, field inspectors, and desktop monitoring techniques
Source Reduction	Routine dumping of standing water, deployment of mosquito fish
Larviciding	Application of larvicides at household level by field workers and using helicopters where indicated
Adulticiding	Delivery of ultra-low volume (ULV) nighttime truck adulticiding and early morning aerial adulticiding using helicopters and airplanes
Biological and Alternative Control	Use of the Sterile Insect Technique and mosquito fish
Disease Surveillance	Mosquito pool submissions to state laboratory in Tampa when disease is detected
Mosquito Control Research	Ongoing research efforts to identify new methods and technologies to improve treatment efficiency
Outreach and Education	Numerous education programs and public outreach efforts

Source: TBG Work Product, Florida Keys MCD.

Analysis of Delivery of Services

Florida Keys MCD delivers several mosquito control services across all main areas of IPM that are within the scope of its charter and purposes outlined in applicable laws and regulations. Florida Keys MCD provides services in all eight areas of IPM as described above, and all district services are directed toward the abatement and control of mosquitoes and are within the scope of its charter and purposes outlined in applicable laws and regulations. No services were noted that fall outside the district's charter or applicable laws and regulations. The mosquito control expert retained by TBG for this review did not identify any alternative methods for providing the district's services that would reduce the district's costs or improve the district's performance.

As reported for other MCDs, the district may currently be incurring costs and inefficiencies in managing waste tire collection and disposal, which is an important source reduction activity. In Florida, DEP regulates the disposal of waste tires by creating requirements for the collection and disposal of waste tires at solid waste management facilities and waste tire processing facilities across the state.[7] These facilities typically charge fees for the disposal of waste tires, which MCDs are required to pay if they choose to collect and dispose of waste tires. These facilities may not be able to waive the fees they charge due to bond requirements for their facilities. Waste tires are commonly found scattered throughout residential and commercial areas across the state, and the design of tires makes them ideal habitat for mosquito larva, particularly for species of mosquitoes that are known to be important disease vectors. The removal of waste tires can help reduce populations of these disease-carrying mosquitoes and reduce the threat of diseases like dengue and Zika. For a district like Florida Keys MCD and its geographic proximity to other counties and higher risk of disease outbreaks than other districts, waste tire collection becomes a very important mosquito control activity. Districts like Florida Keys MCD would benefit from additional sources of funding to help incentivize continued collection of waste tires in the district.

In addition, the district faces challenges when disease outbreaks occur. The likelihood of disease outbreaks is particularly challenging for Florida Keys MCD due to its unique geographic and natural areas characteristics that are conducive to mosquito habitat, and that have over 45 species of mosquitoes present. When disease outbreaks have occurred in the past, costs to the district increase significantly dues to the sudden increased monitoring, surveillance, and control needs. For example, when almost 70 human cases of dengue occurred in the Florida Keys in 2020, the district incurred over $1 million in unbudgeted costs that had to be absorbed by the local taxpayers as the staff worked to control the spread of this disease. Federal funding may be available for mosquito control following a major storm event, however, if a disease outbreak occurs apart from a storm event, the district is not eligible for those types of funds. Making MCDs eligible for state support in public health situations such as this is important for the health of Florida's residents and visitors and for the economic welfare of Florida as a whole.

Comparison to Other Services

Other local government entities located wholly or partially within Florida Keys MCD do not provide similar mosquito control services. TBG interviewed staff and reviewed documents available online to establish if services similar to those provided by the Florida Keys MCD are provided by county and municipal governments within the MCD's boundaries. No such services were identified.

[7] Sections 403.717 and 403.718, *F.S.* and Ch. 62-711, *F.A.C.*

The Monroe County Board of County Commissioners noted in discussion at its regular meeting on February 15, 2023, that specialized scientific knowledge is required to carry out mosquito control services, which the county does not possess. Further, the commission does not believe there would be any benefit to the county undertaking the education necessary to gain such knowledge. The board also unanimously approved a resolution supporting the Florida Keys MCD's continued responsibility for mosquito control activities in Monroe County. County commissioners discussed the efficiency, effectiveness, and public support of the Florida Keys MCD.

Similarly, in March 2023, the Marathon City Council passed a resolution, expressing its support for the Florida Keys MCD's efforts and continued status as a special district.

TBG contacted the Monroe County Health Department and Parks and Recreation. These entities did not respond to multiple requests for input on potential consolidation considerations.

Considerations for Consolidations

Consolidation of operations is not recommended for Florida Keys MCD based on the findings of this review. Florida Keys MCD operates throughout the inhabited areas of Monroe County and no other comparable service has been identified for consolidation. While theoretically some types of Florida Keys MCD staff positions could be incorporated by county government, the expectation is low that doing so would increase effectiveness or efficiency. A 2022 operational review of the Florida Keys MCD indicated that some functions of Florida Keys MCD have similar functions in county government. The operational review detailed the functions that human resources, finance, information services, and fleet management perform and how they all have existing parallels in the Monroe County government. However, due to the specialization and complexity of Florida Keys MCD's existing mosquito control operations, TBG and the subject matter expert retained for this review concluded that there is extremely limited capacity for improvements in cost and efficiency by transferring the duties of current Florida Keys MCD staff to county offices. The district's sophisticated operations, variety of IPM services provided, research and outreach activities would not be easily transferred to county employees.

The Monroe County Board of County Commissioners (BOCC) has stated strongly that they do not believe Monroe County could or should consolidate any of the Florida Keys MCD operations, as they believe current operations are efficient and effective. The BOCC reported that the transfer of the district's responsibilities to county staff would be burdensome and would require significant training for county employees to take over administrative functions for the Florida Keys MCD such as accounting processes. In addition, the long distances required for travel in the Keys make consolidation of activities like mechanical repair unsupported by economies of scale or efficiency. Florida Keys MCD reported that previous studies of the use of centralized county services for vehicle maintenance would result in lost hours of district staff time to accommodate limited county scheduling and locations. Given the size of the Florida Keys MCD fleet, in-house repair staff has proven more efficient over time.

Resource Management

Florida Keys MCD is managing its resources in an efficient and effective manner to achieve its goals and objectives.

To assess the district's resource management, TBG analyzed information on revenue sources, revenue and expenditure trends and their possible causes; analyzed staffing trends and their possible causes; requested data

on services delivered by district staff versus third-party contractors for the last three FYs; analyzed equipment inventory and capital investment trends; reviewed the activities the district conducts to manage costs and plan personnel; requested information on resident feedback survey data related to finances and spending by the district; reviewed performance reviews and audits; and interviewed district staff and board members.

Current and Historic Revenues and Expenditures

Revenues and expenditures for Florida Keys MCD are relatively stable and reflect careful management of operating costs and reserves. Florida Keys MCD's FY begins October 1st and ends September 30th. The district's funding is primarily comprised of ad valorem taxes. The Monroe County Property Appraiser, with approval from the Florida Department of Revenue, certifies the county's tax roll each year and provides the information to the Monroe County Tax Collector, which in turn collects monies authorized under the district's taxing authority. Millage rates are set each year by the district's board of commissioners.

To analyze revenues and expenditures, TBG requested and received annual financial reports from Florida Keys MCD for each year of the review period and received information for FY 2019-20 through FY 2022-23 (year-to-date). Revenues markedly increased from $13.2 million in FY 2019-20 to $15.6 million in FY 2021-22, with the majority of revenues in each year from ad valorem taxes and a relatively small percentage from interest earnings, equipment sales, and other miscellaneous sources (**Table 7**). Expenditures on the other hand, decreased during the same period from $14.7 million in FY 2019-20 to $13.8 million in FY 2021-22. Expenditures were greater than revenues by $1.5 million in FY 2019-20 but revenues in the next two FYs exceeded expenditures in those years by a total of almost $2.1 million. Two important considerations during the period include purchases of new aircraft and the recent dengue outbreaks. Florida Keys MCD was building reserves to fund replacement of expensive helicopters, partially offset by the sale of older fleet aircraft, and anticipates need for less millage revenues going forward, although a 30% increase in chemical costs and other inflation may negate the district's ability to lower millage. Since 2009, there have been two significant outbreaks of locally acquired dengue in the Florida Keys. Additionally, travel-related cases occur on a regular basis. Extensive treatment is required upon detection in the district to contain the outbreak and minimize local transmission to protect public health, which could have occurred had the cases spread. Florida Keys MCD expended more than $1 million in additional chemical costs. Rain and travel-related disease are both completely unpredictable, and budgeting for these uncertainties is difficult. Other costs include non-cash depreciation and debt service.

Table 7. Revenue and Expenditures

Revenues and Expenditures (in $Mil.)	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Revenues	**$13.19**	**$15.23**	**$15.00**	**$15.64**
Ad Valorem	$12.44	$13.13	$14.24	$14.75
Other Sources	$0.75	$2.10	$0.76	$0.89
Expenditures	**$14.74**	**$14.32**	**$13.83**	**$9.53**
Administrative Costs	$2.49	$2.41	$2.43	$1.57
Direct Program and Activity Costs	$11.45	$11.01	$10.50	$7.97
Other Expenditures	$0.80	$0.90	$0.89	$0.00

Source: TBG Work Product, MCD. 2023 YTD through March.

These trends demonstrate that the district has made improvements in its resource management over the past several years. The revenues collected by Florida Keys MCD are sustainable given rising property values, especially as Florida Keys MCD expenditures have steadily decreased since FY 2019-20.

Administrative Costs

Expenditures on administrative costs were stable from FY 2019-20 through FY 2021-22, accounting for about 17% of total expenditures on average. Florida Keys MCD provided a breakdown of total expenditures by administrative program costs such as debt service and depreciation. **Table 8** summarizes the detailed administrative cost data provided by the district. Administrative Personal Services expenditures marginally increased from $841,126 in FY 2019-20 to $843,857 in 2021-22, while Personal Service Benefits declined during the same period. Operating expenses attributable to program administration rose from $693,926 in FY 2019-20 to $728,824 in 2021-22. Across administrative cost categories, however, there was a slight decline in costs between FY 2019-20 and FY 2021-22.

Table 8. Administrative Cost Data

Expenditure Category[1]	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Personal Services	$841,126	$828,558	$843,857	$397,297
Personal Service Benefits	$744,747	$583,666	$553,027	$212,300
Operating Expenses	$693,926	$729,357	$728,824	$565,795
Travel, Utilities, Repair, & Maintenance	$174,432	$215,319	$250,362	$234,287
Supplies and Materials	$31,908	$52,575	$52,526	$28,097
Land and Buildings	$0	$0	$0	$127,541
Total	**$2,486,139**	**$2,409,476**	**$2,428,596**	**$1,565,316**

Source: TBG Work Product, MCD.
[1] Categorization of administrative costs was completed by Florida Keys MCD based on an outline provided by TBG to ensure consistency across reports.
[2] 2023 YTD through March.

Direct Program Costs

Expenditures on direct program costs declined by about $1 million from FY 2019-20 through FY 2021-22, accounting for about 77% of total expenditures on average. Florida Keys MCD provided a breakdown of total expenditures by direct program costs, which are summarized in **Table 9**. Direct Personal Service expenditures increased from $3.97 million in FY 2019-20 to $4.05 million in FY 2021-22 while direct Personal Service Benefits declined during the same period. Direct Travel, Utilities, Repair, & Maintenance-related costs rose from $1,408,313 in FY 2019-20 to $1,762,708 in FY 2021-22. This partly reflects a resumption of the ability to travel as COVID lockdowns were lifted. Another large direct expenditure category, Supplies and Materials, saw cost decreases in FY 2021-22 compared to the prior two FYs. Total direct costs fell between FY 2019-20 and FY 2021-22.

Table 9. Direct Program Cost Data

Expenditure Category[1]	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Personal Services	$3,965,563	$3,673,455	$4,047,606	$2,212,128
Personal Service Benefits	$3,511,176	$2,587,713	$2,652,626	$1,182,073
Operating Expenses	$164,364	$649,312	$196,109	$151,946
Travel, Utilities, Repair, & Maintenance	$1,408,313	$2,265,282	$1,762,708	$266,223
Supplies and Materials	$2,405,362	$1,835,522	$1,826,060	$493,329
Machinery & Equipment	$0	$0	$19,837	$3,662,745
Total	**$11,454,777**	**$11,011,285**	**$10,504,946**	**$7,968,443**

Source: TBG Work Product, MCD.
[1] Categorization of direct program costs was completed by Florida Keys MCD based on an outline provided by TBG to ensure consistency across reports.
[2] 2023 YTD through March.

Expenditures on costs not relating to either administrative or direct program costs totaled to about 5% on average for the period in review.

Florida Keys MCD has taken steps to reduce costs within the last three years. These steps have included deployment of additional remotely monitored traps, testing the use of drones for surveillance of tidal areas, and using trailcams to identify water-inundated areas that may contain larvae. These improved technologies save on the cost of dedicating man-hours to provide in person surveillance and improve efficiency and accuracy in treating targeted areas, and enable personnel to be deployed on more critical tasks such as spraying operations. Florida Keys MCD continues to invest in training, research, and operational improvements to reduce costs.

Contracts for Services

Florida Keys MCD contracts for professional services such as legal, audits, certain IT, and some specialized maintenance items such as regularly required aircraft engine inspections that can only be carried out by specially certified organizations. For FY 2022-23 and the three previous FYs, TBG reviewed documentation provided by Florida Keys MCD to determine what services Florida Keys MCD contracted for rather than conducting in-house, as well for any services the district is contracted to provide. The Florida Keys MCD has contracted during the current and past three fiscal years for several types of services, including legal and engineering services, accounting and auditing, and other services. For example, in FY 2022-23, the district contracted for up to five days of drone-administered larvicide treatment during the summer season, when mosquito populations are the highest. Contracted services show a spike in FY 2020-21 due to a cyberattack during which the district fell victim to ransomware and consequently procured contractual IT services to restore data and systems and avoided paying a ransom. Without this expenditure, FY 2020-21 would have been about $198,000, in line with other years. Most maintenance and other contracted services are scheduled to occur in the off-season (winter) so that the FY is front-loaded with these costs. FY 2022-23 is not expected to be materially higher than the prior three years of baseline costs, per discussion with Executive Director Andrea Leal. **Table 10** summarizes contracted services activity by the Florida Keys MCD for the period of review.

Table 10. Summary of Contracted Services Expenditures

Expenditure Category[1]	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Professional Services	$0	$0	$35	$308
Legal & Engineering Services	$105,493	$137,356	$71,992	$47,796
Accounting & Auditing	$25,105	$27,385	$30,190	$0
Other Contractual Services	$162,984	$648,042	$194,524	$150,621
Total Expenditures	**$293,581**	**$812,784**	**$296,741**	**$198,724**

Source: TBG Work Product, MCD.
[1] Categorization of contracted services costs was completed by Florida Keys MCD based on an outline provided by TBG to ensure consistency across reports.
[2] 2023 YTD through March.

Florida Keys MCD is currently contracted by the Naval Air Station and Balfour Beatty in Key West, Florida to perform mosquito control services, including monitoring, trapping, sampling, reporting, and treating for mosquitoes at the base and naval housing areas. The five-year contract began in FY 2019-20 and will end after FY 2023-24. The total amount of revenue for the Key West Naval Base contract is $1,279,990 over the five-year period. The Balfour Beatty contract is renewed annually upon negotiation. **Table 11** details contracted services the Florida Keys MCD provided for the period of review.

Table 11. Summary of Contracted Services Revenues

Revenue Category	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Key West Naval Base Contract	$305,950	$315,130	$324,585	$334,325
Balfour Beatty Contract	$25,000	$25,000	$25,000	$25,000

Source: TBG Work Product, MCD.
[1] 2023 YTD through March.

Staff

Florida Keys MCD had 79 paid, in-house staff members in FY 2021-22, with a wide range of responsibilities and expertise. Florida Keys MCD had no contracted employees or volunteers in FY 2021-22. Of the occupied positions, 72 were filled by full-time employees, 5 were commissioners, and 2 were part-time or seasonal positions. No compensation for independent contractors was reported. While some volunteers are used for events, the number is not constant or tracked. However, Florida Keys MCD did report that volunteers are largely sourced from local high schools when they are used (they were not used in FY 2021-22). For FY 2022-23 Florida Keys MCD has 76 paid, in-house staff members (71 full-time and the 5 commissioners).

With the advent of new technology including drones, electronic traps, and software advancements, it is possible that some field inspector positions may eventually be consolidated to improve operational efficiency. As remotely accessible traps and drones become more prevalent, the need for having humans in the field may diminish. However, if some of these positions were retained and trained to operate new equipment and retain institutional knowledge, the possibility for even further increases in operational capability and efficiency arises. TBG staff shadowed Florida Keys MCD field inspectors; the institutional knowledge they possess is valuable, and it is unlikely that there is a large pool of able-bodied workers willing to undertake the hot, often inhospitable conditions they face daily. A list of all Florida Keys MCD staff positions is provided in **Table 12**.

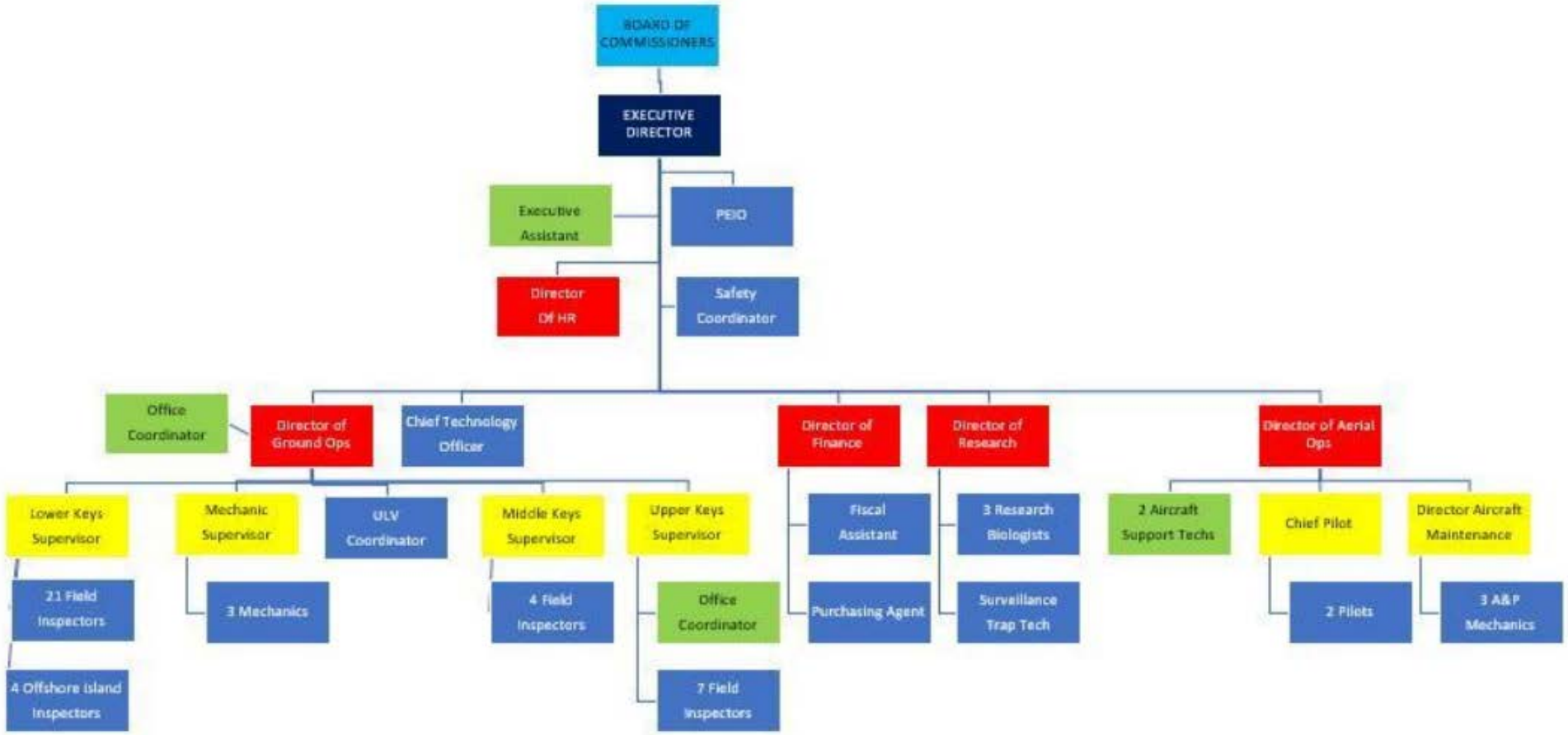
Table 12. Florida Keys MCD Staff Positions

• Commissioners • Finance Director • Fiscal Assistant • Director of Human Resources • Purchasing Agent/Financial Analyst • Research/Survey Biologist • Lower Keys Supervisor • Field Inspector • Offshore Technician • Mechanic Supervisor • Mechanic	• Ground ULV Coordinator • Ground ULV & Surveillance Technologist • Research Director/ Entomologist • Mid Keys Research/Surveillance Biologist • Middle Keys Supervisor • P/T Surveillance Technologist • Upper Keys Supervisor • Upper Keys Research/Surveillance Biologist • Chief Technology Officer • Information Technology Assistant • Air SPT Tech	• Executive Director • Operations Director/Entomologist • Executive Assistant • Director of Aerial Operations • Chief Pilot • Pilot • Director of Maintenance • Aircraft Mechanic • Office Coordinator • Public Education Information Officer • Quality Assurance/Safety

Source: Florida Keys MCD.

An organizational chart is provided in **Figure 3**.

Figure 3. Florida Keys MCD Organizational Chart



Source: Florida Keys MCD.

Analysis of Program Staffing Levels

Florida Keys MCD had a stable number of commissioners and employees over the review period and is appropriately staffed for the scale and scope of its operations. To assess program staffing levels, TBG reviewed documentation provided by Florida Keys MCD, interviewed Florida Keys MCD staff and visited their facility.

Florida Keys MCD reconfigured to create more roles to meet demand from district growth and operational requirements, creating roles for 10 new inspector positions after the 2009-10 dengue fever outbreak in Key West. Increased support needs in the aerial department also led to growth in personnel, with additional administrative positions being created to help facilitate the overall growth. At the same time, efficiencies with new technology have kept staffing relatively stable over the period of review, despite the district's growth. The district reported that it faces challenges in the future with the retention of staff due to the significant increases in the cost of housing and lack of affordable housing in the county.

As discussed previously in this report, several functions (i.e., human resources, finance, information services, and fleet management) that Florida Keys MCD operates in-house have the potential to be consolidated with, and provided by, the Monroe County government. However, due to the complex and highly specialized nature of the work, if these functions were taken over by Monroe County, no significant improvements in efficiency are anticipated since the operations within the MCD are already on par with county abilities. With the complexity of the treatment application equipment that is part of the trucks the MCD services in-house, training of county mechanics to service the trucks would be inefficient when district mechanics are already trained. As noted elsewhere within the report, the Board of County Commissioners has stated strongly that they do not believe Monroe County could or should consolidate any of the Florida Keys MCD operations, as they believe current operations are efficient and effective.

Florida Keys MCD has employed about 70 full-time employees a year, along with a few part-time workers (**Table 13**). In addition, Florida Keys MCD has not historically employed contracted workers or hosted volunteers. About a dozen vacant positions existed until the most recent FY. Florida Keys MCD had an operational review in December 2022. The review noted "a well-trained professional workforce of 70+ employees overseen by a forward-thinking management team with many years of experience. The relatively low 10% annual turnover results in most field employees having significant experience, an important aspect when local knowledge is key." Recommendations in the operational review include filling two key vacancies of the Director of Aerial Operations and the Upper Keys Supervisor, and consolidating some administrative positions as retirements occur, which to date has been accomplished.

Table 13. Florida Keys MCD Staff Counts

Counts	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Commissioners	5	5	5	5
Full Time	73	71	72	71
Part Time	3	2	2	0
Contracted	0	0	0	0
Volunteers	0	0	0	0
Vacancies	10	12	11	1
Total	**91**	**90**	**90**	**77**
Turnover Rate	13%	12%	15%	1%

Source: TBG Work Product, MCD.
[1] 2023 YTD through April.

Equipment and Facilities

Equipment and facilities of Florida Keys MCD are currently sufficient for operations, with equipment being serviced regularly to maintain and maximize efficiency in operational capabilities as well as an ongoing program to update aerial equipment; facilities are sufficient for operations compared to other districts with similar mosquito control activities. To review the equipment and facility trends of Florida Keys MCD, TBG analyzed documentation provided by Florida Keys MCD, interviewed district staff, and inspected equipment and facilities. As part of the inspection, TBG staff rode along for an aerial inspection, visited a trap site, and shadowed a field inspector on daily rounds. Equipment and facilities in use were well aligned with the operational needs.

Compared to Collier MCD and Lee MCD, the most similar MCDs based on expenditures in the most recent FY and staff size, the Florida Keys MCD operates at a similar level. The Florida Keys MCD also has sufficient facilities in comparison to these other similarly sized districts, having more facility locations than the other two districts combined, reflecting its sprawling geography and long distances between facilities and treatment areas.

Florida Keys MCD has an ongoing program to replace outdated airplanes with helicopters, ultimately going from two fixed wing and four rotary aircraft to four standardized rotary aircraft. Parts are becoming increasingly expensive for older aircraft, and the older aircraft are less efficient. Florida Keys MCD has deployed newer helicopters of similar make and model. The aircraft are more efficient operationally, for energy use, and for ease of interchanging consistent parts and mechanical maintenance. Florida Keys MCD schedules regular servicing and maintenance of its aerial fleet to ensure ongoing operability.

Florida Keys MCD owned two airplanes, two helicopters, four boats, 37 trucks, and three all-terrain vehicles in FY 2021-22. Florida Keys MCD also leased two helicopters and 39 trucks in that same year. Equipment owned by Florida Keys MCD included 143 pieces of field equipment, 18 lab items, and 54 computers and other office equipment. Florida Keys MCD owned three facilities in FY 2021-22, which house a total of 6 buildings.

A summary of the number of vehicles, equipment, and facilities owned by Florida Keys MCD is provided in **Table 14** and the number of surveillance equipment are in **Table 15**.

Table 14. District Vehicles, Equipment, and Facilities

	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Vehicles	**69**	**76**	**87**	**90**
Airplanes	2	2	2	2
Helicopters	4	4	4	4
Boats	3	4	4	4
Trucks and Vans	59	65	76	79
ATVs and Utility Vehicles	3	3	3	3
Equipment	**205**	**208**	**215**	**218**
Field Equipment	134	137	143	145
Lab Equipment	18	18	18	18
Office Equipment	53	53	54	55
Facilities	**3**	**3**	**3**	**3**
Buildings	6	6	6	6

Source: TBG Work Product, Florida Keys MCD.
[1] 2023 YTD through April.

Table 15. Surveillance Equipment

Equipment	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Mosquito Traps	**118**	**118**	**133**	**167**
ABC Traps	70	70	70	70
BGC Traps	10	10	25	25
BGS Traps	33	33	33	33
In2Care Traps	0	0	0	25
Ovicup Traps	5	5	5	5
Sirenx Traps	0	0	0	9

Source: TBG Work Product, MCD.
[1] 2023 YTD through April.

Strategic or Other Formal Plans for the District's Future

Florida Keys MCD has developed its 2023-2026 strategic plan that outlines goals and includes measures to account for the needs of district operations and services for the current and next three years. To assess the formal plans for Florida Keys MCD's future, TBG reviewed documentation provided by Florida Keys MCD to determine the full scope of Florida Keys MCD's strategic plan.

Florida Keys MCD published a 2023-2026 strategic plan outlining its completed goals and new goals to achieve in the next three years. This plan reviews the mission of Florida Keys MCD, and details the goals, objectives, and strategy for each priority area of Florida Keys MCD. The priority areas are split into eight categories: Pesticide Resistance, Domestic Mosquito Control Practices, Increase Environmental Sensitivity, Public Awareness of Mosquito Control Practices, Operational Safety Practices, Use of Technology to Maximize Resources and Increase Efficiencies, Employee Retention and Health Initiatives, and Capital Projects. Each category reviews the goals it has, its strategy to achieve them, objectives that have been completed so far, and objectives remaining.

District planning for the future that would affect performance and costs includes

- Continued investment in research to improve effectiveness of methods and techniques in future service delivery. The Miami-Dade Zika outbreak of 2016 ultimately ended through treatment with a product developed by Florida Keys MCD.
- Completion of a seven-year plan to phase out its old aircraft and replace the vintage models the district currently utilizes with modern helicopters, with increased payload, fuel efficiency, safety features, and precision capability, reducing the number of aircraft in the fleet while increasing efficiency.
- Continued investment in equipment that improves future efficiencies in operations, such as the drone surveillance and trailcams described herein.
- Continued investment in employee training and development to maintain staff retention.
- Building maintenance plans have been developed to forecast predictable facilities repairs or upgrades for the next 10 years. An example is the Marathon Hangar will need a roof replacement in FY 2023-24, which has been considered in budget planning.

Previous Performance Reviews, Financial Audits, and Resident Feedback Surveys

Florida Keys MCD had no identified significant issues with performance reviews, financial audits, or public feedback; audits reported past material weaknesses in internal controls with corrective measures taken to remedy each. Florida Keys MCD procured a performance review in late 2022. The review found that "The District is using effective and efficient methods to target mosquito problems, with a well-trained professional workforce of 70+ employees overseen by a forward-thinking management team with many years of experience. The relatively low 10% annual turnover results in most field employees having significant experience, an important aspect when local knowledge is key. FKMCD is at the forefront of operational evaluations of new methods and supporting novel techniques through industry collaborations." The review included a number of recommendations, including increasing the rate at which aging vehicles were replaced, filling outstanding vacancies, and other operational details that Florida Keys MCD management and board took under consideration as they updated their current strategic plan. Regarding TBG's review, the most relevant recommendation was for the district to develop performance measures. As part of its strategic planning, district management and the board addressed this recommendation by identifying key performance measures for future tracking and assigning specific timelines to each.

As noted in the Revenues and Expenditures section, the financial position of the district is sound. Florida Keys MCD manages its operations to stay within forecasted revenues and has covered costs in all but one of the four years reviewed. In FY 2019-2020, the year in which expenses exceeded revenues, a significant cost overrun occurred when a dengue outbreak hit the Keys, necessitating rapid response and extensive purchases of chemicals Reserve funding was used to address the outbreak. The reserves were replenished in the following fiscal year.

Analysis of Florida Keys MCD's financial audits was conducted with provided financial audits from Florida Keys MCD. The audit of Florida Keys MCD's financial statements from FY 2018-19 found issues from the FY 2017-18 audit to have been corrected, but further issues arose with material weaknesses of recording errors of payments and continual projects, as well as payroll personnel files being incomplete. These issues were rectified in the FY 2019-20 audit, with no new issues arising. The FY 2020-21 audit found one material weakness with the incomplete

recording of one transaction. The accrual was related to a settlement payment as part of an agreement with the City of Key West and fell outside routine accounting processes but was made timely. The FY 2021-22 audit report reported no material weakness, and that all prior items had been corrected.

A survey of residents relating to the district's communications efforts was conducted in 2020. The survey focused on which communication methods were most effective in reaching residents and in conveying public awareness of mosquito management. Florida Keys MCD management reported that feedback was positive, with residents noting appreciation for field inspectors particularly. A resident feedback survey for the district is planned for the upcoming FY, with results expected to be compiled in December of 2023.

The Naval Air Station of Key West, Florida provided yearly performance reviews to the district for its contracted services. No major weaknesses or deficiencies were identified, with the quality, scheduling, management, and regulatory compliance all deemed satisfactory. The Naval Air Station recommended the Florida Keys MCD for the provision of future services at the base.

Analysis of Management Reports/Data and Performance Information

Florida Keys MCD actively monitors performance success or failure of its operations and administration and compares against established goals; the district has effective reporting mechanisms in place to measure results on a timely basis. To assess management reporting and performance information, TBG reviewed documentation provided by Florida Keys MCD in their current strategic plan. The current strategic plan shows regular progress towards goals with objective measures that have been achieved, and measures that will soon be achieved. The strategic plan also details the district's strengths, weaknesses, opportunities, and threats exercise, demonstrating the district's strong ability for self-analysis. The information reviewed reflects regular monitoring of performance, identification of issues as they arise, and analysis of opportunities to improve efficiency and effectiveness.

Evaluation of Cost, Timing, and Quality of Current Program Efforts

Florida Keys MCD manages program cost and quality effectively and efficiently. To assess cost, timing, and quality of program efforts, TBG reviewed documentation provided by Florida Keys MCD, publicly available data and reports, interviewed Florida Keys MCD staff, and visited their facility. Current program efforts include continuous monitoring of programs for effectiveness, such as the effectiveness of the sterile insect technology program and the efforts to identify zones of high mosquito populations. Florida Keys MCD monitors the program efforts and documents the district's progress towards the achievement of all of its objectives, detailing the district's progress and next steps towards achievement in the strategic plan. Costs, progress, and next steps are all effectively reviewed and monitored for progression. The fiscal, operational, and management activities align well with the Florida Keys MCD mission and are of appropriate size and scale for the district's tasks. Florida Keys MCD is considered one of the best-managed MCDs by peers across the state, based on unsolicited comments from other MCDs.

Goals, Objectives, and Performance Measures and Standards

Florida Keys MCD has clearly defined goals and objectives that adequately address its statutory purpose; the district tracks and measures its performance, and analysis finds that the district is upholding its performance standards.

To assess the district's goals, objectives, performance standards, and performance measures, TBG requested and reviewed the district's charter; requested and reviewed the district's strategic plan and the last three years of annual reports; requested information on performance measures and standards and records of current and previous three FYs' measures, standards, and records of success or failure to meet the standards and evaluated the district's actual performance in meeting its goals and objectives. TBG assessed whether performance measures and standards are relevant, useful, and sufficient to evaluate the performance and costs of the programs and activities, whether they are being met, and whether they need to be revised. TBG requested and reviewed previous performance reviews and audits; requested district assessments of why (if applicable) the district failed to meet performance measures and standards and/or goals and objectives; and requested information from the district on actions taken to address and prevent such failures in the future. In addition, TBG interviewed district staff and relevant local government entities about district performance and requested any available results of district-generated resident feedback surveys conducted during the current and previous three FY.

Goals and Objectives

Florida Keys MCD has recently established extensive and clearly stated goals and objectives across eight district priority areas. The chapter law that provided for the continuation of the district does not specify goals and objectives for the district. Florida Keys MCD began strategic planning in 2014 and meets internally on a regular basis to ensure goals and objectives are met in a timely manner. This information is discussed annually in board workshops and meetings prior to the budgeting process. Florida Keys MCD created a strategic plan for the upcoming 2023-2026 period. This strategic plan defines eight priority areas that may impact the district's ability to provide services or require modifications or changes to service delivery and further establishes goals and multiple clear and specific objectives under each goal. The extensive, detailed list of goals and objectives reflects the complexity of this district's operations and the detailed, complex planning and management effort required in each area of operation. **Table 16** provides examples of specific goals across each of the priority focus areas.

Table 16. Florida Keys MCD Goals and Objectives

Priority Area	Goals	Objectives
Pesticide Resistance	Understand the potential and causes of pesticide resistant populations of mosquitoes in Monroe County.	• Have a plan in place for testing mosquito populations from each island. • Begin testing mosquito populations for resistance to current adulticide products. • Comparison of results to known susceptible colonies. • Have a method of mapping tested populations by island. • Have a plan in place for testing mosquito populations for resistance to larvicides.

Priority Area	Goals	Objectives
	Continuation of testing newly available products for alternative adulticides to be used in areas of resistant mosquito populations.	• Contact with vendors of major providers updated (ongoing). • Bottle bioassays with new products completed. • Cage trials completed with new products. • New products identified for upcoming season. • Cage trials with RamoaTri.
Domestic Mosquito Control Practices for Invasive Mosquitoes	Determine utility of Wolbachia-infected mosquitoes for control of Aedes aegypti in Monroe County.	• Complete testing Wolbachia-infected mosquitoes on Stock Island. • Complete assessment of initial trial of Wolbachia-infected mosquitoes. • Develop plan for continuation of future use of Wolbachia-infected mosquitoes.
	Determine utility of genetically modified mosquitoes for control of Aedes aegypti in Monroe County.	• Obtain regulatory approval (EPA/DACS) for Experimental Use Permit. • Obtain board approval for trials. • Complete initial testing. • Complete 2nd year testing. • Complete 3rd year testing. • Develop plan for continuation of future use of genetically modified male mosquitoes.
	Determine utility of irradiated (sterilized) male mosquitoes for control of Aedes aegypti in Monroe County to obtain better control of disease vector mosquito populations.	• Identify potential vendors from which to purchase irradiated male Ae. aegypti mosquitoes. • Develop plan for testing irradiated male Ae. aegypti mosquitoes. • Test irradiated male Ae. aegypti mosquito releases. • Have a plan in place for smaller field areas or the potential of "domestic only" inspectors. • Train staff in new areas • Evaluate inspector areas. • Evaluate inspector positions.
	Determine the efficacy of barrier treatments applied around homes and businesses for control of Aedes aegypti and Aedes albopictus.	• Perform bottle bioassays using bifentrhin, deltamethrin, and tau-fluvalinate for Ae. aegypti • Perform leaf tests using above products. • Make operational decision based on results.
	Determine the efficacy of ground Vectobac WDG treatments in neighborhoods in	• Procure initial ground equipment. • Complete multiple applications by ground and air in response to rainfall and/or suspect disease cases. • Analyze trap and larval data for efficacy.

Priority Area	Goals	Objectives
	comparison to aerial applications.	• Set treatment thresholds for use of ground and aerial WDG treatments. • Create routes for routine treatment throughout each area. • Hire and train on call drivers for ground WDG treatments. • Assess routine routes to ensure better coverage. • Create additional routes/maps and schedules.
	Determine utility of specialized traps for the control of Aedes aegypti in Monroe County.	• Research available Ae. aegypti control trapping methods. • Place acoustic larvicide traps in the field. • Assess effectiveness of acoustic larvicide traps in controlling adult Ae. aegypti population. • Place In2Care traps in the field. • Assess effectiveness of In2Care traps in controlling adult Ae. aegypti population.
	Identify important domestic mosquito control harborage areas to better target operations.	• Create list of major Ae. aegypti hotspots. • List all homeowners' associations in the Florida Keys. • Itemize list of potential control measures for each area. • Evaluate areas to conduct special trapping studies. • Conduct Tire Amnesty Day • Schedule annual neighborhood cleanups.
Increase Environmental Sensitivity	Transition to high efficiency vehicles that are more duty-specific.	• Establish which vehicles are due for replacement. • Research current market for viable replacements. • Create a plan for each vehicle. • Obtain smaller, more fuel-efficient vehicles. • Maintain vehicle replacement list. • Research current market. • Research potential multi-function trucks (WDG/ULV/inspector)
	Transition to electric ULV machines.	• Establish a phase out timeline for current ground ULV equipment. • Obtain quote for new equipment. • Procure 3 electric machines (one for each location). • Procure additional equipment according to plan. • Research more robust electric ULV equipment.
	Move towards renewable energy at facilities.	• Research potential for solar energy at all three locations.
	Go paperless throughout the district to increase efficiency.	• Complete network filing system re-vamp. • Complete digital forms. • Print only items that need signature • Research electronic timesheets.

Priority Area	Goals	Objectives
		• Research electronic leave requests.
Public Awareness of Mosquito Control Practices	Making members of the community a more active part of our mosquito control efforts	• Beta version of smart phone app developed. • Testing of beta version completed. • Final version of app completed and incorporated. • Research incentive-based community program.
	Increasing community awareness of what makes up an effective mosquito control program.	• Quarterly sweeps in different neighborhoods throughout the Keys. • Educational materials updated. • Update Homeowner's Guide DVD. • Increase social media posts about ongoing district operations and board functions • Publish 2-3 op-eds or ad placements on operations, innovations, staff highlights • Plan for annual "open house" event at the Marathon facility. • Improve website functionality and look. • Research larger vehicle logos/branding.
	Increase mosquito knowledge and awareness among school-aged children and young adults through educational programs.	• Guest lecture centered around Ae. aegypti control and operations. • Update curriculum for school-aged children. • Teach classes on mosquito control in local schools. • Develop an interactive education center on keysmosquito.org for teachers/students.
	Better understand public knowledge and customer service.	• Finalize questions. • Plan for information gathering completed. • Disseminate survey. • Compile results.
Operational Safety Practices	Reduce work-related injuries through safety awareness.	• Create safety focus groups in each location. • Develop monthly meeting schedule. • Determine common accidents over past 3 years. • Develop and implement monthly safety message plan. • Update district Hurricane Plan • Meet with program directors to determine best method of training. • Develop training tools. • Implement training by department. • Research new training methods.
	Reduce work-related injuries by developing a proactive safety system.	• Determine a method of reporting near miss accidents. • Develop incident review procedures. • Implement near miss incident program.

Priority Area	Goals	Objectives
		• Revisit system annually to ensure capturing pertinent information.
	Reduce work-related injuries by further developing a safety inspection program.	• Create an inspection schedule with input of focus groups. • Create departmental inspection forms. • Develop standard reward program. • Implement inspection program. • Create robust building inspection form. • Revisit system annually to ensure capturing pertinent information.
	Determine the effectiveness of new implementations over the past 3 years.	• Employee safety survey to review effectiveness of the safety program. • Develop reportable injury tracking system. • Repeat employee safety survey. • Develop assessment tool to properly analyze reported injuries.
	Increase capacity and reach of safety training throughout all areas of the district	• Research alternative remote learning opportunities for field staff. • Meet with program directors to discuss remote learning alternatives. • Test remote learning alternatives. • Implement remote learning.
	Increase safety awareness in the aviation department through audits and software implementation to develop more comprehensive safety awareness.	• Complete external safety audit. • Complete update of flight operations manual and maintenance procedures manual. • Implement full maintenance and flight operations tracking. • Conduct external safety audit of flight and maintenance.
Use of Technology to Maximize Resources and Increase Efficiencies	Utilize available technology to identify remote indicator sites.	• Identify and prioritize all larval production sites. • Purchase and set cameras in priority areas. • Determine if area coverage is accurate and sufficient. • Set up buying/replacement schedule. • Camera placement and usage protocol established. • Research potential tidal measuring tools to assist in remote information collected. • Research remote rain sensors.
	Become more precise when treating larvicide areas.	• Train all inspectors on use of red/blue dot feature in Fieldseeker.

Priority Area	Goals	Objectives
		• Implement policy on utilization of this feature to determine polygons and missed areas. • Follow up meetings w/ground and aerial teams after all larvicide treatments.
	Expand the use of Remote Piloted Aircraft (RPA) throughout the district in surveillance and possible treatment.	• Identify lead employees. • FAA certificate of authorization. • Aerial applicators licenses. • Contract w/vendor for initial larvicide treatments with RPAs • Monitor ongoing legislative priorities
	Determine utilization of the Biogents (BG) Auto Counter to replace landing rate counts conducted on a daily basis.	• Determine overall accuracy of trap. • Complete cost/benefit analysis of trap utilization. • Develop procurement plan. • Implement procurement plan. • Develop and implement hurricane plan for traps. • Compare landing rate counts with BG Auto Counter. • Determine if landing rate counts can be reduced with use of BG Auto Counter.
	Increase operational awareness of all district truck operators.	• Research various vendor mapping capabilities. • Submit bids/proposals for budgeting purposes.
Employee Retention and Health Initiatives	Develop a compensation policy and strategies that reward employees for high-level performance that reach district goals.	• Meet with supervisors to ensure accurate job descriptions. • Interview employees re: job descriptions. • Finalize job descriptions. • Conduct salary survey to include local government agencies and other MCDs. • Board resolution to complete salary surveys every three years. • Transition employee evaluations from paper to digital. • Implementation of salary exempt positions. • In-house salary survey completed and presented to board of commissioners. • Digitize retiree and active employee files.
	Develop a sustainable benefits plan that allows the district to continue to provide industry leading benefits that provide and encourage District	• Meet with external partners and evaluate district's benefit package. • Collect and evaluate employee benefit utilization information. • Collect and evaluate marketplace and industry specific trends. • Compile collected data and report to Executive Director.

Priority Area	Goals	Objectives
	employees to participate in their wellbeing.	• Present a benefit policy for board approval. • Begin selecting external partners to start developing benefits packages. • Establish monthly meeting with partners. • Review, solicit and collect benefit costs and present to board. • Bid process completed for medical, dental and vision.
	Develop a comprehensive policy and strategies to enhance housing opportunities for district employees.	• Annual review of other local entities' policies and partnerships for affordable housing.
Capital Projects	Maximize aerial fleet capacity and efficiency	• Complete use analysis of aerial fleet including missions flown, dates, capacity, etc. • Complete maintenance cost projection per aircraft. • Complete cost/benefit analysis for fleet. • Complete future plan direction and present to Executive Director. • Procure 2 Airbus H125. • Surplus 2 Bell Jet Rangers. • Complete use analysis of H125 aircraft and present to board. • Procure 3rd Airbus H125. • Surplus 1st Islander. • Implement 3rd Airbus H125 into service. • Surplus 2nd Islander. • Surplus 1 LongRanger. • Procure 4th Airbus H125. • Implement 4th Airbus H125 into service. • Surplus Last LongRanger.
	Increase efficiency of aerial adulticide treatments.	• Research night vision goggle (NVG) and nighttime spray usage possibilities. • Utilize NVGs to transition to spray areas prior to first light. • Research nozzle technology that can increase our dispersion height. • Droplet testing at 200'.

Source: TBG Work Product, MCD

The goals and objectives of the Keys MCD address the district's statutory purpose, provide sufficient direction for programs and activities, and are aligned with the operating budget. This is evidenced by the fact that the objectives achieved within the last few years were achieved within the operating budget, which was stable and based on the goals and objectives. For example, the reserves built to replace a dated aerial fleet were aligned with

the goal of maximizing fleet capacity and efficiency. Related objectives include (but are not limited to) completing a cost-benefit analysis for comparing aerial and ground treatments and upgrading equipment and presenting the analysis to the Executive Director, surplusing the first Islander aircraft, and placing the third Airbus H125 into service. The first two objectives were met and the third is underway.

The district's goals and objectives address multiple issues including:

- mosquito pesticide resistance;
- control of invasive mosquito species, like Aedes aegypti, that can spread dengue fever, chikungunya, Zika fever, and other viruses;
- use of mosquito control practices that minimize environmental impacts;
- education of the public on mosquito control practices, including practices that can be implemented at home;
- operational safety challenges and work-related injuries;
- development of technology to maximize resources and increase efficiencies in treatments; and
- challenges with employee retention due to the high costs of living in the Keys.

Some expected benefits of reducing mosquito populations are the prevention of disease, including serious illnesses like encephalitis, West Nile virus, Zika virus, yellow fever, and dengue fever. The general public good is also improved with the reduction of nuisance populations of mosquitoes. Benefits of Florida Keys MCD's extensive larval habitat inspections and treatments are reducing the use of harsher adulticides. In addition, the district's house-to-house field work increases the community's knowledge of practices to avoid standing water in garden ornaments and rarely used sporting or boating equipment. To combat rising costs and pest resistance, constant review and research is ongoing to create more efficiencies in programs.

Performance Measures and Standards

Florida Keys MCD has not established formal performance measures or standards tied to each district goal and objective but does maintain and track performance over time for responses to service calls and prevalence of mosquito-borne arbovirus in the district. Florida Keys MCD uses best practices and procedures to meet mosquito control objectives while limiting impacts to other non-target species and Florida Keys residents and visitors. Each goal of its strategic plan is broken down into clear, measurable objectives, and the district has begun to regularly review its progress in accomplishing these defined objectives and goals by indicating whether each individual objective has been achieved or not. The district has not, however, established formal performance measures or standards with which to track its progress towards achieving its goals and objectives. The district has monitored response to service calls and disease prevalence for the current and past three fiscal years. The following is a summary of the district's current performance measures and standards.

1. **Standard:** Address citizen requests for mosquito control efforts in a timely manner.

   Measure: Number of service requests received and addressed.

2. **Standard:** Zero human cases or deaths related to arboviruses acquired in Florida and detected in Florida Keys.

   Measure: Counts of arboviruses disease cases in humans as reported by DOH.

Analysis of Goals, Objectives, and Performance Measures

Florida Keys MCD's achievement of goals set forth in the current strategic plan shows favorable performance. Based on TBG's review, Florida Keys MCD is a well-run, effective, and efficient operation. The district's board and management focus on continuous improvement in program effectiveness, quality and cost control. Many complicating factors for mosquito control occur in the Florida Keys MCD: heavy tourism including international visitors, water on all sides, one road in and out, high living costs that serve as a barrier to entry for field staff, and large areas of environmentally sensitive land that require extensive coordination with regulators. These factors have increased mosquito control costs and complexity for Florida Keys MCD.

In addition, information is compiled continuously for management purposes and reported to the board monthly to allow the Board to conduct continual review of operational and fiscal activities of the district. Information regularly reviewed by the Board includes disease prevalence, number of adulticide and larvicide missions completed, number of service requests completed, number of community and school events, and number of position vacancies and hires.

While the district does not have formally established performance standards and metrics associated with each and every district goal and objective, it does carefully monitor whether it is achieving its individual objectives and it monitors service calls and responses and disease prevalence. Florida Keys MCD appears to be making progress toward its goals and objectives timely, based on review of the district's previous and current strategic plan and reporting documents provided regularly to the Board. Where specific objectives have not been met, the extenuating circumstance of COVID-19 has played a role, such as in some of the outreach activities that had been part of the 2018 – 2023 strategic plan. While data to track indicator performance measures for each district objective was not available, the current 2023-2026 strategic plan indicates, for some objectives, whether they have been achieved or not. While the new strategic plan is relatively recent, many of the objectives are still in progress and therefore achievement at this time is indeterminate, but it is clear from the district's activities, board review of other performance indicators, and tracking of the achievement of objectives that the district is carefully monitoring its performance in a variety of ways that are relevant to its established mission and purpose.

For example, one goal in Domestic Mosquito Control Practices for Invasive Mosquitoes was to identify important domestic mosquito control harborage areas to better target operations. As steps to achieve this goal, the Florida Keys MCD completed the objective to create lists of known hotspots of mosquitoes and homeowners' associations to contact regarding mosquito populations in their respective areas. Other completed objectives included further evaluation being done by conducting special trapping studies to determine areas of high concentrations of mosquitoes, and a Tire Amnesty Day program was successfully conducted, eliminating hundreds of potential mosquito larval habitats.

Table 17 reports disease prevalence within the Florida Keys MCD for the current and previous three calendar years and reports district service delivery metrics for the current and past three FYs. The district has had some incidence of Florida and travel-related arbovirus cases within the past three calendar years, but no arbovirus-related deaths have been recorded. The district has consistently responded to all service calls during the review period.

Table 17. Performance Measures for Florida Keys MCD

Performance Measure	CY 2020	CY 2021	CY 2022	CY 2023[1]
Arbovirus Cases (Florida)	67	0	0	0
Arbovirus Cases (Travel)	0	1	4	0
Arbovirus Deaths	0	0	0	0
	FY 2019-20	**FY 2020-21**	**FY 2021-22**	**FY 2022-23[2]**
Service Calls	2,894	3,254	2,768	1,540
Service Responses	2,894	3,254	2,768	1,540

Source: TBG Work Product, Florida Keys MCD, Florida DOH.
[1] Florida DOH data is provided by calendar year (CY).
[2] 2023 YTD through March.

Performance measures and standards for Florida Keys MCD from the strategic plan are summarized in **Table 18.**

Table 18. Assessment of Performance Measures and Standards for Florida Keys MCD

Performance Measure	Performance Standard	Assessment
Weekly arbovirus surveillance samples and weekly DOH arbovirus reports of human cases of arbovirus	Zero human cases or deaths from arboviruses acquired in Florida and detected in the district	Standard not met in CY 2020 due to 67 cases; standard met in CY 2021, CY 2022, and from January 1, 2023 through April 2023.
Responses to service call-based requests	Respond to all citizen service requests year-round	Standard met based on TBG review of DOH data.

Source: TBG Work Product, based on review of information provided by Florida Keys MCD.

Perception of District's Performance by Local Government Stakeholders, Residents, and Other Relevant Local Stakeholders

Perceptions of Florida Keys MCD's performance by other stakeholders are positive. Comments by other MCD staff indicate a positive perception of Florida Keys MCD's performance. On several occasions, staff in other districts cited the leadership shown by Florida Keys MCD in the areas of managing pest resistance, innovation in surveillance and testing, and coordination with other government entities.

A communications survey was conducted by Florida Keys MCD in 2020. The survey was designed to test the effectiveness of different forms of communications from Florida Keys MCD to residents. The results identified that door-to-door interactions between Florida Keys MCD staff (field inspectors) and residents were one of the most effective manners of raising awareness of Florida Keys MCD's operations. These methods were also determined to be a best practice for conveying information to residents on how to help manage mosquito populations.

As part of its 2023-2026 strategic plan, Florida Keys MCD plans to disseminate a survey to better understand public knowledge of mosquito control and customer service needs. Questions are to be finalized by May of 2023, with the survey disseminated in October and results compiled in December.

3. Recommendations

Discussion and Analysis

TBG analyzed findings by FY to determine if revisions to district organization or administration can improve the efficiency, effectiveness, and/or economical operation of the district and presents several recommendations for the Legislature's and the district's consideration. TBG presents recommendations to allow the district access to solid waste management funds from DEP that could help improve efficiency of the district's operations by reducing costs for an important and never-ceasing source reduction activity of waste tire collection and disposal; to allocate additional funding to help the district manage emergency disease outbreaks that do not occur as part of a major named storm event; and to create incentives for developers to create affordable housing for district personnel.

Waste Tire Collection and Disposal Fees: Waste tires are commonly found scattered throughout residential and commercial areas across the state, and the design of tires makes them ideal habitat for mosquito larva, particularly for species of mosquito that are known to be important disease vectors. The removal of waste tires can help reduce populations of these disease-carrying mosquitoes and reduce the threat of diseases like dengue and Zika. However, the problematic mosquito-producing habitats created by waste tires are difficult to manage through routine chemical applications but can be managed through proper disposal.

Florida Keys MCD's geographic proximity to other countries creates a higher risk of disease outbreaks than in other districts, which makes waste tire collection a very important mosquito control activity in this district. Florida Keys MCD staff reported that the district routinely collects approximately 500 tires per year and in the current and prior three fiscal years estimates that it has spent an average of approximately $1,651 each year for waste tire disposal. The district applied for and received funding from DEP in FY2022-23 to reimburse the district for all costs associated with a waste tire amnesty event hosted by the district in the amount of $6,433. Although Florida Keys MCD has had excess revenues in the past three fiscal years, it is important for any public entity like an MCD to keep funding reserves to be prepared for unexpected expenditures like the extensive dengue fever treatment costs that the district experienced in recent years.

In Florida, DEP regulates the disposal of waste tires by creating requirements for the collection and disposal of waste tires at solid waste management facilities and waste tire processing facilities across the state.[8] These facilities typically charge fees for the disposal of waste tires, which frequently cannot be waived due to bond requirements for the facilities. MCDs must pay these fees if the districts choose to collect and dispose of waste tires.

The state currently collects a waste tire fee of $1 per each new tire sold at retail.[9] These funds are allocated in different amounts defined in statute to various activities related to solid waste management in the state, including funds that DEP is directed to use for general solid waste activities.[10] DEP currently uses a portion of this funding to reimburse counties for hosting waste tire amnesty events during which residents may bring in waste tires for disposal free of charge (businesses are not eligible for participation). DEP opens this opportunity annually from

[8] Sections 403.717 and 403.718, *F.S.* and Rule Chapter 62-711, *F.A.C.*
[9] Section 403.718, *F.S.*
[10] Section 403.709(1), *F.S.*

July through May to all counties in the state, and any county may apply for the assistance through the department by providing a scope of work including a description of how the amnesty event will be held, how many tires the district anticipates receiving, and other information. According to DEP representatives, the department advertises this funding opportunity specifically to counties; however, DEP has also allowed MCDs to apply for and receive the funding for waste tire amnesty events. For example, the Florida Keys MCD, as discussed above, and East Flagler MCD, as discussed in its report, received such funding in FY 2022-23.

For districts in which waste tires present a significant mosquito control challenge, the availability of funding to support waste tire abatement would be beneficial. Although DEP in its discretion has allowed MCDs to apply for the waste tire amnesty event funding in the past, advertising for the funding is not directed toward MCDs, and the department is not required by statute to continue to offer such funding in the future. Moreover, some MCDs would benefit from the reimbursement of waste tire disposal fees and other costs incurred by the district for tires collected and disposed of by district staff, in addition to funding for hosting waste tire amnesty events. Facilitating increased and consistent access to waste tire disposal funds by MCDs could help increase tire collections around the state, which has benefits beyond mosquito control, including general pollution reduction and beautification.

To allow regular access to waste tire abatement funding by MCDs, facilitate increased waste tire collection by MCDs around the state as a means of mosquito control, and increase the hosting of events like waste tire amnesty days by MCDs, the Legislature could consider amending section 403.709(1), *Florida Statutes*, to require a portion of the funds currently administered by DEP for solid waste activities to be allocated to waste tire abatement activities by MCDs.

Disease Outbreak: Similar to disaster declarations related to storms that allow local governments to access federal disaster assistance funds through the Federal Emergency Management Agency, MCDs should be eligible for state funding assistance when thresholds for mosquito-borne disease outbreaks are met. Thresholds for different vector-based diseases are established by the Centers for Disease Control and Prevention (CDC); these indicators provide quantifiable thresholds for vector abundance and infection rates associated with specific disease outbreaks. The financial assistance in circumstances where CDC-defined thresholds of vector abundance and infection rates are surpassed will help ensure the provision of adequate mosquito control services where the outbreak first occurs to help prevent the disease from further spreading throughout the state. This is especially pertinent for diseases such as dengue, chikungunya, and Zika, which are known to be transmitted by mosquitoes whose larva thrive in containers with standing water such as waste tires and trash cans. These types of mosquito habitats require labor-intensive efforts to control, including constant surveillance for any bodies of standing water that mosquitoes could breed in as well as regular treatment efforts to eliminate adult mosquitoes. For example, when almost 70 human cases of dengue occurred in the Florida Keys in 2020, the district incurred over $1 million in unbudgeted costs that had to be absorbed by the local taxpayers as the staff worked to control the spread of this disease.

Making MCDs eligible for state support in public health situations such as this is important for the health of all Florida residents and visitors and for the economic welfare of Florida as a whole. The Legislature could consider amending s. 388.261, *Florida Statutes*, which addresses state aid provided for counties and districts for arthropod control, to direct DACS to allocate a portion of the funding to support the increased treatment costs incurred by districts during mosquito-borne disease outbreaks.

Housing: The Florida Keys MCD has challenges with retaining staff due to rapidly increasing housing costs in Monroe County. The Florida Legislature enacted Chapter 2023-17, *Laws of Florida*, to improve the availability of and access to affordable housing throughout the state. The law created s. 420.50871, *Florida Statutes,* to allocate funding to developers for affordable housing projects that will address the needs of the elderly, young adults who age out of foster care, veterans, persons in areas of rural opportunity, and others. Housing costs are a significant barrier to staff remaining in the Florida Keys, with skyrocketing rents in recent years. The Florida Legislature could consider modifying s. 420.50871, *Florida Statutes*, to include affordable housing projects for Florida Keys MCD workers among the projects eligible for funding.

Performance Standards and Measures: Florida Keys MCD has developed a formal strategic plan with clear goals and objectives but has not developed formal performance measures and standards tied to each district goal and objective. The district could establish clearly defined performance measures and standards with which to assess its progress toward achieving its goals and objectives.

Florida Coordinating Council on Mosquito Control: During TBG's review of the 15 independent MCDs, TBG found that most districts have not developed sufficient goals, objectives, or performance measures and standards. The Florida Coordinating Council on Mosquito Control was established by the Legislature to foster maximum efficient use of existing resources and to assist entities involved in mosquito control with best management practices. Membership on the council includes the agency heads for DACS, DEP, and the Fish and Wildlife Conservation Commission, the State Surgeon General, as well as representatives of federal agencies, the University of Florida's Florida Medical Entomology Laboratory, Florida MCDs, and others. The Legislature could direct the council to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model MCD goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.[11]

Recommendations

Table 19 summarizes TBG's recommendations.

[11] Section 388.46, *F.S.*

Table 19. Recommendations with Associated Considerations

Recommendation	Considerations
The Legislature could consider amending section 403.709(1), *Florida Statutes*, to require a portion of the funds currently administered by DEP for solid waste activities to be allocated to waste tire abatement activities by MCDs.	• This recommendation would require a statutory change. • This recommendation would require DEP staff to communicate information about resources available through the department for waste tire collection and disposal assistance to MCDs and might add nominal additional administrative costs for the department. • This recommendation could lead to additional expenditures by the department from the Solid Waste Management Trust Fund; department staff reported that there tend to be unexpended funds from this funding source each year.
The Legislature could consider directing DACS to allocate a portion of the funding under s. 388.261, *Florida Statutes,* for emergency mosquito-borne disease outbreaks that do not occur as part of a state of emergency.	• Unless additional funds are appropriated, this recommendation could result in less funding being available for the purposes currently addressed by the statute.
The Florida Legislature could consider modifying Section 420.50871, *Florida Statutes*, to include affordable housing projects for Florida Keys MCD workers among the projects eligible for state development funding to increase affordable housing options in the area to retain district workers.	• This recommendation would require a statutory change by the Florida Legislature.
The district could formalize additional performance measures and standards that would allow the district to monitor and track progress toward all its goals and objectives. Such performance information would facilitate the district in consistently monitoring its progress.	• This recommendation would require additional staff time and may result in additional administrative costs to the district.
The Legislature could consider amending s. 388.46, *Florida Statutes*, to direct the Florida Coordinating Council on Mosquito Control to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.	• This recommendation would require a statutory change. • This recommendation would impose additional workload on council members and staff. • The council's membership could assemble a subcommittee with a broad range of expertise that could be ideal for the development of such model performance information. • While this guidance will assist all MCDs, it will be of particular benefit to MCDs that lack staff resources for the development of such performance information.

Source: TBG Work Product, based on review of information provided by Florida Keys MCD.

4. District Response

In response to the two corrections of fact pointed out in the district response letter that is provided on the following page, TBG made edits on page 8 of the report.

Executive Director
Andrea Leal

FLORIDA KEYS
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August 24, 2023

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Ms. Seidel:

Thank you very much for the ample amount of time and research your company has expended while conducting our performance review for the Office of Program Policy Analysis and Government Accountability. The report is very thorough and represents an accurate assessment of our operations, policies, and finances.

The District has two (2) clarifying suggestions to the report for your consideration:

1. Page 8, paragraph 1, sentence 3: "The district submits samples of mosquitoes collected from mosquito pools to the DOH laboratory in Tampa for testing every few weeks."
    a. The District submits samples when disease is detected, as described in all other areas of the report.
2. Page 8, paragraph 2, sentence 2: "Florida Keys MCD is currently using a technique in which male mosquitoes that are genetically modified to be sterile are deployed into the environment where they will mate with female mosquitoes whose offspring will fail to emerge as adults."
    a. Just a point of clarification that in a successful mating of Oxitec males and wild females, only the female offspring will fail to emerge as adults. Male offspring become adults and continue their lifecycle.

We appreciate the working relationship with all parties in the completion of this report and the opportunity to comment. Please do not hesitate to contact me should you have any questions.

Kind regards,

Andrea L. Leal
Executive Director
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"THE FABULOUS FLORIDA KEYS"

Attachment 1

GLOSSARY OF TERMS
MOSQUITO CONTROL DISTRICT REVIEWS

September 2023

Prepared for

The Florida Legislature

Prepared by

The Balmoral Group

165 Lincoln Avenue

Winter Park, FL 32789

Attachment 1

Term	Definition
Adulticide	A chemical that kills adult insects, which is usually applied as a spray; depending on the circumstances, adulticide applications can be made from the ground (most commonly with ultra-low volume spray trucks) or from the air (with either fixed- or rotary-wing aircraft or helicopters)
***Aedes aegypti* mosquitoes**	The primary type of mosquitoes (commonly referred to as yellow fever mosquitoes) that spread Zika, dengue, chikungunya, and other viruses; because these mosquitoes live near and prefer to feed on humans, they are more likely to spread these viruses to humans than other types of mosquitoes
***Aedes albopictus* mosquitoes**	Although competent vectors of dengue, eastern equine encephalitis, and other viruses that affect humans, these mosquitoes (commonly referred to as Asian tiger mosquitoes) feed on animals as well as humans and are, thus, less likely to spread viruses to humans than *Aedes aegypti* mosquitoes
Altosid	The trade name for a mosquito larvicide that contains a synthetic version of the juvenile hormone insect growth regulator methoprene as the active ingredient
American Mosquito Control Association (AMCA)	A professional association that includes individuals working for mosquito control programs, academics conducting research on mosquitoes and other disease vectors, and industry representatives who support mosquito control efforts around the world; the AMCA is active in member training and educating the public on the health importance of mosquito control in the U.S. and beyond; the association is international in scope and has approximately 1,500 members
***Anopheles* mosquitoes**	A genus of mosquitoes with more than 400 species; female mosquitoes in approximately 40 of these species transmit malaria; this is the only genus of mosquitoes that can transmit malaria
Arbovirus	Arthropod-borne viruses that are transmitted to humans primarily through the bites of infected mosquitoes, ticks, sand flies, or midges; includes West Nile virus, eastern equine encephalitis virus, St. Louis encephalitis virus, dengue, chikungunya, Zika, California encephalitis group viruses, and malaria
Arthropod	As defined in Ch. 388, *Florida Statutes*, titled "Mosquito Control," "arthropods" are insects of public health or nuisance importance, including all mosquitoes, midges, sand flies, dog flies, yellow flies, and house flies

Attachment 1

Term	Definition
Barrier island	Land that separates the ocean from the mainland; frequently an estuary or a lagoon will be located between the barrier island and mainland
Biogents	A company that produces mosquito traps with the goal of reducing mosquito populations that are produced in container-type habitats
***Bacillus thuringiensis israelensis* (*Bti*)**	A naturally occurring bacteria commonly used as a mosquito larvicide since the 1980s
Chikungunya	A mosquito-transmitted disease caused by a virus that originated in Africa and is transmitted by *Aedes* mosquitoes; symptoms include fever, joint pain, and rash; the name chikungunya comes from the African Makonde language and means "to bend over in pain," which is the stance that many who contract this disease exhibit
***Culex* mosquitoes**	A genus of mosquitoes, several species of which serve as vectors of one or more important diseases of birds, humans, and other animals; the diseases they vector include West Nile virus, Japanese encephalitis, and St. Louis encephalitis.
***Culiseta melanura* mosquitoes**	A species of mosquitoes (commonly referred to as the black-tailed mosquito) that is significant due to its role in the transmission cycle of eastern equine encephalitis virus and potentially West Nile virus; these mosquitoes primarily feed on birds but can spread arboviruses to mammals as well
Dengue	A mosquito-transmitted virus that causes sudden fever and acute joint pain; occasionally occurs in Florida where the mosquito vector is *Aedes aegypti* or *Aedes albopictus*
Dibrom	The trade name for an organophosphate insecticide with the active ingredient naled; used in mosquito control as an adulticide and is typically applied with aircraft
Dipper	An approximately 300 ml container attached to an extension pole that is used to sample for the presence of mosquito larvae in aquatic habitats
Eastern equine encephalitis virus (EEEV)	A mosquito-transmitted virus that is rare but very dangerous when contracted by a horse, human, or other mammal; an average of 13 cases per year were reported in the United States from 2018-2022; approximately 30% of people with EEEV die and many survivors have ongoing neurologic

Term	Definition
	problems; in Florida, the freshwater swamp inhabiting mosquito *Culiseta melanura* is the primary vector of this disease
Fixed-wing aircraft	Commonly referred to as an airplane, these aircraft include stationary wings that provide lift for the aircraft; in mosquito control, these aircraft are commonly used for larvicide and adulticide applications
Florida Coordinating Council on Mosquito Control	An interagency council created in Ch. 388, *Florida Statutes,* in 1986, primarily to address issues concerning mosquito control applications, possible environmental impacts of control actions, and mosquito control management on State of Florida-owned lands
Florida Department of Agriculture and Consumer Services	The state agency that oversees and regulates mosquito control programs in Florida
Florida Department of Environmental Protection	The state agency responsible for coordinating efforts for intensified mosquito control on protected public lands when needed
Florida Department of Health (DOH)	The state agency responsible for implementing the Florida Sentinel Chicken Surveillance Program, reporting weekly data on the prevalence of arboviruses in this state, issuing public health arbovirus advisories and alerts, conducting or participating in arbovirus epidemiologic investigations, distributing weekly arbovirus epidemiology summary reports for mosquito control agencies, healthcare agencies, researchers, and others, and reporting human and animal arbovirus cases to the national arbovirus surveillance database
Florida Fish and Wildlife Conservation Commission	The state agency responsible for maintaining a database that enables the surveillance of bird mortality from arboviruses and for providing assistance and information on arboviruses in wildlife
Florida Medical Entomology Laboratory	A University of Florida laboratory (within the Institute of Food & Agricultural Sciences) that conducts research primarily on the control of mosquitoes; for the past 70 years, research at this lab has been instrumental in assisting mosquito control programs in Florida and elsewhere
Florida Mosquito Control Association (FMCA)	Created in the 1920s, the FMCA is Florida's professional association that includes individuals working for mosquito control programs, academic personnel conducting research on mosquitoes and other disease vectors,

Term	Definition
	and industry, which supports mosquito control efforts in Florida; the FMCA is active in the training of members and educating the public on the public health importance of mosquito control
Florida Sentinel Chicken Arboviral Surveillance Program	A program of the DOH that provides laboratory assistance to local agencies to monitor for the transmission of mosquito-transmitted viruses; sentinel chickens are stationed at locations throughout the state; when the chicken is bit by an arbovirus-transmitting mosquito, the chicken develops antibodies to the virus (the chicken does not become sick and cannot spread the virus to other mosquitoes); blood samples obtained from the sentinel chickens are submitted to DOH's lab in Tampa to be examined for the presence of antibodies; when present, the results indicate that arbovirus-transmitting mosquitoes are circulating in the location, enabling the increase of mosquito control efforts to reduce the risk of humans and animals from becoming ill
Genetically modified mosquitoes	*Ae. aegypti* mosquitoes that have been genetically modified to carry two genes: 1) a self-limiting gene that prevents female mosquito offspring from surviving to adulthood; and 2) a fluorescent marker gene that glows under a special red light, thereby allowing researchers to identify the genetically modified mosquitoes in the wild; because the female offspring die before becoming adults, the population of *Ae. aegypti* mosquitoes decreases
Geographic Information System (GIS)	Integrated computer hardware and software that stores, manages, analyzes, and visualizes geographic information
Good Laboratory Practices Program (GLP)	The goal of GLP is to ensure the quality and integrity of test data related to non-clinical safety studies
Granular application	Granular applications of chemicals differ from liquid applications by having a solid particle carrying the insecticide, which can better penetrate vegetation; this application is primarily used for larvicides to deliver mosquito toxin to the water where mosquito larvae are developing
Impoundment	Impoundments along Florida's central-east coast were created in the 1950s and 1960s by building earthen dikes around salt marshes known to produce mosquitoes; this allows the mosquito control program to manage the water level within the impoundment to prevent saltmarsh mosquitoes from laying

Term	Definition
	their eggs in these areas, thus effectively reducing their populations with a minimum need for pesticides; approximately 40,000 acres of impoundments were constructed from Volusia County south to Martin County; the impoundments remain a source reduction control method in the region
Landing rates	A surveillance method to determine the extent of a mosquito problem, where a person stands in a specific location and counts the number of mosquitoes that land on them within a designated period (such as 60 seconds)
Larvicide	A chemical that kills insects in their larval stages; for mosquitoes, larvicide must be introduced into the water where the larvae are developing; depending on the circumstances, larvicide applications can be made from the ground or from the air with either fixed- or rotary-wing aircraft or drones
Light Detection and Ranging (LiDAR)	A remote sensing technology used to precisely detect objects, such as mosquitoes, in real space
Malaria	A life-threatening illness transmitted primarily in tropical locations by female mosquitoes in the genus *Anopheles* primarily in tropical locations; symptoms include fever, headache, and chills and usually occur within 10-15 days after a bite
Methoprene	A synthetic juvenile hormone, which is an insect growth regulator, that has been used as a larvicide since the mid-1970s
Millage	A tax rate on property expressed as the number of dollars assessed for each $1000 of property value; for example, the property owner of a house valued at $250,000, which is assessed at a millage rate of 1.0, would be charged $250
Mosquito Control District	A local government entity enabled through a voter-approved local or state legislative act to provide mosquito control services in a geographically defined area
Mosquito counts	Surveillance of mosquito populations using a variety of techniques (*e.g.*, traps or landing rates); this term is usually used in reference to adult mosquitoes rather than immature ones
Natular	The trade name for a larvicide that includes the bacteria spinosid as its active ingredient

Term	Definition
Nuisance mosquito	A term used to designate a mosquito that typically does not transmit a pathogen such as a virus; these mosquitoes are in contrast to disease-transmitting mosquitoes that are readily capable of transmitting a pathogen
Pest resistance	The situation in which mosquitoes are no longer killed by the standard dose of an insecticide or manage to avoid coming into contact with the insecticide
Pyrethrum	A biochemical derived from a chrysanthemum plant that contains insecticidal properties; typically used in mosquito control as an adulticide
Rotary-wing aircraft	Aircraft that use a rotary blade rather than wings; a helicopter is the most common example
Rotational impoundment management	A management technique common in saltmarsh impoundments along Florida's Indian River Lagoon where the impoundment is artificially flooded during part of the spring and summer to prevent mosquitoes from laying their eggs in the marsh and is opened for the remainder of the year through culvert pipes to provide a hydrological connection between the impounded marsh and adjacent estuary or lagoon
Saint Louis encephalitis virus	A virus most commonly transmitted by *Culex* mosquitoes that can affect the central nervous system when a human is infected
Source reduction	Refers to the elimination of habitats that can produce mosquitoes; ranges from the proper disposal of waste containers to the complicated management of impoundments
Spinosid	A naturally occurring bacteria that contains insecticidal properties; is commonly applied as a larvicide; Natular is a commercial product that uses spinosid as its active ingredient
Sterile Insect Technique	A method whereby male insects are sterilized by radiation or other means; when the sterilized male mates with the female insect, viable offspring are not produced
Subcommittee on Managed Marshes	An interagency committee created in 1986 by the Florida Legislature in Ch. 388, *Florida Statutes,* to promote the wise management of Florida's wetlands for the mutual benefit of mosquito control and environmental enhancement
Ultra-low volume	A technique to dispense extremely small droplets of insecticide; while historically used for adulticiding, in some instances the technique is now used for larviciding

Term	Definition
United States Department of Agriculture (USDA)	Through its national Agricultural Research Service, the USDA participates in Florida mosquito control efforts largely with the Center for Medical, Agricultural and Veterinary Entomology, a laboratory in Gainesville, Florida, that conducts research on the biology and control of mosquitoes and other insects
United States Environmental Protection Agency	The federal agency that regulates mosquito control in Florida primarily through their approval and enforcement of chemical labels for insecticides
Unmanned Aerial System (UAS)	Aerial vehicles and associated equipment that do not carry a human operator and are remotely piloted or fly autonomously; drones are an example of a UAS
Vector	A living organism that transmits a pathogen (*e.g.*, virus, plasmodium, nematode) from an infected animal to a human or another animal; mosquitoes are an example of a vector
Vector surveillance	Monitoring for vectors that can be accomplished in several ways (e.g., various types of traps or landing rates)
Waste tires	Vehicle tires that are no longer of value and that have been improperly disposed in a manner that allows water to collect in the tires; some species of mosquitoes (e.g., *Aedes aeypti* or *Aedes albopictus*) lay their eggs in the standing water where the immature mosquitoes will develop to adulthood
Water management	In mosquito control, this term refers to a source reduction technique to minimize the production of mosquitoes in a particular aquatic habitat; the management of saltmarsh impoundments and some ditches are examples of water management projects
West Nile virus (WNV)	Introduced into the United States in New York around 2000, the virus is carried by birds and primarily transmitted by *Culex* mosquitoes; humans who contract the virus can develop a fever and other symptoms including headache, body aches, joint pains, and rash; most recover completely but symptoms can linger for weeks to months
Yellow fly trap	A sticky-type trap used to entangle yellow flies, a type of biting fly that occurs regularly in the Florida Panhandle, to reduce their population without insecticides

Term	Definition
Zika virus	A virus that originated in the Zika region of Africa and is transmitted by the mosquitoes *Aedes aegypti* and *Aedes albopictus;* humans who contract the virus can have symptoms similar to dengue such as fever, rash, headache, and joint pain; Zika passed from a pregnant woman to her fetus can result in birth defects including microcephaly and other brain abnormalities

Source: TBG work product.

Attachment 2

INTEGRATED PEST MANAGEMENT SUMMARY

September 2023

Prepared for

The Florida Legislature

Prepared by

The Balmoral Group

165 Lincoln Avenue

Winter Park, FL 32789

Attachment 2

Term	Summary
Integrated Pest Management	Most mosquito control programs use an Integrated Pest Management (IPM) approach to control mosquito populations, which targets the different stages of a mosquito's life cycle with various prevention and control measures. IPM addresses eight areas. Surveillance of mosquito populations is an essential component of all IPM programs with chemical treatments based on the surveillance findings. IPM can also include source reduction (e.g., container disposal and water/impoundment management), larviciding and adulticiding (using ground and/or aerial treatments), biological and alternative controls, and disease surveillance. Research and education are also important components of IPM programs.
Mosquito Surveillance	The general approach to surveillance is to define area-specific problems with mosquitoes through the establishment of a mosquito surveillance program. The program assists in determining the types of mosquito control efforts needed in each area so that pesticide applications are used only when necessary. Service requests made to mosquito control programs serve as one means of surveillance. Other means for adult mosquito surveillance include monitoring the landing rates and counts of mosquitoes in traps to determine when and where they are most prevalent and observing the effects of adulticide, larvicide, and source reduction efforts. Immature mosquito surveillance is conducted by collecting eggs, larvae, and pupae. Surveillance may also include inventorying and mapping data and using emerging technologies such as geo-referenced maps, geographic information systems (GIS), smart traps (e.g., a trap with an electronic device that differentiates mosquitoes from other insects, counts them, and wirelessly transmits the results), and unmanned aerial vehicles.
Source Reduction	Source reduction, also known as physical or permanent control, is considered the most effective mosquito control technique and is accomplished by eliminating larval habitats in salt marshes, freshwater habitats, temporarily flooded locations, and containers. Current saltmarsh source reduction techniques in Florida include • construction of shallow ditches that enhance drainage and thus eliminate mosquito-producing sites and create connectivity among water bodies to allow larvivorous fish (fish that feed upon insect larvae) access to mosquito habitats; and • management of impoundments by maintaining a sheet of water across a saltmarsh to prevent mosquitoes from laying eggs on the soil; this achieves saltmarsh mosquito control with minimum insecticide use.

Term	Summary
	Source reduction is also conducted in freshwater habitats and is based on the principle that manipulating water levels in low-lying areas will eliminate or reduce the need for insecticide use. The primary strategy used is reducing the amount of standing water or reducing the length of time that water can stand in low areas following significant rainfall. Another important area of source reduction is through aquatic plant management, which can be accomplished using chemical, biological, or mechanical control methods. Waste tire management is also a significant activity for many mosquito control districts because the proliferation and accumulation of discarded tires throughout the state continues to create habitats highly favored by mosquitoes, and these tires can be costly and labor-intensive to remove. Removing any receptacles that can contain water is beneficial in controlling mosquitoes.
Larvicides and Larviciding	Larvicides are insecticides used to kill insects in the larval stage. Most mosquitoes spend three to five days of their life cycle in the larval stage when they are highly susceptible to predation and control efforts; therefore, well-planned and timed larviciding is important for efficient operations to save labor costs and reduce chemical use. This also requires understanding the local mosquito ecology and patterns of arbovirus transmission to select the appropriate control techniques. Equipment used for ground application of larvicide can include trucks with sprayers mounted on the front bumper, all-terrain vehicles (ATVs), boats, and various hand-held and backpack sprayers. Aerial application uses various devices such as nozzles and metered systems that are attached to fixed-wing or rotary-wing aircraft (i.e., helicopters).
Adulticides and Adulticiding	Adulticides are insecticides used to kill adult mosquitoes. The majority of adulticiding in Florida is conducted using ultra-low volume (ULV) spraying during which an aerosol spray is released by specialized spray equipment mounted in aircraft, on the back of trucks or ATVs, or carried by hand or in a backpack. The spray drifts through the air and is effective only while it remains airborne; thus, having a short-term effect only. Where a longer-term effect is needed, residual sprays are applied to barriers or surfaces such as a stadium, park, or resident's yard and are often applied with a modified vehicle-mounted hydraulic sprayer. The mosquito must land on the surface where the residual insecticide has been deposited for it to be effective. Equipment operators must be properly trained in equipment maintenance and adulticide application because timing, targets, and thresholds for the application are based on numerous factors and can be challenging to establish.

Term	Summary
Biological and Alternative Control	Biological control agents include microbial control agents (e.g., bacteria, such as *Bacillus thuringiensis* or *Bt*, that can be sprayed over waterbodies to kill developing mosquito larvae), invertebrate arthropod mosquito predators (e.g., small aquatic crustaceans, such as copepods, that eat insect larvae), and vertebrate mosquito predators (e.g., larvivorous fish and birds). It is common for mosquito control districts in Florida to provide larvivorous fish as a service to the public. For example, Collier Mosquito Control District provides Gambusia mosquitofish to Collier County residents to release in standing water on their property to manage mosquito larvae. Alternative control methods include the sterile insect technique, trapping, repellents, and bug zappers.
Disease surveillance	Because of its geographic location and proximity to the Caribbean, Florida is vulnerable to the introduction of new vector-borne pathogens as occurred with the introduction of Zika virus in 2016 in South Florida. Disease surveillance includes monitoring for human cases of mosquito-borne arboviral diseases including dengue, chikungunya, West Nile virus, St. Louis encephalitis, and others. In addition, many mosquito control programs conduct regular blood testing of sentinel chickens. The state established the Florida Sentinel Chicken Arboviral Surveillance Program (FSCASP) in 1977 to provide laboratory services to local agencies to monitor the transmission of certain vector-borne diseases. The services are primarily used by mosquito control programs around the state. The programs submit sentinel chicken blood samples to the Florida Department of Health's Bureau of Laboratories in Tampa, where an antibody test is performed to identify if the chicken has been exposed to one of several viruses. Results are provided to participating agencies on a weekly basis.
Mosquito Control Research	Mosquito control programs must base their activities on sound and up-to-date scientific research in order to provide safe, effective, and efficient mosquito control services. Research that is either conducted or reviewed by mosquito control programs is essential to developing and implementing new and innovative methods and technologies. Numerous federal, state, and other entities conduct mosquito control research, as do several mosquito control districts in this state.
Outreach and Education	Increasing the public's understanding of the work of the mosquito control districts is an important component of overall mosquito control efforts. Public education helps people understand what is involved in mosquito control, the biology of mosquitoes, ecological issues, arboviral disease transmission, and actions that can be taken to prevent mosquito bites and reduce mosquitoes in yards and

Term	Summary
	neighborhoods. When adequately informed, the public is in a better position to protect themselves and support mosquito control efforts. This state's mosquito control programs and other entities, such as the Florida Department of Agriculture and Consumer Services, Florida Mosquito Control Association, and the University of Florida's, Institute of Food and Agricultural Sciences-Florida Medical Entomology Laboratory, dedicate significant efforts toward education.

Source: TBG work product.