



Warren County Mosquito Extermination Commission



2022 ANNUAL REPORT

January 1, 2022 - December 31, 2022



*Wings Aerial Applicators
loading the plane for
aerial larviciding
treatment
April 2022*

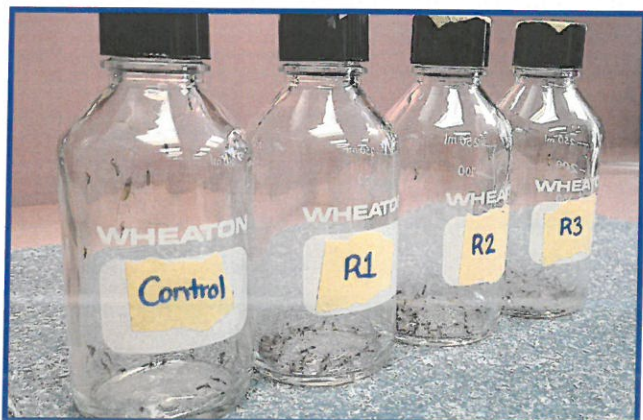


Ditch Project
Kasper Road ,
Allamuchy Township
September 2022



Insecticide Resistance Trial Team
August 2022

Insecticide Resistance Testing
using Bottle Bioassay
September 2022



Wings Aerial Applicators
making the turn over the office to head back
to treat Cat Swamp in Oxford
June 2022

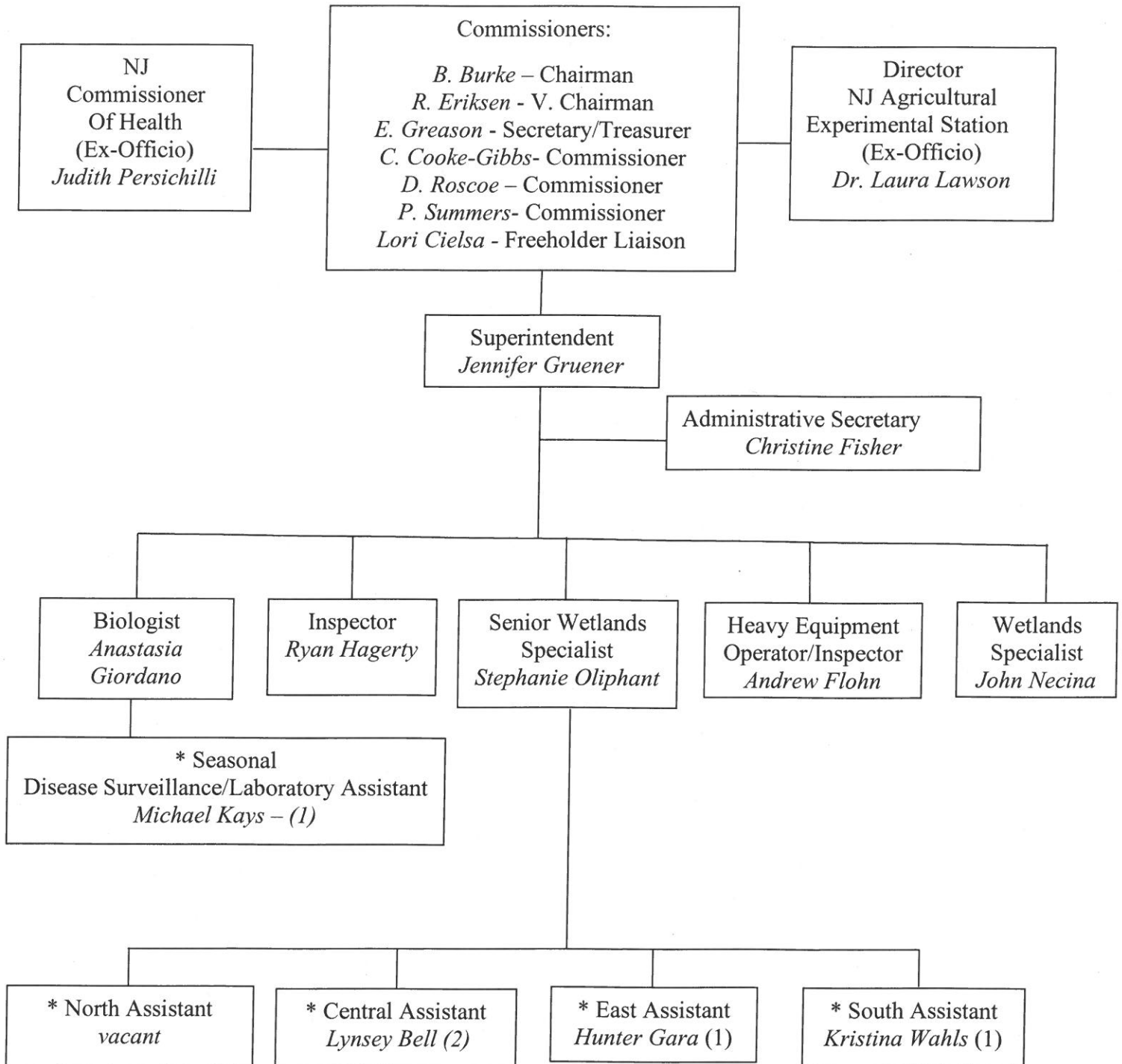


TABLE OF CONTENTS

ORGANIZATIONAL CHART	1
I. ADMINISTRATION	2
A. Budget/Treasurer's Report.....	2
B. Personnel	2
1. Staff	2
2. Education/Training	3
3. CDL Testing Program	5
4. Employee Assistance Program	5
C. New Jersey Mosquito Control Association (NJMCA).....	5
D. Associated Executives of Mosquito Control Work in New Jersey (AEMCNJ).....	6
E. American Mosquito Control Association (AMCA)	6
F. Northeast Mosquito Control Association (NMCA).....	6
G. Entomological Society of America (ESA).....	7
H. Public Tick IPM Working Group.....	7
I. U.S. EPA - Pesticide Environmental Stewardship Program.....	7
J. Safety Coalition	7
K. Records Retention	7
L. Insurance	8
II. FACILITIES/EQUIPMENT	8
A. Facilities	8
B. Equipment.....	8
1 a. State Equipment.....	8
1 b. Commission Owned Equipment	9
2. Vehicles	9
3. Computers.....	9
4. Inventory.....	10
III. COMPLAINT RESPONSE.....	10
IV. VECTOR BORNE DISEASE	11
A. Disease Response Guidelines	11
B. Vector Borne Disease Working Group (VBDWG).....	11
C. VectorSurv	12
D. West Nile Virus (WNV), eastern equine encephalitis (EEE), St. Louis encephalitis (SLE), and Jamestown Canyon Virus (JCV)	12
1. Bird Testing	12
2. Mosquito Sampling/Testing.....	12
a. West Nile virus.....	13
b. Eastern equine encephalitis	13
c. Jamestown Canyon virus (JCV) and St. Louis encephalitis (SLE).....	14
3. Equine Cases.....	14
4. Human Cases.....	14
5. National Recreation Area Cooperation.....	14
D. Chikungunya Virus (CHIKV) and Dengue Virus (DENV) and Zika Virus (ZIKV).....	14
E. La Crosse Encephalitis (LAC).....	15
F. Tick-borne Disease.....	15
V. SURVEILLANCE.....	16
A. Adult Mosquito Surveillance.....	16
1. NJ Light Traps	16
2. Portable Carbon Dioxide Baited Light Traps.....	17
3. Landing Rates.....	18
4. Resting Boxes.....	18
5. BG Sentinel Traps.....	18
6. Ovitrap.....	19
7. <i>Aedes albopictus</i>	19
B. Rainfall Monitoring.....	20
C. Larval Mosquito Surveillance	20
1. Breeding Site Inspections.....	20
2. Larval Dip Counts.....	21
D. Species List.....	21

VI. CHEMICAL CONTROL	21
A. Larviciding/Pupiciding	22
1. Ground Applications.....	22
2. Catch Basins	23
3. Aerial Larviciding	23
B. Adult Mosquito Control.....	24
1. Notification	24
2. Ground Treatments for Adult Mosquito Control	24
3. Aerial Adult Mosquito Control.....	25
VII. BIOLOGICAL CONTROL.....	25
A. Predatory Fish	25
VIII. RESEARCH & FIELD STUDIES/COLLECTIONS	26
A. Insecticide Resistance Studies	26
B. Mosquito Rearing Colony.....	29
C. Unmanned Aircraft Systems (UAS) – Drones.....	30
D. Grant Funded Tick Surveillance Project	31
IX. WATER MANAGEMENT.....	33
A. Activity Summary	34
1. Projects.....	34
a. FWW GP1&15/FHA GP2 Projects.....	34
b. Permit-By-Rule Ditch Clearing Projects.....	34
2. Maintenance	35
a. Hand Cleaning	35
b. Access Brushing	35
c. Trail Mowing	35
d. Stream Desnagging	35
B. Stormwater Facilities	35
C. Tires.....	36
D. Catch Basins	37
E. Swimming Pools.....	37
F. Beaver Management	37
G. Site Plan Review	37
X. PUBLIC EDUCATION	38
A. Literature/Poster Distribution	38
B. Community/School Presentations/Displays.....	39
C. Office/Truck Files.....	39
D. Ticks/Lyme Disease	39
E. Presentations/Publications.....	40
F. Internet Presence	40
G. Media Coverage.....	40
H. National Week Observance	41
LIST OF ABBREVIATIONS.....	41

2022
WARREN COUNTY MOSQUITO COMMISSION
ORGANIZATIONAL CHART



* Seasonal Position

(x) Indicates number of seasons worked

I. ADMINISTRATION

A. Budget/Treasurer's Report

Following the body of this report are the final Budget and Treasurer's reports (Figures 1 & 2, respectively) for the year, which reflect the Commission's expenditures and financial status as of December 31, 2022.

Please note that the look of Figures 1 & 2 have changed from previous years. While taking the Intro Public Purchasing class in 2021, Ms. Gruener became aware that changing to a fund accounting system would be in the best interest of the commission as it would allow for the proper encumbrance of funds. After searching for the best fit and most cost-effective software, Municipal Software Inc. (MSI) was chosen. The switch from manual accounting using a combination of Excel and QuickBooks to MSI began on January 1, 2022. Learning the new system was initially slow, as some beginning data had to be manually entered since the commission's data was not moving from another similar system that could be uploaded. The system was completely utilized to supply the monthly reports and pay the monthly bills starting at the May 2022 meeting, with all back data entered as well. The utilization of MSI has allowed for the proper encumbrance of funds. It has also reduced the multiple entry points required for paying bills and producing reports; therefore, reducing the chance of data entry errors.

In 2022, an audit was performed on the 2021 financial records by Nisivoccia & Company LLP, Newton, New Jersey with no recommendations made regarding the accounting procedures. It was also noted on the audit that the prior year's recommendation regarding the dating of purchase orders was resolved.

Options for setting up a Health Saving Account and account administrator were researched in 2011 in response to new health insurance mandates. Either Health Saving Accounts or Flexible Spending accounts can now be implemented if any employee chooses to participate (depending on their choice of health care plan at the end of the prior year). This was not necessary for 2022.

Forty-eight thousand two hundred dollars (\$48,200) from reserve funding was applied to the 2022 budget to contribute towards the following year's budget, this amount was intended for the major equipment purchases of a computer server, side-by-side all-terrain vehicle (ATV), and an additional desk for the lab. Commission staff decided to hold-off on the purchase of the ATV for year 2023 since the ATV that best fit their needs was not available due to shortages.

As of December 31, 2022, there was \$59,832.75 unencumbered from the 2022 budget. This combined with \$517.90 in miscellaneous receipts, the balance of the 2022-23 Tick Grant received \$9,806.34 and the \$77,222.40 left in reserves brought the total balance in reserve funding to \$147,379.39. An effort to keep these funds in reserve for capital purchases and unforeseen emergencies will be made.

B. Personnel

1. Staff

At the start of the New Year, two of the previous year's five seasonal staff had indicated they were interested in returning, leaving at least three positions open. Advertisements for the seasonal positions were posted on the County's Facebook page, shared on Community Facebook sites and at all the local area colleges through their career centers and department professors at some of the colleges. As the season approached, one of the returning seasonals withdrew her application leaving four positions open. Seasonal positions were readvertised at that point.

Four applications were received, and interviews took place in person. Two new seasonal employees were hired to assist with larval routes, and one was hired to assist with disease surveillance and laboratory functions. One of the new seasonal employees was a paid intern and had availability in late

March so her training started March 28, 2022. The other two seasonal staff were trained during spring break. One of them was available for continuing employment from that point forward so he was trained initially for a larval route and then later for disease surveillance. The other was a senior in high school and wasn't available until late June. It was difficult to fill the final open position but eventually another application was received, and that individual was hired and began training on June 14, 2022. Unfortunately, that employee resigned July 8, 2022; therefore, full-time staff were left to cover the north route for most of the season.

The Commission went from six (6) back to seven (7) full-time employees for 2022; Superintendent, Administrative Secretary, Senior Wetlands Specialist, Biologist, Inspector, Heavy Equipment Operator/Inspector, and Wetlands Specialist. In March of 2022, John Necina was hired in the Wetlands Specialist title through an Intergovernmental Transfer from Bergen County.

2. Education/Training

The Commission makes a significant investment in their employees in terms of training, education and attendance at professional meetings.

- **Mosquito Control/DEP Licensing Training/Tick IPM**

In order to expedite pesticide applicator/operator licensing, an in-house training program was developed in 2002 and was approved by NJDEP- Pesticide Control. This program has been updated, revised, and modified over the years to keep current with changing pesticide regulations and requirements. The Basic Pesticide Training Program along with 40 hours of on-the-job training fulfills the NJ DEP requirements for pesticide operator licensing. Currently, Jennifer Gruener and Stephanie Oliphant provide this training to new staff along with general mosquito biology, Right-to-Know/HazCom, general safety, and respirator training. Defensive driving, anti-discrimination and harassment training are provided online from PMA Companies Websource for all new staff. After their initial in-house training is completed, staff are accompanied by a full-time staff to learn specific surveillance routes.

All full-time staff, except the Administrative Secretary, are certified by the NJDEP to be commercial pesticide applicators with their core pesticide license as well as category 8B, specifically for mosquito control. Ms. Gruener holds additional certifications in categories 8A (Public Health), 10 (Demonstration & Research), and 11 (Aerial Applications). Ms. Oliphant and Mr. Necina are both certified in category 11 (Aerial Applications) and Mr. Necina also holds category 10 (Demonstration and Research) certification. New seasonal staff are trained and tested to obtain certification as pesticide operators. If a seasonal staff returns for multiple seasons, they are encouraged to obtain certification as a full applicator.

Additional virtual and in-person training sessions were attended to provide instruction on basic pesticide safety, pesticide applications, and to obtain recertification credits, which apply for the requirements for maintaining pesticide applicator licenses. Those courses follow:

- Warren County MEC, "Basic Pesticide Safety Training": H. Gara, M. Kays, K. Skinner, & Kristina Wahl
- NJMCA, Northern Training Session, St Elizabeth University: J. Gruener & J. Necina
- Cornell University, eCornell, "Vector-borne Disease Surveillance Course": S. Oliphant
- University of Florida, "Introduction to Mosquito Control", DODD short course, online: S. Giordano * awarded a training fellowship to attend from the Southwest Center of Excellence in Vector Borne Diseases
- FMC Professional Solutions Webinar, "Mosquitoes": S. Giordano & R. Hagerty
- Valent Biosciences', "Global Mosquito Resistance Management Virtual Summit": J. Gruener, S. Giordano, & J. Necina

- NEVBD, "Insecticide Resistance Submission Preseason Webinar": J. Gruener & S. Giordano
- Center for Vector Biology, Rutgers U., "Mosquito ID Refresher": S. Giordano & R. Hagerty
- North Central IPM Institute, University of Minnesota, "Tick Academy": S. Giordano & R. Hagerty *funded entirely through NJDOH Tick Surveillance Grant Funding
- NEVBD, "Vector Boot Camp", recorded webinar series: K. Wahl & M. Kays
- U.S. Department of Health & Human Services, "Tick Basics", tickborne disease webinar series: M. Kays
- US EPA, "EPA Protecting Species through Pesticide Registration Review", listening session: S. Oliphant (live) & J. Gruener (recorded)
- Center for Urban Agriculture, "Basics of Insecticide Classification & Modes of Action for Pest Management Professionals": S. Giordano
- Rutgers Center for Vector Biology, "Mosquito Identification Refresher": S. Giordano & R. Hagerty
- Clarke Mosquito Control Products, "Field trials for resistance testing": Zoom: J. Gruener, S. Giordano, R. Hagerty & J. Necina
- AMCA, "Mosquito Myths & Fallacies", recorded webinar: S. Oliphant
- CDC, "Tickborne Diseases, A CDC Update", recorded webinar: S. Oliphant
- EPA, "ESA Work-plan Update: Nontarget Species Mitigation for Registration Review & Other FIFRA Actions", webinar: J. Gruener (recorded) and S. Oliphant (attended live)
- Continuing Education University, "Aerial Application Methodology": J. Gruener

- **- Right-To-Know/Hazard Communication Training**

Due to training requirements implemented in 2004, a written Hazard Communication Program with an in-house training program (incorporating information from prior Right-to- Know training requirements) was developed in 2005. All new staff members receive a copy of this written program and a list of Hazardous Substances and Material Safety Data Sheets, which are updated annually. Associated training is provided on the first day of work. Information is also supplied as necessary to contractors. Refresher training is given to staff once every two years along with Bloodborne Pathogens Awareness Training. PMA Companies provided this refresher training in 2022 to all staff that were due.

The annual Right-To-Know survey distributed by the New Jersey Department of Health and Senior Services was completed. This survey catalogs all hazardous materials used by the Warren County Mosquito Extermination Commission. Online reporting for the Right-To-Know Survey has been required since Survey Year 2013. The 2021 Right to Know Survey was completed in 2022.

- **Respirator Training**

A written respiratory program was developed in 2006 and a related training program established that same year due to a label change for precautions while handling *Bti* products. This program was put into policy format, reviewed and adopted as Commission policy in 2007. This policy was thoroughly reviewed and revised in 2019 and a new training program was developed. Fit testing and training takes place annually for anyone having the potential to need a respirator during that particular year. Jennifer Gruener and Stephanie Oliphant are trained to perform fit testing.

- **Other Training**

- Rutgers Center for Government Services, "Public Purchasing II": J. Gruener
- Rutgers Center for Government Services, "Public Purchasing III": J. Gruener
- PMA Companies, "OSHA Record Keeping: Completing Form 300A, Posting Deadlines & Electronic Filing Requirements", live webinar: J. Gruener
- Aplos, "Fund Accounting 101", recorded YouTube: J. Gruener

- NJ Civil Service Commission, “County & Municipal Personnel System (CAMPS) Training”: J. Gruener
 - PMA Companies, “Harassment Training for Supervisors”: J. Gruener & S. Oliphant
 - PMA Companies, “Distracted Driving Continues to Worsen: Is Technology the Solution?” recorded webinar: J. Gruener
 - Business Solver, “Visions 2022, Benefits Summit”: J. Gruener
 - Business Solver, “Minimizing Risk for HR & Benefits”, recorded webinar: J. Gruener
 - Navi Maraj, CPA, “Do I Need to Issue a 1099? 1099-NEC & 1099 – MISC Explained”, YouTube: J. Gruener
 - FMC Professional Solutions, “Spiders, got to Love Em”, webinar: S. Oliphant
 - Bobcat of NJ, “Northeast Outdoor Industry Showcase & Expo”: D. Flohn & S. Oliphant
 - Natural Areas Association, “ID & Preventing Plan & Extinction Events”: S. Oliphant
 - Natural Areas Association, “Collaborate to Conserve Crop Wild Relatives”: S. Oliphant
 - Natural Areas Association, “Long Term Data & Outcomes from the Nachusa Grasslands Restoration”: S. Oliphant
 - Pest Control Technologies, “Mid-level Management Training – How to Build a Leadership Bench”: J. Gruener
- **Computer Software/New Technologies**
 - Tony & Chelsea Northrup, “Free Drone Certification Study Guide: FAA Part 107s UAS test”: R. Hagerty
 - NJDPB/SHBP, “Business Solver Training Session”: J. Gruener
 - Leading Edge, “Mosquito Management & Unmanned Aircraft Technologies”, Middlesex County MEC: R. Hagerty & J. Necina
 - Leading Edge & Target Specialty, “Unmanned Aircraft Supporting Application Operations”, webinar: R. Hagerty
 - NJ Civil Service Commission, “County and Municipal Personnel System (CAMPS) training: J. Gruener
 - Drone Pilot School, “National Airspace System (NAS) – series”: J. Necina
 - Drone Pilot School, “Drone Flight Operations – series”: J. Necina
 - Alien Drones, YouTube, “Remote ID Rule for Drones, the FAA Interview”: J. Necina
 - Microsoft Support, “What is Access”: S. Giordano
 - Microsoft Support, “Get Started with Databases”: S. Giordano
 - YouTube, “How to Use Microsoft Access- Beginner Tutorial”: S. Giordano

3. CDL Testing Program

Our equipment operator is the Commission’s only Commercial Driver’s License (CDL) holder. The employee working in this title is included in with the County pool of employees to be randomly tested for drugs and alcohol, which is required by Federal DOT regulations.

4. Employee Assistance Program

The Commission staff members were able to utilize the Employee Assistance Program (EAP) in 2022, which is made available through the NJ Intergovernmental Insurance Fund, NJIIF. This program offers assessment, counseling, and referrals for a variety of personal and work-related problems, including those related to drug and alcohol abuse. EAP services are available by calling 1-888-243-5744 or visiting www.sandcreekeap.com; anonymity and confidentiality are assured.

C. New Jersey Mosquito Control Association (NJMCA)

The New Jersey Mosquito Control Association is the oldest mosquito control association in the country and celebrated its 109th Year Anniversary in 2022. The NJMCA is a state-wide professional organization comprised of members from the 21 county mosquito agencies, the NJDEP Office of Warren County Mosquito Commission – Annual Report 2022

Mosquito Control Coordination, the State Mosquito Control Commission, Rutgers University's Center for Vector Biology, and other interested parties. The purpose of the NJMCA is to promote and encourage close cooperation among those directly and indirectly concerned with mosquito control work, stimulate educational activities to increase the knowledge of mosquito control, and advance the cause of mosquito control and related environmental concerns in the State of New Jersey and elsewhere. The NJMCA's primary goal is to promote, encourage, develop and record safe, effective and environmentally sound mosquito control activities in order to protect the health and welfare of the citizens of New Jersey, and to make this information available to all who may be interested or concerned with mosquito control activities. The strength of the mosquito control community in New Jersey is reflected in the strength and activity of this association.

At the 2022 Annual Business Meeting of the NJMCA, Jennifer Gruener was re-elected Treasurer of the Association and Christine Fisher was reappointed as Bookkeeper for the Association. The pair maintained the Association's accounting, produced quarterly reports, filed the annual taxes, and developed a budget for the following year's activities.

Ms. Gruener serves as Trustee on the NJMCA Board with Ms. Oliphant as alternate. In addition, the following staff members were named to various committees including:

Jennifer Gruener: Convention Arrangements Committee,
Editorial Committee, Legislative Committee

Christine Fisher: Membership Committee

Stephanie Oliphant: Editorial Committee

John Necina: Archives Committee, Research and Development Committee

D. Associated Executives of Mosquito Control Work in New Jersey (AEMCNJ)

The regular membership of the Associated Executives of Mosquito Control Work in NJ consists of Superintendents and Directors of the county and state mosquito agencies, as well as representatives from the NJ Agricultural Experiment Station. Associate members may also be voted in but must be technical full-time mosquito control professionals. The main purpose of this Association is to promote, preserve, and protect, professional standards of full-time mosquito control employees throughout the state. As members of this operationally oriented organization in New Jersey, Jennifer Gruener and/or Stephanie Oliphant attended most of these monthly meetings throughout the year. Association meetings in 2022 were a combination of in person and virtual meetings.

Commission members who were named to the following committees:

Jennifer Gruener: Vector-borne Disease Working Group, Legislative Committee

E. American Mosquito Control Association (AMCA)

The AMCA is a professional association of individuals and organizations interested in mosquito and other vector control comprised of members from over 50 countries. The Commission maintains a sustaining membership in the National Association, which directly supports legislative and regulatory advocacy. Membership also includes but is not limited to: lowered rates for attendance at national meetings, web access to member only information, Technical Advisor services, the *Journal of the American Mosquito Control Association*, *Wingbeats* - magazine for mosquito control, the *AMCA Newsletter*, monthly e-newsletters, and free webinars throughout the year on numerous relevant subjects.

F. Northeast Mosquito Control Association (NMCA)

NMCA is a non-profit, educational organization of nearly 250 mosquito research and control professionals from New England, New York, New Jersey and Pennsylvania. Their objectives are to promote the efficiency of mosquito abatement and related activities, through the encouragement of research, development of procedure, and the interchange of information; to circulate among its

members and other interested parties pertinent knowledge relative to mosquito abatement and related subjects, and; to encourage field trips and meetings of its members.

Ms. Gruener and Ms. Oliphant attended the Northeast Mosquito Control Association annual meeting held in Cape Cod, MA from December 5-7, 2022. The meeting included participants from all the New England states down to and including Pennsylvania and New Jersey. Information was shared on mosquito and tick programs at state and local levels as well as research from the Center of Excellence and the US Centers for Disease Control. Legislative updates were provided by representatives from the American Mosquito Control Association on EPA pesticide reviews, label changes, endangered species protections, and the Massachusetts Mosquito Task Force.

G. Entomological Society of America (ESA)

Membership in this association began in 2007 and continues annually. This membership allows our Commission access to valuable literature in multiple professional journals.

H. Public Tick IPM Working Group

Superintendent Gruener continued to participate in the Public Tick IPM Working Group, which is composed of tick experts, tick-borne disease advocates, medical professionals, vector control professionals, and other interested parties. The group collaborates (via a monthly conference call) on Integrated Pest Management related activities, exchanges knowledge, and shares resources to expand the network and reduce the public's risk of exposure to infected ticks. This work is supported by the USDA National Institute of Food and Agriculture, Crop Protection and Pest Management Program through the North Central IPM Center.

I. U.S. EPA - Pesticide Environmental Stewardship Program

At the end of 1997, the New Jersey Mosquito Control Association (NJMCA) approved an extensive mosquito control strategy document for the Pesticide Environmental Stewardship Program (PESP) to be submitted under the American Mosquito Control Association's PESP partnership. The New Jersey document was based on the approved strategy document from the AMCA (the national organization) but goes beyond in specific areas of surveillance, biological control and water management, some of which were pioneered in New Jersey and all of which are employed today. The New Jersey strategy document was accepted by the AMCA in March of 1998 establishing New Jersey as an official sub-partner. This document is frequently referred to around the country to outline details of a comprehensive mosquito control program. Warren County's current programs are consistent with the strategies outlined in this document and the Commission participates in the annual PESP survey from the AMCA.

J. Safety Coalition

The Mosquito Commission is represented on the Warren County Safety Coalition where current safety related topics are discussed and information is disseminated. The Commission was not aware of any safety coalition meetings in 2022.

Mosquito Commission staff safety meetings are also held on occasion when appropriate.

Superintendent Gruener meets with PMA Companies safety representative, Tim Weir, at least annually to ensure compliance with safety standards and to plan for safety training for employees. Safety training is listed in part B.2. under "other training" and a hard copy of safety training logs are kept in the office.

K. Records Retention

A request and authorization for records disposal was completed on the New Jersey Division of Archives and Records Management website, *Artemis* in 2022 for disposal of appropriate records. This request was forwarded first to Nisivoccia & Company LLP for necessary signatures, then uploaded to *Artemis* for final approval prior to our disposing of old records. Certain documents are considered permanent and will remain in our central files. Pesticide application records are retained in accordance

with the NJ Pesticide Regulations and the NJPDES Pesticide General Permit, which combined results in 5-year retention of all pesticide records.

L. Insurance

In 2017, the Commission became an independent member of the NJ Intergovernmental Insurance Fund, NJIIF. The Commission had been insured through the County of Warren's policies with the NJIIF for its Public Officials/Employer Liability, Workers Compensation, General Liability, Excess Liability, and Automobile Liability coverages from 2004 through 2016 but had held its own separate policy for Pollution Liability with a different carrier. Confusion with a minor workers compensation claim spurred discussions with the County and the Insurance brokers, and it was decided that the Commission would be better served if it had its own policies under the NJIIF, separate from the County's. Now all the Commission's insurance policies, including Pollution Liability and Cyber Liability, are under the NJIIF. All claims are managed through PMA Companies, which also offer a variety of training resources.

II. FACILITIES/EQUIPMENT

A. Facilities

The Commission continues to utilize the county owned building and grounds at 2 Furnace Street in Oxford, New Jersey. The building is shared with the Department of Weights & Measures and the grounds are shared with the Oxford crew of the Warren County Road Department. A 44' aluminum shipping container is located in the yard behind the building and is used for storing all of the dry, non-flammable pesticides. Liquid pesticides are stored in a temperature controlled chemical storage building located between the building and the shipping container.

Both office and yard space are extremely limited, so efforts are made to make the best use of the space we have. The breakroom serves as an office to both the Senior Wetlands Specialist and the Heavy Equipment Operator/Inspector and the laboratory serves as an office to the Inspector, Biologist, and Wetlands Specialist as well as an overflow area for seasonal staff. Storage sheds have been purchased for materials and supplies that need to be out of the elements but that can withstand the extreme temperatures of winter and summer. There are storage sheds designated for public relations, fish supplies, trapping supplies, water management supplies, and utility supplies. There is also a carport for storing the Polaris Ranger, the Forklift, and items being sent tagged for the annual county auction. Efforts are made to keep vehicles and equipment under cover to extend their usable life; however, the larger excavator, bulldozer, Eager Beaver Trailer, the utility trailer, and all of the service vehicles are currently stored out of doors due to limited garage space. The Commission-owned dump truck is kept in the garage as much as possible.

B. Equipment

1 a. State Equipment

The following equipment is provided by the State Mosquito Control Commission (SMCC) on an annual lease basis for the Commission's use:

1980 John Deere 350C Bulldozer
2003 Kobelco Low Ground Pressure Excavator with Powertilt
1988 Bausch & Lomb Stereo Zoom 7 Microscope with Fiber-Lite Illuminator
1990 Eager Beaver 20-Ton Tagalong Trailer
2001 Revco Freezer

The heavy equipment is the mainstay of our water management program. The Bulldozer and Excavator, along with the Eager Beaver Trailer are all utilized. The Eager Beaver trailer was refurbished in 2022 with all new decking installed, rusted parts replaced or resurfaced, and the body was sandblasted and painted. While the repairs were being done, the SMCC put a 1987 20-ton trailer from Union County on temporary assignment to Warren County MEC, which allowed the water

management program to continue until the repairs were complete. (See the *Water Management section* for program description and current activities).

The ultra-low temperature freezer is used for storing mosquitoes that are submitted for disease monitoring. This freezer also allows for the extended storage of the dry ice that is used for our surveillance program. After the SMCC officially stopped supporting the Revco freezers in 2017, the Commission requested they surrender ownership of the freezer; however, they have not responded to date and the freezer remains on the lease agreement but not supported by the SMCC.

1 b. Commission Owned Equipment

The following surveillance/treatment equipment is owned by the Warren County Mosquito Commission. The Commission also owns numerous small pieces of surveillance, collection, and treatment equipment that are too cumbersome to list in this report.

2006 Polaris Ranger – Utility Vehicle
2006 16 ft Ringo Trailer
2013 AcrEase 44” Trail Mower
Cougar ULV Sprayer with GPS/SmartFlow Assembly
2012 London Fog ULV Sprayer
Bausch & Lomb – Stereo Zoom 5 Microscope
Southern Precision Microscope
AmScope Fiber Optic Illuminator
Tuttnauer 7-inch tabletop Autoclave
RAMP Virus Testing System
Maruyama Back Pack Sprayer
2007 Clark Forklift
Red Lion Aluminum 6.0 hp Trash Pump & hose (2015)
Northstar Tank Sprayer
2020 Clarke Electric Promist ULV Sprayer with GPS/SmartFlow Assembly
2021 Leica S8 APO Stereozoom Microscope with View 4K digital camera & software

2. Vehicles

The Commission has a fleet of 4WD pickup trucks and a dump truck to utilize in its operations. Annual inspections of all our vehicles are performed prior to the end of January, before our season begins, in the event repairs are necessary as a safety measure and to avoid untimely delays during our busy season.

Almost all vehicles are kept equipped with 2-way radios utilizing the county frequency, which were all new in 2011, (including the office base station, installed in January 2012) a full complement of inspection, safety/emergency equipment and informational materials for distribution. The notebooks containing pesticide labels in each vehicle are updated annually with current labels for each of the products we use.

3. Computers

The Commission staff currently utilizes 7 desktop workstations, 2 laptops, and a Chromebook linked together by a local area network (LAN), which is held on an in-house server. The Superintendent, Administrative Secretary, Biologist, Inspector, Senior Wetlands Specialist, and Wetlands Specialist each have their own workstations. All computer workstations are set up with upgraded battery backup units (Uninterrupted Power Supply- UPS) to protect against data loss in the event of power problems. A quadruple backup system was purchased and installed in 2020 and an off-site back up was renewed weekly; however, late in 2022 the outdated (2010) server was replaced, and it was discovered the

backup system had four faulty drives. As of the end of 2022, the backup system was still being repaired. This computer system has become integral to the daily operations of the Commission and is maintained by an outside IT company. As particular workstations age and become outdated they are replaced.

The primary laptop is used for the Superintendent to work away from the office and with our LCD projector for educational purposes. The other laptop is shared by the Heavy Equipment Operator/Inspector, Seasonal Inspectors, Research Interns, and the Disease Surveillance/Laboratory Assistant as needed. During the Coronavirus pandemic in 2020, a subscription to AnyDesk was purchased to enable staff to remotely log into their computers from home, when necessary, as well as a subscription for GoToMeeting to allow for virtual Commission meetings and other meetings as needed. Late in 2022, the Commission merged the subscriptions to LogMeIn professional, which allowed for both remote access and virtual meetings from one vendor at significant cost savings.

The Commission continued to use the FieldSeeker GIS data collection system from Frontier Precision for the 2022 season. Since the Commission staff had expressed so many concerns about the program with Frontier Precision representatives, the company loaned the Commission several different types of iPads to use for the 2022 season in hopes that the program would run better on the iOS platform. And indeed, the FieldSeeker program did perform much better on the iOS platform than it did on Windows 10 or Android. Therefore, in late 2022, Frontier Precision exchanged 6 of the Mesa tablets (3 Mesa II, 3 Mesa III) for 6 brand new iPads with accessories at no cost. The three Mesa III tablets that have 9-pin serial ports were retained since they are required to use the FieldSeeker ULV software.

4. Inventory

A comprehensive item inventory with corresponding replacement values was developed in 1996 and is maintained. The inventory list is modified as items are purchased or sold at the Warren County auction. A separate inventory is maintained for pesticides, which incorporates delivery and billing records to insure loss prevention. Pesticide inventory is documented in excel and verified with product usage in FieldSeeker.

III. COMPLAINT RESPONSE

Service requests are directed to our office to complain of standing water, abandoned swimming pools, mosquitoes, and other related concerns. Specific information is obtained directly from the caller in order to deal with the problem most efficiently. Service requests are entered into the FieldSeeker database when received. The database automatically maps the request, and it becomes available on all the handhelds once they are synced with the computer. Each request is assigned to an inspector depending on the nature of the request and its location within the county. The inspector can complete the entire request digitally via the handheld, and then each request is closed by either the Senior Wetland Specialist or the Superintendent. A paper copy of each request is still generated and kept on file to ensure completion.

Our staff investigates all spray requests to verify the presence of adult mosquitoes before the Commission will apply insecticides with truck-mounted sprayers. In addition, staff works to locate the source of the problem (the water where the larval mosquitoes are developing) and then applies appropriate control measures (larvicides with ground equipment or by aircraft; fish stocking and/or water management) to control the immature stages of the mosquitoes when necessary.

Slightly lower than average rainfall in 2022 resulted in a manageable number of service requests (145 in 2022 versus 378 in 2021). A breakdown of 2022 complaints is as follows: 66% adult mosquitoes, 14% standing water, 8% swimming pools, 2% containers, 1% stream blockages, 0.7% ticks, and 8.3% other (fish requests, stormwater facility concerns, and inquiries about our operation procedures).

IV. VECTOR BORNE DISEASE

In 2022, the NJ Public Health & Environmental Laboratory (PHEL) continued panel testing for increased efficiency and detection of several more viruses. All samples that are tested for West Nile virus (WNV) are automatically and simultaneously tested for eastern equine encephalitis (EEE), Jamestown Canyon virus (JCV), and St. Louis encephalitis (SLE). The written trap placement plan was slightly revised in 2022 to reflect changes in disease activity. This plan has been modified as needed for other mosquito-borne disease surveillance in the past and is updated periodically when the need arises. The plan merges the trapping schedules and trap placements for all disease surveillance, which was done primarily by the Disease Surveillance/Laboratory Assistant. The plan provides for standard trap sites that have had a history of, or have a high potential for, disease activity. The Disease Surveillance Trapping Schedule is provided in Figure 3. In addition to these standard sites, random sites throughout the county are also trapped on a weekly basis for disease testing. This procedure enhances our ability to detect mosquito-borne disease activity in the county. In 2022, routine trapping for Asian Tiger Mosquito (ATM) continued on an as-needed basis with the disease trapping schedule and those sites are also indicated on Figure 3. This is discussed further under Section V. A. 5 – BG Traps. The collections from these traps are often sent in for WNV, EEE, JCV, and SLE panel testing but other panel testing, specific to ATM such as the Zika, Chikungunya, and Dengue panel and the LaCrosse panel are available if the need arises.

A. Disease Response Guidelines

The Commission's Mosquito Borne Disease Response Guidelines were reviewed and revised in 2018 to provide consistency and in order to respect state restrictions on the use of identifiable personal information with respect to human disease involvement. These guidelines are based on the current knowledge regarding West Nile virus and take into consideration other potential disease detection. The current version can be found in Figure 4. This serves as a guide for communication, surveillance and control when evidence of mosquito borne disease is noted in Warren County.

B. Vector Borne Disease Working Group (VBDWG)

This interagency group is comprised of representatives from the State Health Department, the State Public Health Laboratory, the NJ Office of Mosquito Control Coordination, the military, State Epidemiologists, the NJ Department of Agriculture-Division of Animal Health, US Department of Agriculture, Rutgers Center for Vector Biology, Local Epidemiologists, NJ Health Officers Association, and the Associated Executives of Mosquito Control in NJ (AEMCNJ). The Superintendent is one of the AEMCNJ representatives for the group. The group typically meets every month during the active season (with sub-committees meeting during the off months) in an effort to discuss current activities and guide each agency in enhanced activities that would help address important public health issues caused by vector-borne disease in the state. Meetings in 2022 were held monthly from March through September with additional meetings in November and December. They were a mix of in-person and virtual meetings. Subcommittee meetings were held in March and October.

For the first time in almost 10 years, the VBDWB updated the Disease Surveillance Guidelines in 2021 for the state and distributed these guidelines to the 21 county mosquito agencies. These guidelines outline the species and ideal number of mosquito samples (pools) per week for each disease that the county agencies should aim to submit to the state testing laboratory in order to provide an accurate account of the presence of mosquito borne disease throughout the state. These guidelines were revised in 2022 to reflect the comments of the participating county agencies.

C. VectorSurv

In 2022, New Jersey continued to utilize CalSurv for statewide arbovirus data management. This database system was developed by the University of California, Davis as a collaborative between the state, university, and county public health entities. The NJ Vector-borne Disease Working Group worked with the developers to customize the system for use by the NJ counties, creating JerseySurv. The Centers for Disease Control funded the entire effort and more states/territories have joined, so the system has been renamed “VectorSurv”. Now the PHEL and the 21 counties, as well as Rutgers University and the NJ Office of Mosquito Control have free access to this system.

Mosquito control and public health agencies who use the VectorSurv system do so through the Gateway, which is an online interface for managing and analyzing surveillance and control data related to mosquitoes and arboviruses. The Gateway requires login credentials for each user, who must belong to an identified agency. Each agency maintains all privileges to manage its own data and user accounts, and higher-level aggregate reporting functions are managed by the state. The counties enter the sample information for the specimens being sent to PHEL (or the Cape May laboratory) for disease testing and when the laboratory receives the samples and tests them, they enter the results. VectorSurv has the capacity to handle all trap data (including NJ Light Trap data) not just disease surveillance data. This system increases efficiency and communication between the various agencies and allows for data sharing and data analysis. In 2022, tick surveillance data and pools were also entered into this system.

Mosquito samples and testing results submitted from Warren County to the state are reported in the NJ Vector Surveillance Summary along with other mosquito-borne disease surveillance results for the entire state, published by the NJ Agricultural Experiment Station. A year-end summary of this report can be found in Figure 5.

D. West Nile Virus (WNV), eastern equine encephalitis (EEE), St. Louis encephalitis (SLE), and Jamestown Canyon Virus (JCV)

A chart showing real time disease activity by municipality is included on the Commission’s website to keep residents informed. Mosquito-borne disease surveillance activities are described below. The Commission has been monitoring for West Nile virus since its introduction into New Jersey in 1999; therefore, most historical disease data pertains to WNV. A map showing the locations of all cumulative WNV activity in Warren County to date (including mosquitoes, birds, and horses) can be found on the WNV Cumulative Positive Map, Figure 6. Locations of confirmed human cases are not publicly disclosed; therefore, these points are not shown on Figure 6. As mentioned earlier, in 2022 all samples submitted for WNV were simultaneously tested for EEE, SLE, and JCV. Although the Commission has periodically been able to test for these and other viruses before, the panel testing allows for a much more comprehensive surveillance program.

1. Bird Testing

The bird testing regime followed since 2001 was discontinued in 2016. This service is no longer available through the NJ Department of Health and Human Services; however, the NJ Department of Agriculture does occasionally test birds for WNV. In Warren County, dead bird reports are entered as service requests, and the area is trapped as soon as possible for mosquitoes that are likely to be carrying the virus. The mosquitoes caught from those areas are submitted for testing and often result in detections of the West Nile virus.

Statewide, seven birds tested positive for WNV in 2022: one Cooper’s Hawk, five Red-tailed Hawks, and one Blue Jay. The WNV positive birds reported from Essex, Morris, Somerset Counties.

2. Mosquito Sampling/Testing

In 2022, a total of 499 pools (samples) of mosquitoes comprised of 9,947 mosquitoes from Warren County were submitted to the NJ PHEL for virus testing. The State Mosquito Control Commission

covered the total costs of testing for each county (up to 25 pools per week). Please refer to Figure 6a, Mosquito Samples by Species Submitted to PHEL for Mosquito-borne Disease Testing to see the species and counts of mosquitoes submitted. A map of all the sites where mosquitoes were collected and submitted to PHEL in 2022 for disease testing can be found on Figure 6b, Mosquito-borne Disease Trapping Locations.

a. West Nile virus

Currently, West Nile virus (WNV) is the primary mosquito-borne virus of concern in Warren County; therefore, the methodology of our disease surveillance program is centered on this disease. For West Nile virus surveillance, gravid traps were placed at locations throughout the county to target *Culex* mosquitoes, the primary vector of WNV. These traps were set beginning May 4 through November 1 in 2022. All municipalities were sampled multiple times starting with sites on the trapping schedule, then supplemented with sites that had a high disease potential to fill geographic voids. Neighborhoods with positive WNV indicators were also focused on to assess the general mosquito activity as well as the WNV activity in those areas. *Culex* species (mostly *Cx. pipiens* and *Cx. restuans*) were tested, since they are the known amplification vectors of WNV. If any of those pools tested positive, then additional trapping and/or testing was done to include other species that may bridge the disease to humans.

In 2022, Warren County had 8 WNV positive mosquito samples out of the 499 samples tested for WNV. This is below the county average of 12 WNV positive samples/year. The first WNV positive pool of the year was collected from Phillipsburg on August 8, 2022. The final WNV positive pool of the year was collected from Harmony Township on September 19, 2022. The eight (8) mosquito samples that tested positive for WNV from Warren County in 2022 were from the following townships: Allamuchy (1), Belvidere (1), Hackettstown (1), Harmony (2), Phillipsburg (1), and Washington Township (2). The species that tested positive for mosquito-borne disease in 2022 were *Aedes japonicus* (2 pools), *Culex pipiens* (1 pool), and *Culex pipiens/restuans/salinarius mix* (5 pools). This information can be found in Figure 6a and both positive and negative trap locations are mapped in Figure 6b.

Statewide, 2022 was also a below average year for WNV activity. Ninety four (94%) of the WNV positive mosquito samples were *Culex* species and the remaining six percent (6%) comprised 9 different species (*Aedes albopictus*, *Ae. japonicus*, *Ae. triseriatus*, *Ae. vexans*, *An. punctipennis*, *An. quadrimaculatus*, *Coquillettidia perturbans*, *Aedes cantator*, and *Aedes canadensis*).

b. Eastern equine encephalitis

To better conform to the Mosquito and Vector Surveillance Submission guidelines, the goal was to have some pools submitted for testing each week that would target eastern equine encephalitis and Jamestown Canyon virus vectors in addition to West Nile Virus vectors. For eastern equine encephalitis, the target species are *Culiseta melanura* and *Coquillettidia perturbans*, the primary vectors of EEE. In 2022, although additional traps were set in areas to target EEE vectors, populations were fairly low. Most of the samples submitted for EEE were from service requests (complaint trapping). Since the inception of panel testing at PHEL, all samples submitted for the WNV testing panel are also tested for EEE; therefore, 464 mosquito pools (9,838 mosquitoes) were tested for EEE. None of the mosquito samples from Warren County tested positive for EEE in 2022. If positive mosquitoes were to be found in any sampling, more extensive trapping would have followed to determine the best course of action.

Statewide, 2022 was an inactive year for EEE with only four (4) mosquito pools testing positive from Bergen (2), Atlantic (1), and Morris (1) Counties. Three of these pools were *Culiseta melanura* and one

was a pool of *Culex* Mix.

c. Jamestown Canyon virus (JCV) and St. Louis encephalitis (SLE)

In Warren County, specific trapping for JCV was done early in the season, beginning April 14, 2022. Between April 14 and May 4, CDC traps baited with dry ice were set at snowpool habitats throughout the county to target early season *Aedes* species. Collections included *Anopheles punctipennis*, *Anopheles quadrimaculatus*, *Culex species*, and *Aedes vexans*. Jamestown Canyon virus is included in the West Nile virus multi-plex panel, so in the end, 464 pools (9,838 mosquitoes) submitted for WNV panel testing were tested for JCV and SLE yielding no positive pools in Warren County for either of the two viruses. However, statewide Jamestown Canyon virus was detected in three mosquito samples in NJ in the following counties: Bergen (2) and Sussex (1). There was no Saint Louis encephalitis activity in NJ in 2022.

3. Equine Cases

No horses were confirmed to have WNV in Warren County in 2022. No horses tested positive for WNV or EEE in the entire state of NJ.

4. Human Cases

The Commission is kept abreast of human cases being tested for mosquito-borne diseases via regional meetings (Associated Executives of Mosquito Control in NJ, Vector-borne disease working group, and NJMCA Board meetings). If the Superintendent was notified of suspect human cases in Warren County via phone calls from the State Mosquito Control Commission, this would then prompt contact with the county health department for additional information. Information about each individual case is shared between the county health department and the mosquito commission superintendent. If a case is confirmed positive for mosquito-borne virus, the superintendent notifies the Commissioners and the county freeholders.

There were no human cases of WNV, EEE, JCV, or SLE detected in Warren County in 2022. In the state, there were a total of twenty (20) confirmed WNV human cases from Bergen (3), Burlington (2), Camden (3), Middlesex (1), Monmouth (5), Morris (1), Ocean (2), Somerset (1), & Union (2) Counties. Thirteen of those cases were classified as neuroinvasive and four of those cases resulted in fatalities. Additionally, there was one (1) presumptive WNV positive blood donor. One human case of JCV was reported from Sussex County in 2022. There were no reported confirmed human EEE or SLE cases in the state of NJ in 2022.

5. National Recreation Area Cooperation

Usually, the lines of communication are open regarding detection of WNV in the Delaware Water Gap National Recreation Area (DWGNRA) and surrounding areas. Provisions have been made to allow for limited control measures to be taken in the park if WNV occurs there. Although National Park Service Collection Permits were received for the 2022 season, there was no sampling done in the DWGNRA in 2022.

D. Chikungunya Virus (CHIKV) and Dengue Virus (DENV) and Zika Virus (ZIKV)

Humans can serve as a reservoir for Chikungunya (CHIKV), Dengue (DENV), and Zika (ZIKV) Viruses. Therefore, a mosquito can actually acquire enough virus from an infected person (while obtaining a blood meal) to pass that virus onto another person. Unlike WNV, these viruses do not require a bird reservoir. *Aedes aegypti* and *Aedes albopictus* are both able to transmit the virus. *Ae. aegypti* is not present in Warren County but *Ae. albopictus* is becoming more abundant.

To date, there have not been any locally transmitted cases of CHIKV, DENV, or ZIKV in New Jersey; however, there have been travel related cases of all three viruses in the state. It is theoretically possible for local transmission to occur in Warren County in areas where *Ae. albopictus* are abundant (when

travel related cases are present).

Mosquito testing for these diseases was made available from the State PHEL; In 2022, following a possible human case of Zika in Warren County one sample consisting of twelve (12) *Aedes albopictus* was submitted for CHIKV, DENV, or ZIKV testing; the result was negative. The human case was later resulted as negative as well.

A detailed Zika Action Plan was developed and approved by the Commission in 2017. The Plan follows the recommendations set forth by the CDC for Zika Vector Control in the Continental United States and incorporates properties of the NJ DOH Interim Zika Virus Concept of Operations Plan and the AMCA Best Management Practices for Integrated Mosquito Management. The Commission's Zika Action Plan outlines the preparations and responses to various scenarios of a Zika virus epidemic. The actions laid out in this plan would also be applicable to many other vector-borne disease outbreaks.

E. La Crosse Encephalitis (LAC)

Mosquito testing for La Crosse encephalitis was made available through the NJ PHEL for 2019 by choosing a separate LAC/WNV panel test instead of the WNV/EEE/SLE/JCV panel testing. There was no suspected LAC activity in Warren County in 2022; therefore, no specific trapping was done for LAC. However, in an effort to adhere to the Mosquito and Vector Submission Guidelines that suggest 1-2 pools per week for LAC surveillance, pools were submitted for LAC testing as often as possible. *Aedes triseriatus*, the Treehole Mosquito, is the primary vector species for LAC and it is seldom caught in high numbers in Warren County traps; the greatest single collection in 2022 was 10 specimens from a BG trap set on June 7. Most pools were derived from gravid traps, but there were also submissions from BG and CO² baited traps as well. In 2022, a total of 37 pools (totaling 101 mosquitoes) were submitted for LAC testing; all samples tested negative for LAC. Statewide, there were no positive pools of LaCrosse detected and no confirmed human cases.

F. Tick-borne Disease

Since 2000, the number of tickborne diseases in Warren County has markedly increased. The tickborne diseases reported to the NJ State Health Department from Warren County include Lyme disease, babesiosis, ehrlichiosis/anaplasmosis, Rocky Mountain spotted fever, and Powassan virus. The State Health Department has not released the final number of cases per county of the aforementioned tickborne diseases for 2022 as of the date of this report; however, once finalized it can be found at: <http://www.nj.gov/health/cd/statistics/reportable-disease-stats/index.shtml>.

From 2010-2019, Warren County was consistently one of the top three counties for the highest incidence of Lyme disease in the state and experienced the highest incidence in both 2016 and 2017. Increasing numbers of babesiosis, ehrlichiosis/anaplasmosis, and spotted fever group rickettsiosis are also occurring and unfortunately, in 2013, there was a fatal case of Powassan virus that occurred in Warren County. The Board of County Commissioners passed a resolution in 2019 designating the county mosquito commission as the designated agency for tick surveillance in Warren County should funding become available. The Commission sought and was awarded grant funding for tick surveillance in 2021 and 2022.

One goal of the grant-funded tick surveillance project is to calculate the density of infected ticks in Warren County for a variety of tickborne pathogens. However, there have been delays in developing and validating the tick testing methods at the NJ Public Health and Environmental Laboratory (NJ PHEL). The first 145 ticks collected in the fall of 2021 were tested for Powassan virus; however, the NJ PHEL did not have the ability to test for other pathogens at that time. One *Ixodes scapularis* tick collected from Frelinghuysen in the fall of 2021 tested positive for Powassan virus. The bacterial pathogen testing was supposed to be conducted at the CDC in Fort Collins, CO; however, problems with reagents and tainted samples have prevented that from occurring to date. As of the writing of this

report none of the collected specimens from 2022 have been resulted but are awaiting testing at NJ PHEL for bacterial, protozoan, and viral pathogens that cause tickborne disease in New Jersey. Detailed information about the tick surveillance project can be found in Section VIII. Grant Funded Tick Surveillance.

V. SURVEILLANCE

Surveillance is the foundation of all of the Commission's efforts and is a necessity to make sound, scientifically based decisions. Rainfall surveillance guides our efforts and allows for the most efficient use of Commission time. Rainfall events are tracked throughout the county so that inspection efforts are concentrated where the most flooding potential exists. Adult and larval mosquito surveillance is time-consuming, but it is an integral part of any Integrated Pest Management approach. County-wide mosquito surveillance not only provides the data needed to make control decisions but also provides an overall picture of mosquito productivity in the county. This information is useful in identifying where future problems may occur, such as invasive mosquito species and the potential introduction of emerging infectious diseases.

A. Adult Mosquito Surveillance

Routine surveillance for adult mosquitoes occurs at predetermined Surveillance Stations utilizing stationary New Jersey light traps. The locations of the 2022 Warren County Surveillance Stations can be seen in Figure 7. These stations are vital to our mosquito abatement efforts. They provide adult mosquito population data to direct and justify control measures and provide follow-up data to evaluate the control measures employed. The detailed 2022 seasonal synopsis of mosquito species collected from the routine Surveillance Stations can be found in Figure 7a. A summary of the overall number of mosquitoes collected from these stations is graphed on the New Jersey Light Trap Figure 7b.

In addition to the routine surveillance, randomized adult mosquito surveillance is done throughout the county utilizing Gravid traps, CDC (dry ice baited) traps, and BG Sentinel traps. These traps are often set in response to resident complaints of biting mosquitoes or for disease testing. The Five-Year Summary of the 2022 Disease, Complaint, and Field Study Surveillance Synopsis is shown on Figure 8. Please note that only complete data was used to calculate the mosquitoes per trap night and species abundances in 2022; that is, any malfunctioning traps and their collections (or lack thereof) were removed from the equation. If a trap was set and yielded no collections but was functioning upon retrieval, then it was included in the calculation. In 2022, there were thirty-two malfunctioning traps disregarded from the collection data. This approach to analyzing trap data will continue in 2023.

Calls from residents are not necessarily used as a surveillance method themselves; however, they do help bring attention to areas with adult mosquito problems. Inspections made at the site of these service requests often include setting adult collection traps (usually CDC traps baited with CO₂) to ascertain the mosquito species present and the extent of the problem. Occasionally, residents are urged to gently swat and collect adult mosquitoes that may be present and call our office so that a staff member can pick up what they have collected if the CDC trap does not produce any mosquitoes. If a resident has a bona fide problem that has not been detected by our staff, this technique is very helpful, and residents are happy to assist.

1. NJ Light Traps

Seven New Jersey light trap (NJLT) surveillance stations were maintained in Warren County in 2022. All NJLTs were in operation from May 9, 2022, through October 17, 2022. Some of these traps have been monitoring the same areas for over 25 years. The consistency of placing light traps in an area for a number of years is beneficial to obtain a long-term picture of the mosquito production in that area. Totals of all the NJLT collections for 2022 are found in Figure 9.

The top five mosquito species sampled through our NJLT surveillance were: *Ae. vexans* (31.97%), *Culex spp.* (26.11%), *An. punctipennis* (11.52%), *An. quadrimaculatus* (8.93%), and *Ae. trivittatus* (5.11%). Year 2022 yielded an average of 11.24 mosquitoes per trap night (T/N), which is a 60.7% decrease from the average number of mosquitoes per trap night collected in 2021 (28.60 mosquitoes/TN). In 2022, 12,666 mosquitoes were trapped in NJLT's compared to 32,465 mosquitoes in 2021 showing that overall populations were remarkably lower than the previous year. The greatest species diversity was observed at Ivaseczko's on Post Lane in Independence Township; this trap collected 23 different species throughout the course of the season although five of those species were collected in singular abundance. The least diverse trap in 2022 was a tie with both Woronowicz's on Pequest Road in Oxford Township and the Independence Township Municipal Building in Independence Township (13 species collected). Other traps ranged from 16 to 19 species collected over the course of the season. Compared to 2021, whose traps ranged in diversity from 18 to 22 different species, the 2022 season saw larger variation in the species diversity of the light traps.

In 2021, *Aedes tormentor*, a woodland pool floodwater mosquito was collected from three surveillance stations, in addition to larval collections, and was recorded for the first time in Warren County history. Additionally, one surveillance station collected a single *Aedes infirmatus* adult female. This season, however, there was only one *Aedes tormentor* specimen collected from one surveillance station and no collections of *Aedes infirmatus*. Since both species utilize floodwater habitat, the dry summer conditions of 2022 likely led to a decrease in their collections due to reduced available habitat. The *Ae. tormentor* adults and singular *Aedes infirmatus* adult collected in 2021 were sent to Rutgers in April and were tested in 2022 with a restriction enzyme assay to confirm their identifications. Since there have been no further collections of *Aedes infirmatus* to date, it still has not been added to the Warren County species list until more substantial collections confirm its establishment.

With funding from the State Mosquito Control Commission, Rutgers Center for Vector Biology began a statewide NJLT Surveillance program in 2003. Included in this statewide program are three traps from Warren County: Pequest Road in Oxford Township (Woronowicz - Trap 2A); Young's Island Road in Independence Township (Ivaseczko - Trap 5), and Bear Creek Road in Allamuchy Township (Schulster - Trap 4A). Mosquitoes from these traps are collected regularly by the cooperators and then picked up weekly by Commission staff. The collections are then sorted in the lab to isolate the mosquitoes from the other insects trapped. After prompt identification, the count and species information are entered directly into the New Jersey VectorSurv platform. By doing so, the trap data is accessible by Rutgers staff for inclusion in the statewide database. The three chosen traps from Warren County, along with three chosen traps from Sussex County, represent the Northwest Rural region figures on the state report. Rutgers' weekly summaries are made available to all mosquito control agencies in the state as part of the NJ State Surveillance program reports and can be found at: <http://vectorbio.rutgers.edu/surveillance.php>

2. Portable Carbon Dioxide Baited Light Traps

Historically, landing rates were used at our regular surveillance stations to augment the New Jersey Light Traps by collecting mosquito species that are not readily attracted to light. *Aedes trivittatus* is one of our primary summer nuisance species and falls into this category. With the onset of West Nile virus, it was deemed too dangerous to conduct regular landing rates. So, CDC traps baited with dry ice became a substitute for the human landing rates and were conducted regularly at NJLT locations for many years. However, the increased presence of *Aedes albopictus* in Warren County along with the increased demands of setting, identifying, and processing the disease surveillance traps made it burdensome to continue with the CDC trapping at our regular New Jersey light trap surveillance sites. There was very little to no new information being gleaned from double trapping each NJLT location with a CO₂-baited trap; therefore, in 2019, we ceased setting these additional traps. Nonetheless, CO₂-baited traps continue to be used for the majority of our service request/complaint trapping when host-

seeking mosquitoes are being targeted. These traps are also used alongside our gravid traps for disease surveillance when species other than *Culex* are being sought as well as for conducting field studies near highly productive sites.

In 2022, CDC traps were the primary trap set in response to residential complaints and service requests to validate an adult mosquito problem. However, CDC traps were also set on occasion to monitor adult populations both before and/or after adulticide applications, set in response to positive West Nile virus samples, and set in proximity to identified larval breeding sites to gauge larviciding efficacy and adult hatch-off. When looking at Figure 8 (Surveillance Synopsis), it is important to take these trap uses into effect, namely being that CDC traps are not 100% synonymous with service requests.

3. Landing Rates

As previously stated, the presence of mosquito-borne diseases eliminated the use of landing rates as a safe and effective means of surveillance. A small subset of samples was collected as landing rates early in the 2022 season. Notably, the spring had above average rainfall and higher abundances of *Aedes sticticus* in select regions than is usually observed. However, a majority of residential complaints were evaluated using a carbon dioxide baited CDC trap, mostly because the remainder of the season experienced below average rainfall in comparison to previous years so there were staff available to deploy and retrieve traps and the biting adult populations were generally low.

4. Resting Boxes

Resting boxes are primarily used to assess population levels of *Culiseta* species mosquitoes. *Culiseta melanura* is the primary species implicated in the amplification of eastern equine encephalitis. After years of trapping for *Cs. melanura* utilizing resting boxes in various sites throughout Warren County, this species was only found occasionally, which led to resting box surveillance being terminated in 2009. Resting boxes can be set periodically if requested by the State, but we have had better success collecting *Cs. melanura* from the NJLTs and CO₂-baited traps.

5. BG Sentinel Traps

BG Sentinel traps are the standard trap type used to monitor *Aedes albopictus*. This type of trap is known to collect higher numbers of *Ae. albopictus* than the other traps mentioned because they are set low to the ground and are more in line with the flying height of a host seeking *Ae. albopictus*, they are baited with an additional human scented lure, and they use high contrast coloring. BG sentinel traps can be cumbersome to set and do not produce quality results if left out in the rain, so collections are often supplemented with other trap types. There have been several years when CDC traps collected significantly more *Ae. albopictus* than BG traps did; however, over the past two seasons, the opposite has held true. In 2022, BG traps collected 724 adult *Aedes albopictus* females, whereas CDC and gravid traps combined only yielded 117 *Aedes albopictus* adults. This is partly due to the preferential selection of BG traps in areas with known populations of *Aedes albopictus*. For example, when conducting surveillance in Phillipsburg, where *Aedes albopictus* is the greatest nuisance, BG traps are primarily used, but CDC traps are generally given preference for surveillance efforts in other regions of the county because they attract a broader range of species that are more likely to be causing a nuisance.

In 2022, BG Sentinel traps were deployed at set locations throughout the county to monitor the spread of *Ae. albopictus* (refer to Figure 3). Locations were chosen in areas with established populations as well as locations that had small or no prior collections of *Ae. albopictus*. BG traps were set bi-weekly in Alpha, Belvidere, Blairstown, Hackettstown, Independence, Phillipsburg, Washington Borough, and White Township. In 2022, *Aedes albopictus* adults were collected from every routine BG trap with the exception of the BG trap located in Blairstown. To date, the occurrences of *Ae. albopictus* in the Hackettstown and Belvidere BG traps differs significantly from the high numbers observed farther

south in the county. However, these traps still demonstrate an increase in *Aedes albopictus* collections from the 2021 season such that the Hackettstown trap yielded 3 adult females as opposed to just 1 in 2021 and the Belvidere trap yielded 25 adult females and 17 adult males as opposed to just 1 female and 1 male in 2021.

Because Phillipsburg has an established *Aedes albopictus* population, BG traps are the primary device used to monitor the adult mosquito population in that portion of the county. Over the past two seasons, a transition has been made to primarily use BG traps in Phillipsburg so that the trap data between locations is consistent and can be compared from site to site and from season to season. There are six trap locations with historical data that are used to compare the populations from year to year and are generally trapped in preparation for an area wide adulticide following large influxes of residential service requests. In 2022, these locations were trapped three times from early June through early July. However, the dry conditions that developed over the summer resulted in reduced habitat, so very few service requests were received from the area, so trapping efforts fell to the wayside.

Over the past couple of seasons, *Aedes albopictus* has been found sporadically in Allamuchy, Hackettstown, and Blairstown; if samples continue to be collected in these areas, it is likely that *Ae. albopictus* will be established county-wide. BG traps were chosen for this routine trapping so that populations could be easily compared to trapping done in other counties.

6. Ovitrap

Ovitrap are a unique surveillance method that targets the egg stage of container-type mosquitoes. The traps are simply small containers baited with organically rich water and they are lined with egg laying paper or seed germination paper. It is a very labor intensive trapping method, and since *Ae. albopictus* can be easily collected with other trap methods, it was decided to abandon the use of ovitraps as a regular surveillance method. However, ovitraps have been used since 2017 when there was a need to collect *Ae. albopictus* eggs for insecticide resistance workshops (see VIII. Research & Field Studies for more information). During the winter of 2020, a significant amount of time was dedicated to planning how lethal ovitraps could be used in high population communities within Phillipsburg to contribute to control efforts during the season. However, due to the COVID-19 pandemic, this project was delayed to limit interactions between Commission staff and the public since these traps would have to be placed within private yards and serviced weekly. To date, time and resource limitations have prevented this project from being revisited and there is no definitive date to revisit as of 2022.

7. *Aedes albopictus*

The most recent invasive species, *Aedes albopictus*, also called the Asian Tiger Mosquito (ATM), was first detected in Phillipsburg (at the Filmore Street Cemetery) on August 28, 2012, in both a gravid trap and a portable light trap which had been set following the report of a dead crow. Warren County was the last county in the state to fall prey to this invasive species. *Ae. albopictus* is a potential vector of several mosquito-borne diseases and unfortunately, requires non-conventional means to control. Up until 2017, Commission staff was able to contain this species to the townships in close proximity to Phillipsburg; however, in 2017 samples were collected in Washington Borough several times throughout the season and one sample was collected from the Pollution Control Financing Authority (PCFA) in Oxford Township. The extreme weather conditions of 2018 led to a population explosion and northward advancement throughout the county. In 2022, *Aedes albopictus* was collected in fourteen municipalities, with varying abundance relative to trapping effort within a given area. The presence or absence of *Aedes albopictus* in a municipality from season to season has not been consistent such that *Ae. albopictus* was not observed in Blairstown in 2021 or 2022, but it had been observed in previous seasons. Similarly, there were no collections of *Aedes albopictus* in Lopatcong or Mansfield Townships in the 2022 season, but that is most likely due to reduced trapping efforts and not eradication of the species from those municipalities. To date, *Aedes albopictus* has been collected at some point in time from all but four municipalities, those municipalities being Frelinghuysen,

Hardwick, Hope, and Knowlton. See Figure 10 for a map of *Ae. albopictus* collections in 2022 and Figure 10a for a closer look at 2022 *Ae. albopictus* collections in Phillipsburg, Alpha, and Belvidere.

For the past two seasons, the commission has seen a slight decrease in *Aedes albopictus* activity throughout the county, but this is most likely related to reduced time and effort spent trapping. In 2022, a total of 841 adult female *Ae. albopictus* mosquitoes were collected across all trap types (CDC, BG, and gravid), a 1% decrease from the 850 adult females collected in 2021. Out of 495 total traps set in 2022 (inclusive of GT, BG, and CDC traps and exclusive of malfunctions), a total of 114 traps (23.03%) collected *Ae. albopictus* (either males, females, or both). A total of 79 traps, BG and CDC, were set in response to service requests; twelve (15.20%) of those traps were positive for *Aedes albopictus*. Although the goal is to put forth a regular and consistent effort towards monitoring ATM populations throughout the Phillipsburg and surrounding areas, the dry conditions surrounding the 2022 season did not require the same wide-scale efforts to control *Aedes albopictus* since habitat was readily reduced throughout much of the summer. Service requests were extraordinarily low, reducing the need to set service requests traps or traps to prepare for an area wide adulticide. This was the first season since 2014 that an area wide adulticide did not occur in the Phillipsburg area.

B. Rainfall Monitoring

The State Climatologist's Office reported the annual average precipitation for the state was 44.02", which is 3.54" below the 1991-2020 normal. The summer of 2022 was the driest summer since 1966 and ranked the 4th driest on record (dating back to 1895). The annual statewide temperature was 0.7° above the 1991-2020 average at 54.3° and ranked the 12th warmest year since 1895, tied with 2019 and 2002.

The rain gauge located in Oxford at the Commission office collected a total of 50.44 inches of precipitation for the 2022 year. Rainfall amounts from this gauge are shown in Figure 11 for the months of April through September and reflect the rainfall that fell in the county in 2022. Please refer to Figure 11 for the ten (10) years of rainfall monitoring data from the Oxford rain gauge for the above-mentioned months.

The rainfall observed in 2022 was unique compared to previous years. In April, at the start of the mosquito season, monthly rainfall was well above the ten-year average. However, by June, monthly rainfall fell below the ten-year average, and it remained considerably below the ten-year average through August. It was not until September that monthly rainfall and the ten-year average coincided once again. As a result, the 2022 mosquito season had an incredibly busy spring with extensive flooding and high demand to treat larval habitat, but by mid-summer was approaching drought-like conditions. As a result, even though equilibrium was beginning to be restored by the fall, the ground was so dry that flooding was limited; coupled with changes in temperature and daylight, mosquito productivity was considerably low.

While the records kept at our office are helpful in comparing one year to the next, it does not provide accurate knowledge of what goes on in other parts of the county. The Community Cooperative Rain, Hail and Snow (CoCoRaHS) network was identified in 2009 as a source of real time precipitation data. This nationwide network had an increase of sites in 2009, in part due to newspaper coverage regarding this network. Cooperators in the county include Secretary Christine Fisher and Superintendent Jennifer Gruener in addition to our Oxford office. The CoCoRaHS precipitation maps were referred to almost daily and served well in 2022 to identify rainfall patterns that needed attention in various parts of the county.

C. Larval Mosquito Surveillance

1. Breeding Site Inspections

A detailed route system for our four districts is followed to inspect for larvae. Eight thousand, seven hundred and fifty-six (8,756) inspections were performed on mosquito breeding habitat throughout Warren County in 2022. Each year new sites must be added and sites that no longer pose a problem must be deleted from the site logbook and the detailed inspection route system. Inspection data is recorded in the field with handheld tablets. Site specific data is collected for every inspection and treatment, as per NJ Pesticide Control Regulations, and this data is then downloaded into the database at the end of every day. The FieldSeeker system allows for additional data to be recorded in the field, such as ownership information, site access, and inspector comments. Inspection and treatment history are stored on the tablets and are available to the inspector in the field at the touch of a button. The Activity Summary chart on Figure 12 contains a breakdown of inspections, control measures and education activities in the field by township for the 2022 season.

2. Larval Dip Counts

Larval samples are taken at every location when possible. Larvae are transported back to the laboratory and reared to 4th instar or adult so accurate identifications can be made. This information serves as justification for the pesticide application as well as documentation for permit applications for water management projects. Larval identifications are later entered into the FieldSeeker database for each site collection.

The first larvae of the season were collected on March 7, 2022, in sites located within Independence Township and included samples of *Ae. canadensis* and *Ae. stimulans*. Spring collections mostly consisted of *Aedes canadensis* and *Aedes stimulans* with occasional collections of other characteristic early spring and snow pool species, including *Aedes cinereus* and *Aedes excrucians*. There is a continuing trend of early collections of *Aedes vexans*, a common summer species; the first larval sample of *Aedes vexans* in 2022 was collected on April 2, and this species continued to be consistently sampled in April throughout the county. Other normal summer species, such as *Ae. trivittatus* and *Psorophora ferox* were found starting late May and early June, but their larval collections diminished as the summer progressed due to lack of habitat. Most larvae collected from container-like habitats were *Aedes japonicus*, and the larval *Culex* collections were predominantly *Culex restuans* or *Culex territans*. Due to the dry conditions, larval collections become less abundant as the season progressed.

D. Species List

The full New Jersey Species List (64 species), with Warren County species (46 species) bolded, can be found on Figure 13. There have been no new additions during the 2022 season. The most recent addition, *Aedes tormentor*, occurred on July 7, 2021. *Aedes tormentor*, a floodwater mosquito, was first collected as larvae on July 7, 2021, from a swamp in Independence Township. Adults were later collected from a CO₂-baited trap set at the same site. Although *Aedes tormentor* was documented in five townships in 2021, there were only two adult collections in 2022 in Allamuchy and Independence Townships totaling four specimens. There were no confirmed larval collections in 2022.

Even though there was one adult female *Aedes infirmatus* collected in September of 2021 from a New Jersey Light Trap in Independence Township, there were no collections of *Aedes infirmatus* in 2022. As a result, it remains unclear currently if there is an established population. Continued surveillance efforts must be made to collect additional adults and larvae before adding this species to Warren County's list.

VI. CHEMICAL CONTROL

All pesticide applications comply with pesticide regulations established by the NJ Department of Environmental Protection. Recommendations for Insecticide Use in New Jersey, as provided by the New Jersey Agricultural Experiment Station are used for guidance in product selection and use.

Particular insecticides have the ability to alter cholinesterase levels of exposed individuals. So, baseline cholinesterase levels are documented pre-season for each new employee that would be in contact with these insecticides. Currently, the only product in use in Warren County that would fit these criteria is Fyfanon ULV used for adult mosquito control (active ingredient malathion). Mid-season blood work is done when appropriate to check cholinesterase levels for employees who handled Fyfanon ULV regularly during the season. Appropriate action, if any, is taken based on test results. In 2022 Fyfanon ULV was used rotated with a synthetic insecticide, Zenivex, in the adult mosquito control program. Employees deemed susceptible to the cholinesterase-inhibiting product avoided contact with it.

In 2010, a comprehensive plan was developed and put into place to address the New Jersey pesticide regulations that deal with the requirements of the School Integrated Pest Management (IPM) Act. A complete list of public and private schools was compiled. Any known breeding sites on any of these properties were designated for long term briquets and preparations are in place for notification to be made before these are applied in the spring. After yearend, annual reports are sent to affected schools listing insecticide applications. In 2022, sites located on eight (8) school properties required pesticide treatments.

Under the US Clean Water Act administered by the US Environmental Protection Agency, the New Jersey Department of Environmental Protection developed a Pesticide General Permit (PGP), which included a use pattern for mosquito control to operate under. The draft general permit went into effect in November of 2011 with renewals being issued every five (5) years. On February 13, 2020, a final reissued General Permit under the PGP category was issued by the Department of Environmental Protection, which went into effect on March 1, 2020. The Commission received their permit on April 3, 2020. The general permit authorization is issued in accordance with the NJPDES Regulations (N.J.A.C. 7:14A-1 et seq.). This permit authorizes the applications of biological and chemical pesticides in water when such applications are made in, over, or near surface waters of the State for certain pesticide use patterns (including mosquito control). The PGP required the Commission to develop and operate under a Pesticide Discharge Management Plan (PDMP). The PDMP was updated and revised in 2021 to reflect changes in the permit requirements and staffing changes at the Commission. Other forms were developed (ex: adverse incident report) or existing forms modified (ex: adult mosquito control application cover sheet to allow conversion of application to acreage) to satisfy requirements of the General Permit.

A. Larviciding/Pupiciding

Controlling mosquito larvae before they can emerge as adult mosquitoes and cause problems remains the primary focus of our operations. Larviciding is performed when source reduction, water management, and/or biocontrols cannot be employed.

1. Ground Applications

Ground larviciding is a major component of our abatement program. The Biologist, Senior Wetlands Specialist, Wetland Specialist, Inspector, and Heavy Equipment Operator along with the four seasonal inspectors manage the inspection routes during the season. The full-time staff members assist during the early and late season weeks and also during the season peak, while the seasonal inspectors carry out the bulk of the work from June-August. This staffing allows us to keep up with inspecting and treating over 1100 sites currently (refer to Figure 14). These districts and the number of sites in each township are shown on Figure 14, Inspection Districts & Site Breakdown. Inspection and treatment data for each site is recorded in the field with the use of the handheld tablets and that data is transferred into the FieldSeeker database at the end of every day. Treatment records can be quickly retrieved by site, date, inspector, insecticide, or municipality.

The majority of larval sites are treated with a liquid *B.t.i.* formulation using hand-pump compression

sprayers. Extended release briquets are also utilized although primarily in situations where there is a hazard or access concerns and in sites that are on school property. These briquets are utilized in the spring and provide season long control at these sites. In 2022, ground applications for larval mosquito control took place from late March through the middle of October. A portion of treated sites were backchecked to determine insecticide effectiveness and also to make sure seasonal inspectors were visiting the correct sites and correctly applying the insecticides.

Starting in 2012, a relatively new and innovative way to apply larvicides for *Aedes albopictus* control was used. Area-wide applications of Altosid Liquid Larvicide were performed utilizing a truck-mounted Ultra - Low Volume (ULV) sprayer. This method allows the product to settle in small pockets of water that are not practical to treat using traditional methods. A standard procedure for this unusual type of application was tested and published by the Rutgers, Center for Vector Biology. Area-wide notification utilizing the RAVE system was done prior to the applications as well as notification postings on the Commission's and pertinent town's websites and social media accounts. One ULV larvicide application was performed in 2022. This application took place on July 25th at Kucharski's Junkyard on Ryan Road in Independence.

2. Catch Basins

Catch basins, also referred to as roadside storm drains, are numerous and provide perfect larval habitat for *Culex* and other container breeding mosquito species. Through the years, the county's catch basins have been inspected and the hundreds of basins that consistently hold water have been indicated on paper maps. Those paper maps are still referred to but now, the catch basins that the Commission treats are automatically mapped with the FieldSeeker GIS database system as they are being treated. In 2022, catch basins on the central and north routes were treated twice while catch basins on the east and south routes were treated three times.

Although catch basins were sampled in 2022, it was not to the same degree of effort as in years past. Specified catch basins in Hackettstown with previous larval inspection history were sampled in early June to identify the mosquito species utilizing those basins for larval habitat. The species collected, in order of abundance, included *Culex restuans* (8), *Aedes japonicus* (6), *Aedes triseriatus* (1), *Culex pipiens* (1), and *Aedes vexans* (1). Hopefully, collection activities in 2023 can be more frequent and abundant. In the future, the commission would like to use this data to 1. Compare larval activity in catch basins with adjacent adult trap activity and 2. Compare larval collection abundance in relation to the timing of catch basin treatments.

3. Aerial Larviciding

Large tracts of larval habitat that cannot practically be treated by ground applications are indicated for treatment with fixed wing aircraft. Aerial approval forms were sent to municipalities in 2022 where acreage is currently mapped for possible aerial larviciding. This approval is necessary to comply with FAA regulations if the area could possibly be determined to be congested. Copies of the signed approvals were obtained and forwarded to the contracted pilot prior to any aerial larviciding applications taking place.

Wings Aerial was awarded the Aerial Larviciding Contract by the Commission in 2022. All of our aerial larviciding sites are digitally mapped and uploaded to an onboard navigation program, AgNav, which the pilot uses to accurately record his applications. The pilot uses these digital maps to locate individual sites. In 2022, aerial larviciding sites were inspected by the Senior Wetlands Specialist, the HEO/Inspector, and/or the Commission Superintendent following significant rainfall events. When specific sites met the criteria, they were added to the list for the pilot to perform aerial treatment. A granular formulation of *B.t.i.* was used in all aerial applications during the year.

A wet spring and dry summer resulted in four airsprays between April and June in 2022. Rainfall in early April triggered two airsprays. On April 5th, 1,088 acres were treated after one to three inches of rain. Then, on April 15th, 687 acres were treated after another three to four inches of rain fell. Two to three inches of rain in early May resulted in a treatment of 1,205 acres on May 12th. The final airspray of 2022 was performed over two days due to weather hazards on the first application date. One to four inches fell prior to this event. On June 2nd, 546 acres was treated, and the remaining 743 acres was treated on June 3rd.

Figure 15 maps the locations of the aerial sites and shows the number of times each airspray site was treated in 2022. Figure 15a contains a summary of the aerial larviciding applications that took place throughout the year as well as the acres aerially larvicided each year since the beginning of the Commission's aerial larviciding program in 1987. The graph shows the trend line of increasing aerial acreage over time.

B. Adult Mosquito Control

Our adult mosquito control program continues to emphasize preventative control, based on our surveillance program, to keep the adult mosquitoes from entering the populated areas and generating complaints. However, service requests from the public are responded to and investigated.

1. Notification

The legal notice for area wide adult mosquito control was reviewed and updated for 2022. The schedule was developed for publication of this advertisement throughout the season in two newspapers (a legal ad in one paper, a display ad in the other) to best cover the entire county in accordance with pesticide regulations. Our advertising in 2022 continued to utilize two daily papers for better exposure.

Due to increased notification requirements as of November 2001, a Question and Answer Sheet on our Commission's program was developed and approved by NJDEP- Pesticide Control Program (PCP) in April 2002. This fact sheet was updated in 2015 and reapproved by the PCP. It was assembled with other required packet components (information on any product we may use in a given year for adult mosquito control, a copy of our legal advertisement, etc.) and sent to each municipality in the county prior to March 31, 2022. A copy of the entire municipality packet was posted to the Commission website, as well as most municipality websites, in 2022 to provide easy access by the residents.

Since 2006, our website has been utilized to supply countywide adult mosquito control treatment information. Adult mosquito treatments are posted by township at least 12 hours prior to the scheduled treatment. All beekeepers within the county and three miles of the county border were notified by email 24 hours prior to any ground adult mosquito control treatments. While pesticide regulations require notification of treatments occurring within a three-mile range of the hives, a blast email was sent to the entire list for every treatment. The blast email is much more efficient than identifying which hives are within three miles of each treatment every time. Twelve-hour notification calls were made to those residents who requested pre-notification. In highly urbanized areas, the county's RAVE system was used to alert residents of the upcoming adult mosquito control treatments.

Forms created for listing our adult mosquito control application sites were modified in 2010 to include a notification indicator related to school properties. The forms were also modified to allow for easier recording of applications made at different rates (primarily related to the speed of the vehicle in various situations).

2. Ground Treatments for Adult Mosquito Control

Our ground treatments for adult mosquito control operations ran from May 19, 2022, through October

6, 2022. A summary of our adult mosquito control applications by township can be found within the Activity Summary on Figure 12. Most of our early season adult mosquito control applications were in response to floodwater species in 2022 due to above average rainfall in the spring. As the season progressed container and permanent water species numbers increased. Additionally, there were nine adulticide sprays conducted in response to West Nile virus positive pools between August eighteenth and October first. Frelinghuysen Township saw the highest number of truck-mounted adult mosquito control applications this past year.

After the ULV sprayers were mounted on the trucks but before they were used, flow rate and droplet size were calibrated to ensure that each sprayer was performing according to label specifications. Droplets were checked by an AIMS machine provided by a vendor (at the beginning of the season). Prior to any adult mosquito control applications taking place, adult mosquito surveillance was conducted to justify the applications. Surveillance included the setting of CO₂-baited portable light traps, landing rate collections, or disease monitoring. Spraying for adult mosquitoes was dependent upon the number and species of mosquitoes collected and/or if any mosquito-borne virus was present in the area.

3. Aerial Adult Mosquito Control

Aerial approval forms were sent to municipalities where aerial larviciding takes place. This was done in preparation for the possible need to aerially treat for adult mosquitoes in case of mosquito-borne disease control in 2022 with the expectation that aerial applications would only be required in the municipalities with huge mosquito production areas. This approval is necessary to comply with FAA regulations if the area could be determined to be congested. Copies of the signed approvals that were obtained were forwarded to the contracted pilot prior to any aerial taking place in the respective municipalities. Aerial adult mosquito control applications were not necessary again in 2022.

VII. BIOLOGICAL CONTROL

A. Predatory Fish

The NJ State Mosquito Control Commission mosquito fish bio-control program was utilized again in 2022. Stocking fish in permanent/semi-permanent wet areas to control larval mosquito populations remains a vital part of our integrated pest management approach. Larvivorous fish are an excellent alternative to pesticide applications in certain situations. A total of 69,947 fish were stocked throughout many areas of Warren County in 2022 to control mosquitoes primarily on the following dates: April 8th, 21st, 25th and 28th; and May 20th, and 24th (see Figure 12).

There were 57,365 *Pimephales promelas* (fathead minnows) stocked in Warren County in 2022. Fathead minnows have been utilized in our biological control efforts at sites that connect to streams and other bodies of water where native fish populations exist as per DEP regulations.

Gambusia affinis (mosquito fish) continue to work well in various habitat types that retain water long enough to support the fish population, but stocking is limited to sites that are not connected to streams. Under correct conditions mosquito fish reproduce rapidly to establish a substantial population. A total of 10,075 *Gambusia affinis* were stocked at 8 sites on April 25th.

For the 2022 season, *Lepomis macrochirus* (Bluegill sunfish) were made available for stocking and were received from the Hackettstown State Fish Hatchery. On May 20th there were 2,507 Bluegills stocked in eight sites throughout Warren County. The sites selected were more permanent water bodies capable of supporting long term fish populations. By establishing stable, long term fish populations demand for resources such as pesticides and valuable personnel time can be reduced.

The Commission utilizes two 300-gallon livestock water tanks as temporary holding ponds for *Gambusia affinis* and fathead minnows. The fish are held in these tanks until they are needed to stock

areas as needed during the breeding season. This is extremely useful when stocking small amounts of fish in abandoned swimming pools. Rescue operations are performed when we know of an area that is in danger of drying down and those fish are relocated temporarily into our holding tanks. We use one purchased 30-gallon transportation tank along with two fabricated 100-gallon transportation tanks, for our in-house stocking and fish rescue.

VIII. RESEARCH & FIELD STUDIES/COLLECTIONS

A. Insecticide Resistance Studies

Insecticide resistance is a heritable decrease in the sensitivity of an insect population to a particular insecticide or class of insecticides. It is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that species.

Resistance usually occurs when the same or very similar insecticides are repeatedly used on one insect population over many years. With a limited number of insecticide choices available to mosquito control professionals, great care must be taken to rotate active ingredients and to monitor local mosquito populations for any sign of resistance.

The SMCC funded workshops for counties to learn and practice insecticide testing techniques and establish baselines for their local populations in 2017, 2018, and 2019. In the past, mosquitoes collected within Warren County were tested and found to have varying degrees of susceptibility to products being used. Unfortunately, due to the COVID-19 pandemic, there have been no workshops hosted since the last one in 2019. As a result, the commission decided to make developing our own Insecticide Resistance program a priority in 2022. The dry conditions of the season allowed us to dedicate the time and focus to this project.

Plans to conduct a more formal field experiment analyzing the effectiveness of our adulticide products began in 2020 with preparation of materials and experimental design. The goal of a field trial is to place colony-reared or wild caught mosquitoes in disposable cages in a symmetrical arrangement at a designated field site, perform a truck-mounted adulticide, collect the cages, and evaluate the average mortality of the mosquitoes based on distance from the spray vehicle and time elapsed since exposure to the pesticide. The information gathered from this experiment would help determine a baseline for insecticide resistance and provide insight into the product's efficacy. Unfortunately, it came to the commission's attention that the original colony obtained from Rutgers was not considered susceptible, having prior exposure at some point in time which halted the project in 2021. However, circumstances in 2022 led for this project to be revisited and ultimately implemented.

The Northeast Regional Center for Excellence in Vector-borne Diseases (NEVBD) at Cornell University continued their program to offer insecticide resistance testing on *Culex pipiens* and/or *Aedes albopictus* samples collected by public health agencies. The commission first participated in this program in 2019; the results of the 2019 submission showed moderate resistance of *Aedes albopictus* to Etofenprox, an active ingredient in one of the adulticide products (Zenivex E4). Although a collection attempt was made in 2020, Cornell was unable to perform insecticide resistance testing because there were too few eggs of the correct species. Unfortunately, collection attempts in 2021 were not fruitful. In 2022, two of the sites used for the 2019 submissions were revisited on July 15 to collect *Aedes albopictus* eggs; however, the traps were damaged, and the collected materials were either unusable or visibly lacking enough eggs for testing. A second collection attempt took place at one of the sites on August 3, but again, the number of eggs collected were not in high enough abundance to warrant submission. When collecting eggs, it must be assumed that the egg papers contain both *Aedes albopictus*, the target species, and *Aedes japonicus*, the bycatch, eggs. Therefore, no *Aedes albopictus*

samples were submitted to Cornell for testing in 2022. There are plans to resume participation in this program should it be offered in 2023.

In addition to testing *Aedes albopictus* samples for insecticide resistance, Cornell also accepts submissions of *Culex pipiens* larvae. In 2019, there were never enough egg rafts collected to be submitted, and in 2020, no attempts were made. In 2021, the program was revisited, resulting in the submission of *Culex pipiens* larvae collected from three sites in Washington Township, Belvidere, and Hackettstown. The results from Cornell indicated that all three sites showed high resistance to etofenprox.

In 2022, Meadow Breeze Park in Washington Township was selected as the focal site for this program. This site has a strong history of mosquitoes positive for West Nile virus, is the location of the only eastern equine encephalitis positive mosquito pool ever collected in Warren County and is a popular recreation destination. A combination of either hay and grass infusion water or oak leaf infusion water was placed in gravid trap pans (without the collection attachment) and set at Meadow Breeze Park in proximity to the Morris Canal, a productive larval site. To increase collections, there were often three pans deployed at a given time. Egg rafts were collected in individual containers and brought back to the lab to be reared to larvae. Once the eggs hatched, larvae were identified to genus and species, the goal being to have collected *Culex pipiens* that could be submitted to Cornell's program.

Between June 9 and August 9, there were six collection attempts at Meadow Breeze Park, including one egg collection directly from the field site. The number of egg rafts collected was variable, anywhere from five to forty-one egg rafts! Unfortunately, the collections were almost exclusively *Culex restuans*. After four attempts at Meadow Breeze Park, eggs were collected from the office in Oxford to determine if the dominance of *Culex restuans* was site specific or more widespread. Those egg rafts were also *Culex restuans*. This led to a unique scenario- the commission was collecting *Culex* egg rafts in high abundance, but they were not able to be submitted to Cornell because there was no published diagnostic time for this species. The diagnostic time is the pre-determined threshold that evaluates if there is resistance in a population based on the percentage of mortality. At this point, the commission was ready to revisit a field trial; even though there was no published diagnostic time for *Culex restuans*, the commission saw value in simply determining whether a truck-mounted adulticide caused mortality in field-caught specimens.

At this point, collecting eggs to send to Cornell was ongoing with the ideology that any *Culex pipiens* egg rafts would be submitted to Cornell for testing, but the commission would continue to work with the excess *Culex restuans* in a field trial. Once it was decided to conduct a field trial, there were a lot of other project components that needed to be addressed. First, was conducting an in-house CDC Bottle Bioassay. In this experiment, bottles are coated with an insecticide and mosquitoes are introduced to the bottle for a set time while the number of dead and alive mosquitoes is recorded at regular time intervals. The percent mortality is compared to the published diagnostic time, which is when mortality is expected within that species. Since there is not a published diagnostic time for *Culex restuans*, the goal of conducting the bottle bioassay was to simply confirm that mortality occurred, and the results were compared to the diagnostic times for other species.

Egg rafts collected from Meadow Breeze Park on July 8 were reared to adults and maintained in colony until staff was ready to perform the experiment. Both male and female adults were used in the bottle bioassays. The first bottle assay against etofenprox occurred on July 22. Unfortunately, all three replicates contained between 45 and 64 mosquitoes, while the recommended number of mosquitoes per

bottle is 20-25, which likely caused some of the humidity issues observed in the bottles. Regardless, the percent mortality at fifteen minutes (the published diagnostic time for *Culex pipiens*) ranged from 67-93%. One-hundred percent mortality was observed in all replicates at thirty-five minutes. A second bottle bioassay against malathion occurred on July 25. The goal of testing against malathion was to determine if the malathion was more effective, especially since the site has a history of resistance to etofenprox. Like the etofenprox assay, the assay against malathion varied between 24-44 adults per bottle. One-hundred percent mortality was observed at thirty-five minutes (the diagnostic time for *Culex pipiens* with malathion is forty-five minutes). This was good news because malathion is in a different insecticide class than etofenprox and the mosquitoes showed no resistance to it. Ideally, both active ingredients will be tested again next season with less mosquitoes per bottle to remove bias from overcrowding and changes in humidity within the bottles. This was an important first step to have data derived from a controlled environment to draw comparisons between the field trial data.

The fifth egg collection attempt at Meadow Breeze Park occurred on August 4 through 5 and even though there were only seven egg rafts collected, two of those egg rafts were *Culex pipiens*! The hatched larvae were packaged and then overnight shipped to Cornell University where they were reared to adults and tested for resistance to malathion, an active ingredient in one of the adulticide products. Since the 2021 insecticide resistance results, the commission has been more diligent to rotate products. Any adulticide applications that needed to occur at Meadow Breeze Park used the active ingredient malathion as opposed to etofenprox in the 2022 season. The results from Cornell were received on September 30 and showed 100% mortality in the diagnostic time of 45 minutes.

Collection efforts will continue in 2023 with the goal of collecting enough *Culex pipiens* eggs to submit to Cornell to hopefully pinpoint the mechanism involved in the resistance to etofenprox through synergist testing.

The sixth and final egg collection took place August 8 through 9 and yielded fifteen *Culex restuans* egg rafts. These egg rafts were hatched into larvae then reared into adults and maintained as a colony until the commission was ready to conduct the field trial. On August 24, a droplet analysis was performed using the Promist Dura sprayer. Teflon-coated slides were both manually waved behind the sprayer and mounted on the impingers developed by the wetlands specialist for use in the field trial. The purpose of this step was to calculate the volume median diameter of droplets. Droplet size is important when conducting adulticide applications because it affects how the pesticide disperses through the air and ultimately if it will contact a flying mosquito in a high enough dose to kill.

Field trials occurred on August 25 and August 29, 2022, at a field adjacent to the Charles O'Hayford Hackettstown Fish Hatchery. *Culex restuans* collected from Meadow Breeze Park as eggs on August 9 were used for both nights as well as the product Zenivex, active ingredient etofenprox. A grid of 200 feet by 300 feet was set up such that cages of mosquitoes were located 100 feet, 200 feet, and 300 feet from the path of the spray truck. The grid orientation was dependent on the direction of the wind. A truck with a mounted ultra-low volume sprayer would drive a designated path past the grid then commission staff would collect the cages and aspirate the adult mosquitoes into transfer cups. The transfer cups were observed for sixty hours post pesticide exposure.

The first night consisted of four total trials. Two trials occurred at an application rate of 0.75 ounces per acre and the remaining two occurred at 1.5 ounces per acre. The cages constructed by commission staff and the impingers built by the wetlands specialist were utilized as well as materials supplied from Clarke mosquito control company, including disposable cages, impingers, and a weather station. Due

to inexperience with conducting an experiment on this scale, there were delays in recording data such that counting mortality at 10 minutes and 60 minutes did not occur. Additionally, there were some instances where cages may have changed orientation and therefore were not exposed to the product in the same way as other areas of the grid.

The second night of field trials mirrored the first night with one addition. Clarke supplied susceptible *Culex quinquefasciatus* mosquitoes. This time, there were only two trials, one at 0.75 ounces an acre and the second at 1.5 ounces per acre. The field collected *Culex restuans* were side by side with the susceptible mosquitoes supplied by Clarke during the experiment. This was important in determining if a certain area of the grid was properly treated with pesticide based on the mortality observed in the susceptible colony. Unfortunately, the wind plays a large part in how effective a field trial will be, and on that night, the wind direction and field orientation and space were not at optimum operating parameters. Although data was gleaned from both nights, the commission is hesitant to draw any conclusions based on the data because of the learning curves involved.

Conducting our first field trials was a huge step in implementing a pesticide resistance program in Warren County. Commission staff were able to troubleshoot what did or did not work for any stage of the project and recognize where they might find limitations or restrictions. For example, the capacity of lab to hatch egg rafts and maintain the larvae through adulthood was determined to have a maximum capacity of 30 egg rafts. However, when the trials were conducted, six trials were able to be performed with the collection and maintenance of 15 egg rafts. The goal is to continue this work as time allows in 2023 now that commission staff have a better understanding of how to conduct the experiment to produce quality data that can be analyzed and interpreted.

Starting in 2020, there was effort given to regularly and consistently set traps just prior to a scheduled adulticide event and just after an adulticide event to determine the effectiveness of the spray, as time allowed. This surveillance strategy served as a prelude to developing a more robust in-house insecticide resistance program. In 2022, there was no special attention given to this surveillance approach due in part to the hectic spring conditions and dry summer conditions that severely reduced the need for adulticide applications. Any additional time and resources throughout the summer were dedicated to the implementation of the field trials.

B. Mosquito Rearing Colony

There are often occasions when live mosquito larvae and/or adults are needed for insecticide studies and public outreach events. Since most events often occur during the off season, it is sometimes difficult to find live samples that are uniform in age. In the past, live larvae and/or aged adults were obtained from Rutgers University; however, they no longer maintain mosquito colonies for outreach purposes. In 2015, a colony cabinet was built and assembled in the laboratory for rearing mosquitoes in house. Initially, *Aedes atropalpus* eggs were taken from the Rutgers stock and raised. This species is ideal for colonization since females can lay their first batch of eggs without a blood meal and those eggs are resistant to drying out. However, the *Ae.atropalpus* colony was finicky and required daily maintenance (including weekends), so in 2016, a colony of *Culex molestus* was started as a replacement. This species is also able to lay its first batch of eggs without a blood meal; however, the eggs must stay wet in order to remain viable. This colony has been very successful and is much easier to maintain. The colony continued to be maintained in 2022 with the goal to continue maintenance throughout 2023.

In 2022, adults raised in colony were used in the bottle bioassays conducted in house as a point of comparison and evaluation. It had come to the commission's attention that the colony had previous

exposure to insecticides and therefore may not be susceptible. They were tested against both malathion and etofenprox. Each iteration or replicate included both males and females from the colony, and both sexes were used when calculating percent mortality. The first bottle bioassay took place on June 28 to etofenprox. This was the first in-house attempt, and as a result, it wound up being a learning opportunity and the data was deemed unreliable.

On July 22, etofenprox was tested again. This time, the process was more refined. There was between 5.26% and 53.6% mortality in 15 minutes, the diagnostic time for *Culex pipiens*, depending on the replicate being observed. Based on this, the colony shows resistance to etofenprox. The last bottle bioassay against the colony occurred on July 25 to malathion. There was 100% mortality within 30 minutes. The diagnostic time is 45 minutes; therefore, the colony expressed no resistance to malathion.

The commission would like to incorporate future iterations of this project to include observations for knockdown resistance (KDR). Knockdown resistance is a type of resistance to pyrethroids with a genetic component, so after exposure to a pesticide, these mosquitoes might not experience mortality. This addition to the bottle bioassay simply requires an extended observation period of the mosquitoes exposed to insecticide after being transferred to a clean, untreated container. Additional bottle bioassays will likely be conducted in 2023 to validate the results of 2022's bottle bioassays, especially with etofenprox. In the meantime, an effort is being made to acquire a susceptible colony that can be used in future insecticide resistance trials.

Although there were no larval experiments conducted in 2022, the inspector and biologist began designing an experiment in the fall of 2022 to determine the lethal dose of bleach to mosquito larvae. The original concept was developed by the Inspector following inspections and treatments of unmaintained swimming pools. Many homeowners claim that their unmaintained pools are treated with bleach, but larvae are often still found in those pools. As a result, the experiment is designed to determine the concentration of bleach in water that will kill larvae and then apply that ratio to the average size of a swimming pool to determine if and how effective a homeowner using bleach as a control method might be. Materials were acquired in the fall of 2022 with the goal of executing the experiment in the winter of 2023.

C. Unmanned Aircraft Systems (UAS)/Unmanned Aerial Vehicles (UAV) – Drones

The utilization of drones continues to be of interest so licensing staff to pilot commission-owned drones was pursued. The Wetland Specialist researched a myriad of online test preparation services. After several sample courses were reviewed UAV Coach/Drone Pilot Ground School was chosen. Several weeks were dedicated to study and review and the test was scheduled for December 2, 2022. Several exam sites were researched online for both location and reviews which were given by clientele. After filtering out testing locations by distance and review ratings, Air Fleet Training, based in the Essex County Airport, was chosen. The Wetland Specialist completed the FAA knowledge test and passed with a score of 95% out of 60 questions. The 3 questions which were missed were reviewed after completion of the exam.

After Completion of the exam preparation material by the Wetland Specialist, the username and password were given to the Inspector for review and preparation for his impending examination. The Inspector continued to prepare for the part 107 exam and scheduled the exam for early 2023.

The Wetland Specialist also researched different avenues of drone registration to mitigate any potential legal and liability issues. The Wetland Specialist and Inspector also examined the airspace of Warren County for any potential airspace incompatibilities with limitations set forth in the Part 107 rules and the commission needs. The Wetland Specialist also investigated the possibility and feasibility of operation under a COA (Certificate of Authorization) which would give more leeway for operations

within the borders of Warren County, as well as make it easier to request waivers that could otherwise limit operations when operation under the limitations set forth in Part 107.

Both the Wetland Specialist and the Inspector researched and reviewed different drone manufactures based on the immediate criteria of cost, mission capability, and endurance. It was agreed that for the time being, a modestly priced drone would be utilized to demonstrate proficiency and feasibility of the drone pilot/s and program. After a time, another more capable drone would be considered.

D. Grant Funded Tick Surveillance Project

In 2021, the New Jersey Department of Health announced that a small amount of grant funding would be available to five counties for a tick surveillance project. The Commission submitted a Letter of Interest and an application and was awarded \$12,000.00 in grant funding along with four other counties. Grant funding runs on a fiscal cycle from July – June and can possibly be renewed for a 5-year cycle. The first grant cycle was August 1, 2021 – July 30, 2022, and grant funding was renewed for a second cycle from August 1, 2022 – July 30, 2023.

The NJDOH Grant Funded Tick Surveillance Project started in Warren County in the fall of 2021. The primary focus at that point in time was to select long-term surveillance sites with suitable habitat for *Ixodes scapularis* ticks, the perpetrator of the majority of tick-borne disease in Warren County and the focal species for the surveillance project. By the end of 2021, four sites meeting site criteria and preferences were chosen as regular and routine surveillance sites, based on accessibility, habitat suitability, Lyme disease incidence in the municipality, and land ownership. During the winter of 2022, a fifth site was established in Blairstown. Each site has a predetermined 750-square meter area (set up as either a linear transect or a grid) that is sampled using a 1-meter square drag. The following five permanent sites constitute the tick surveillance program in Warren County for the 2022 season: Frelinghuysen Township (FRL) Forest Preserve (grid), Hardwick Township (HDW) White Lake Orange Trail (grid), Harmony Township (HRM) Merrill Creek Reservoir off of Fox Farm Road (grid), Knowlton Township (KNL) Paulinskill Valley Trail at Station Rd (transect), and the newest edition, Blairstown Township (BLR) Paulinskill Valley Trail at Footbridge Park (transect). During the spring season, a small handful of tick collections, mostly off clothing, were from other locations throughout the county, considered non-routine sites. The 5 routine surveillance sites can be seen in Figure 16 alongside Lyme Disease incidence data from 2017-2021 received from the Warren County Department of Health.

The target species for the spring collection season was *Ixodes scapularis* nymphs. The first collection attempt occurred on March 2, 2022, but sampling was most abundant from May through June. The last collection for the spring season occurred on July 21, 2022. According to publications, the nymphal peak is anticipated between May and July, but since there was not a consistent and regular tick surveillance program in Warren County or historical data to analyze, surveillance efforts were focused on identifying the nymphal peak specifically in Warren County. The grant required that each site be visited a minimum of two times for each collection season (spring and fall), but Warren County's sites were visited more often. Two sites in particular, the Frelinghuysen Forest Preserve in Frelinghuysen Township and Merrill Creek Reservoir in Harmony Township, were prolific for collecting nymphal ticks compared to the other sites. The Forest Preserve is in the northern portion of the county, where Lyme disease incidence is highest; one adult *Ixodes scapularis* collected there during the fall of 2021 collection season also tested positive for Powassan virus. Although Merrill Creek is in the southern portion of the county where Lyme disease is less abundant, it is a popular recreation destination and is very accessible for the more populated municipalities. These two sites were sampled on a bi-weekly basis through July so that there was data collected at regular intervals to determine our nymphal peak.

During the spring collection season, there were thirty-two complete site visits, meaning that the site was dragged for a total of 750-square meters for a single collection. Each site was visited between four and eight times between March and July. A total of 719 specimens were collected, which included 52 *Ixodes scapularis* adults, 286 *Ixodes scapularis* nymphs, 352 *Ixodes* larvae, 28 *Dermacentor variabilis* adults, and 1 *Dermacentor variabilis* nymph. Merrill Creek and Frelinghuysen Forest Preserve yielded the most *Ixodes scapularis* nymphs, constituting nearly 87% of total nymph collections! Another interesting observation from the spring collection season was the abundance of *Ixodes* larvae collected, notably at the Frelinghuysen Forest Preserve, although larval collections occurred at four of the five routine sites. Between four collections occurring from May 24 and July 21 at the Forest Preserve, there were 342 *Ixodes* larvae found! Typically, *Ixodes* larvae are not collected in high abundances until later in the summer. Based on data from Merrill Creek Reservoir and the Frelinghuysen Forest Preserve, the nymphal peak in Warren County was determined to be between the last week of May and the first week of June. This information is valuable so that time and resources can be allocated during that time frame to increase collections in future years. Overall, there were 384 tick pools from the spring collection period submitted to the Public Health and Environmental Lab (PHEL) for disease testing. Seventeen of those pools were from collections outside the normal surveillance parameters, either from clothing or our cooperative partner at Merrill Creek Reservoir. Larval samples were not submitted to PHEL because larvae have not blood fed yet and are less likely to be carrying disease. Samples are still awaiting testing, so no results have been received to date.

Collection efforts for the fall season, where the primary species of interest is *Ixodes scapularis* adults, began on September 23 and concluded on November 29. There were 20 complete site visits at the five routine sites during this time. Unfortunately, weather in the fall was not conducive to tick sampling. The fall of 2022 was characterized by wet, overcast conditions. Even in instances where the conditions were dry enough to sample, the overcast and wind resulted in temperatures that were too low according to the sampling parameters. For instance, there were two attempts made to sample at Merrill Creek Reservoir in December but the conditions at the site did not favor sampling. Additional specimens were collected by experimenting with carbon-dioxide baited traps at routine surveillance sites. Coolers of dry ice were set on white sheets in proximity to the surveillance site and were retrieved three to five hours later. *Ixodes scapularis* ticks were collected off the sheet and cooler. This collection method may be utilized in the future if time allows but was not found to have a huge pay off for effort and time required and abundances collected. A total of 60 specimens were collected during the fall season, which were exclusive to *Ixodes scapularis* adults. This was a significant decrease in the 145 *Ixodes* ticks collected in the fall of 2021. A total of 65 tick pools from the fall collection period were submitted to PHEL and are also awaiting test results. Five of those pools were from either carbon-dioxide traps or collected off clothing. A summary of the tick species and life stages collected at routine sites during both the spring and fall collection periods can be found in Figure 16a.

In the year 2022, a total of \$9,859.05 was expended on the tick surveillance project. Payroll accounted for \$6,403.06; training for \$2,650.62; public outreach and education for \$527.28; and supplies for \$278.09. Neither fringe benefits nor mileage were charged against the grant funding. A little over two hundred staff hours were recorded for spring tick surveillance (204.75); whereas fall tick surveillance accounted for roughly half of that (100.75) hours. Spring tick surveillance was more laborious due to the higher numbers and smaller size of the nymphal ticks encountered. Also, sampling for the fall surveillance was limited due to the poor weather which limited collection efforts.

As mentioned, the tick surveillance project was funded by a grant from the NJ DOH that was first awarded for the 2021/2022 surveillance year and was renewed for the 2022/2023. This grant is provided through the Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) Cooperative Agreement between the NJDOH and the Centers for Disease

Control (CDC). The current ELC Cooperative Agreement between the NJDOH and the CDC is from 2019 – 2023 with a possibility of renewal for another 5-year cycle.

IX. WATER MANAGEMENT

Water Management, following the established Best Management Practices for Mosquito Control in Freshwater Wetlands, allows for the elimination of mosquito breeding habitat. Source reduction is an effective long-term means of mosquito control. The Commission's current permit to perform water management activities is valid until May 10, 2023. It includes a Flood Hazard Area General Permit 2 (Mosquito Control Water Management Activities), Freshwater Wetland General Permits 1 (Maintenance and Repair of Existing Features) and 15 (Mosquito Control Activities), and a Water Quality Certificate. A new permit will be sought in Spring of 2023. The application process for all NJDEP permits is now entirely online, so a slight learning curve is anticipated.

Eight water management complaints in eight separate townships were responded to in 2022.

Elizabeth Roy from the Warren County Planning Department called in February to report a blockage in Lopatcong Creek in Lopatcong Township. There was reportedly a "sand bank blockage" that was collecting debris at the instream supports of a bridge at the entrance to the Morris Canal Plane 9 site. Inspection of the site revealed a deposit of a sand bank in the creek, but no blockages at the bridge. Further inspection a short way downstream, however, revealed a tree that had fallen out of the bank and into the creek. The tree had gathered a bunch of organic debris and was blocking the natural flow of water. A right-of-entry was obtained, and the blockage was removed with the Kobelco in August.

In March, a service request was received from a resident on Rymon Road in Washington Township regarding a clogged detention basin. The basin was inspected two days later and was found to have already been shoveled out and no longer clogged. This particular basin has been on an inspection route since 2001. Half of the basin has become a sort of naturalized wetland over the years due to soil hydrology. The low flow channel is kept clear during the regular season, and the wet areas are treated as necessary.

A blockage in the Paulinskill River was reported in early May. It was located via the Paulinskill Trail at a footbridge on the border of Hardwick and Frelinghuysen Townships. It was found to be rather large, blocking at least half of the river, and was put in line to be addressed by the water management team. All necessary right-of-entry agreements were obtained, and the Commission is planning to remove the blockage in 2023.

A resident called in mid-May requesting that we clean a ditch (unmanned tributary of the Paulinskill River) near his property that runs through the Columbia Wildlife Management Area in Knowlton Township. Earlier in the year, an active beaver dam was found about 600' downstream from his property line. The beaver dam had already been knocked down and found to be rebuilt overnight. Spring rainfall had been plentiful, and more water than usual was backed up on his property, causing him concern. The area was inspected in early June when floodwaters had receded, and water was back within the banks of the ditch. The surrounding area was still quite soggy, and the presence of small fish were detected. It was determined that no action would be taken at the time. There was an active beaver, no mosquito issue due to the fish, and the ground was going to be too wet to traverse with any machinery for a while. The area will be monitored in 2023.

A resident from Panther Valley in Allamuchy Township called in mid-May to report backed up water near the tennis courts. This issue has been reported in previous years as well. The issue was identified as a crushed outlet pipe at the end of Tracy Lane restricting water flow from the lake in Panther Valley.

The landowner (where the damaged pipe is) was contacted and informed of the issue. However, the landowner denies that his pipe is the issue and won't address the problem. Luckily, there is an abundance of small fish in the water that is backed up into the tennis courts, and therefore no larval mosquitoes are present.

In mid-May, a resident from Mansfield Township called about standing water and a ditch located along his property on Route 57. He claimed the "State" came out and cut channels to drain the standing water into the ditch, but that they stopped maintaining the ditch about 5 years ago. He was talking about filling in the ditch and was looking for someone to clean it for him. The area was inspected in early June, and the ditch was clearly recently cleaned out. The channel was clearly defined, and vegetation was cut and sprayed with herbicide. Perhaps he convinced the NJDOT to come out and take care of the issue.

A resident from Pheasant Run Road in Liberty Township called in late May about a stormwater facility on her property that the township stopped maintaining. Inspection of the facility revealed evidence of standing water in the recent past. Contact was made with the resident who reported that she attended a township meeting and was told that the township would no longer mow the facility due to budget cuts. The resident decided that she will hire a company to mow the area for her.

In early June, a resident from Greendell Road in Frelinghuysen Road called about standing water in the fields behind their property. An inspector found the area to be breeding, treated it, and reported it back to the office as a possible water management issue. The property was revisited later in the summer. The now dry field that was flooded was equipped with a small standpipe near the resident's property line. There was no obvious outlet for the standpipe. Consultation of GIS maps shows that, despite the area looking like part of a hay field, it is classified as a deciduous wooded wetland. The area will continue to be monitored and added to the route if necessary.

The activity of the statewide Water Management network established in 2001 has been rather dormant throughout the duration of the Covid-19 pandemic. However, the network of people are still active in their respective agencies and these connections provide hope to bring the network together again in-person in 2023.

A. Activity Summary

1. Projects

a. FWW GP1&15/FHA GP2 Projects

A stream cleaning project was performed on 2,250 feet of Trout Brook in Allamuchy Township. This portion of the brook runs alongside the airspray site on Kasper Road. Preparation was a lengthy process that included a Phase I Bog Turtle Habitat Survey and multiple site visits from the NJDEP and USFWS. The project began on August 24th and was completed by late September.

b. Permit-By-Rule Ditch Clearing Projects

Regulated ditches, as well as waterways, can be cleared of blockages under a Permit-By-Rule 6 (removal of major obstructions from regulated waters with machinery). Two ditch clearing projects were undertaken in 2022. The ditches at Youngs Island in Allamuchy Township were cleared of fallen trees and debris and the roads were cleared for safe access. The same was done at the Love Pallet Company ditch system in Pohatcong Township.

2. Maintenance

a. Hand Cleaning

Hand cleaning for the maintenance of existing drainage structures was completed 50 times in 14 municipalities in 2022. Container dumps were completed 5 times in 5 municipalities. (Each recorded instance of a 'container dump' may, and often does, include the drainage of multiple sources of larval habitat in each area.)

b. Access Brushing

Hand clearing of brush for access to mosquito breeding sites was performed 73 times in 14 municipalities in 2022.

c. Trail Mowing

Trail mowing was completed at all six locations that are regularly maintained by the Commission for access. The locations mowed in 2022 were: the Freeborn Lane ditch system in Allamuchy Township, Young's Island Road ditch system in Independence, Cat Swamp and Axford Avenue Wildlife Management Area in Oxford Township, the Bear Creek Road airspray access road in Allamuchy Township, and the Love Pallet Company in Pohatcong Township.

d. Stream Desnagging

This activity is regulated by Permit-By-Rule 6. All activities that meet the requirements of the Permits-By-Rule may be conducted without prior NJDEP approval. However, machinery must be situated outside the regulated water. They may be used to reach into the waterway to remove material but cannot be driven or otherwise placed in the regulated water.

Three stream desnagging projects were completed in 2022.

The blockage removal from Lopatcong Creek in Lopatcong Township is detailed in the water management complaints above.

A minor blockage was removed from the Musconetcong River in Mansfield behind 1440 Route 57. On August 9th the Kobelco excavator, along with a couple cables, were used to remove the tangle of branches and trees partially blocking the river. There are four active larval inspection sites in the immediate vicinity of the project location. Removal of the blockage will likely prevent further flooding of these larval sites in the future. Three seasonal workers (Kristina Wahl, Hunter Gara, and Lynsey Bell) assisted in the project.

Following the stream cleaning project in Trout Brook in Allamuchy Township, an upstream portion brook was cleared of fallen trees and debris from the project site to Rydell Road. This project took place in early October.

Permit-By-Rule 5 (removal of accumulated sediment and debris from a regulated water by hand) was not utilized by the Commission in 2022. This rule authorizes the removal of accumulated sediment and debris by hand provided no machinery besides handheld equipment is used in the regulated water, the bed and natural banks are not altered, fishery resource timing restrictions are followed, and disturbance is minimized.

B. Stormwater Facilities

NJ stormwater rules were enacted in 2004. The collective stormwater regulations are actually comprised of two rules; one governs how municipalities will regulate new development with respect to stormwater and a second requires municipalities to comply with new permits that control how

municipal storm systems are managed. The NJDEP has developed a guidance manual with input by various constituents including the Warren County Mosquito Commission and several other NJ Mosquito Control agencies. Of particular interest and concern to mosquito control agencies is the recommendation of Best Management Practices (BMP's) such as constructed wetlands and infiltration basins. These systems are known to breed mosquitoes without proper design, construction and maintenance. Underground stormwater facilities are becoming more common in Warren County. These present nearly impossible conditions for inspecting and treating. Without surveillance capabilities it is unknown whether these underground structures will produce mosquitoes, which is problematic.

In 2016, the Commission was notified of a resource called the New Jersey Hydrologic Modeling Database. This electronic database is available online and is the culmination of several decades of data collection efforts by NJ Soil Conservation Districts and the NJ Department of Agriculture. It shows mapped locations of stormwater facilities throughout New Jersey. A task was undertaken to identify and inspect the stormwater facilities in Warren County that weren't currently in our database. Inspections began in the fall of 2016, continued through 2017, and were completed in 2018. The data on these facilities was combined with the data on stormwater facilities already in our database. Now the Commission is aware of 391 stormwater facilities throughout the county.

Detention basins have one or more inlets and one outlet structure. If designed and constructed correctly, water should drain from these within 72 hours. Infiltration basins have one or more inlets and no outlet structure. Water should infiltrate these within 72 hours. Retention basins have one or more inlets and no outlet structure. These should hold water year-round and usually have aeration or fish to prevent them from becoming larval habitat.

All basins were inspected for standing water and larval mosquitoes. There are different ways that basins can provide larval mosquito habitat. Clogged drainage holes in outlet structures cause water to back up and stagnate in low flow channels. If a basin is mowed under saturated soil conditions, ruts are created that collect water and serve as larval mosquito habitat. Lack of maintenance can cause basins to convert into mosquito-producing wetlands. Infiltration basins without the proper substrate will hold water longer than they should.

Many of the stormwater basins that the Commission is aware of are inspected and treated, if necessary, on a weekly basis.

A sumped outfall structure is one in which the bottom of the structure is lower than the bottom of the pipe that is meant to convey the water out of the structure. This causes water to stagnate in the concrete structure. The length of time that the water remains depends on the depth of the water which can measure anywhere from 1" to 12" or sometimes more. Many species of mosquitoes will utilize this larval habitat. Outfall structures without sumped bottoms drain properly and quickly and do not hold water.

C. Tires

Since 2008, a cooperative agreement between the Warren County Planning Department and the WCMEC has allowed for a shared 45' trailer to be placed at the County Road Department facility in Belvidere. The trailer is filled, by both road department staff and mosquito commission staff, as abandoned tires are found throughout the year. At year end, the trailer is picked up by a recycling facility and replaced with an empty trailer for the next year. In the past, payment has alternated between the Commission and the Warren County Planning Department. However, since 2017 the Planning Department has been receiving a grant that covers the cost of the tire recycling. The number of tires picked up by Commission staff is listed by municipality in the Figure 12. Activity Summary.

In cooperation with the Musconetcong Watershed Association (MWA), every year since 2011 we have picked up tires from their river clean-up sites and added them to the trailer we utilize for recycling. In 2022, the MWA notified the Commission of the locations of stockpiled tires from their cleanup. The Commission collected four tires from Greenwich and six tires from Hackettstown.

The PCFA tire recycling program, launched in 2015, was continued in 2022. The program was brought about by the Warren County District Landfill, in conjunction with the Warren County Board of Chosen Freeholders, the Warren County Mosquito Control Commission, and the Warren County Health Department. One of the stated purposes in mind was to help control West Nile virus and other diseases spread by mosquitoes. The landfill located at 500 Mt. Pisgah Avenue in Oxford began accepting tires with or without rims from residents, small businesses, and farming communities in Warren County only. The fees were: \$2.50 for tires up to 22", \$5.00 each for tires 22.5" to 24", and \$10.00 each for tires 24.5" to 50".

If tires are seen on private property, attempts are made to contact the property owners. This is an opportunity to educate them about tires and their ability to produce mosquitoes and the diseases those mosquitoes can transmit. Residents are advised to keep tires under cover and dry, or to recycle them through PCFA. If time and space allow, employees offer to take the tires to our trailer. If a resident isn't home at the time the tires are seen, any present mosquito breeding is abated, and a door knocker is left for the resident. The visit is documented, and a return visit is made when time allows to follow up on the situation.

D. Catch Basins

The maps used to locate and treat catch basins that hold water throughout the county were updated in 2019. Each route has its own designated binder of laminated maps along with a written route to follow. This allows catch basins throughout the county to be treated in a timely and efficient manner.

No specific measures were taken in 2022 to encourage clean out of catch basins to keep water flowing but this is to be done routinely by departments of public works under existing stormwater legislation.

E. Swimming Pools

Abandoned swimming pools can be prolific mosquito producers. A spreadsheet of unmaintained swimming pools has been kept since 2012. The spreadsheet is divided by district and contains the addresses and inspection notes for each pool. Ms. Fisher reviews all the unmaintained pool complaints for each year and updates the spreadsheet accordingly. The list is updated as pools are taken down or restored to use. By the end of 2022, 54 unmaintained pools, located in 21 townships, remained on the list. This number was down from 73 unmaintained pools in 2021, which included the removal of 28 pools and the addition of 9 new pools, one of which was previously on the list with history dating back to at least 2009. The pools that are found producing mosquitoes are stocked with mosquito-eating fish or treated with a long-lasting control product and reported to the Warren County Health Department.

F. Beaver Management

One beaver dam was located in Knowlton Township in 2022. Details of this can be found above in water management complaints.

G. Site Plan Review

Copies of Land Use Regulation Permit applications are periodically received by our Commission and are to be reviewed and have comments/suggestions made when appropriate.

Warren County has been the target of a growing number of Wetland Mitigation sites in recent years. When the Commission is made aware of these sites, the plans are sought and reviewed. Comments on

these plans are given to the respective Township Land Use Boards and other interested parties, when requested. Mitigation sites are often previously ditched farm fields that are being restored to natural wetlands. The Commission has been monitoring these sites by attending township meetings and conducting site inspections.

The Commission is currently aware of six wetland mitigation sites in Warren County. Roes Island mitigation site is located off Island Road in Independence and Liberty Townships. Kenco wetland restoration site is located off Alphano Road in Independence Township. The Trout Brook wetland preservation/mitigation bank is located at 203 Bear Creek Road. The Pequest River mitigation bank is located at 55 Gibbs Road in Allamuchy Township. The Oxford Western mitigation bank is located off Lower Denmark Road in Oxford. The Watergate Wetlands Restoration project is located off Old Mine Road in the Delaware Water Gap National Recreation Area. According to information given at a Delaware River Roundtable meeting in October 2021, the project was halfway done at that time. The project will be under a winter shutdown from December 2021 until April 2022, and the work is expected to be completed by September 2022. The Commission has been monitoring these sites when time allows by conducting site inspections. Growing numbers of larval and adult mosquitoes are being found at these completed mitigation sites. The burden of inspection and treatment of these sites is proving to be quite time consuming. Discussions seeking reimbursement from the state for partial or total costs for mosquito control on state owned and/or state created mitigation sites began with the State Mosquito Control Commission in 2018.

In 2022, inspections were performed at all wetland mitigations sites except the Pequest River mitigation bank.

The Trout Brook preservation/mitigation bank is on the regular airspray inspection route. It is inspected and treated, if necessary, after rainfall events of 1" or greater.

The Kenco and Roes Island mitigation sites were inspected in April and found to be partially flooded. Larvae were sampled and brought back to the lab for identification. Both sites were inspected again in May, found to be partially flooded again, and more larvae were sampled. In July, both sites were inspected again and found to be dry.

The Oxford Western mitigation site was inspected in May and found to be puddled. The few larvae and pupae found were sampled for identification.

The Watergate Wetlands Restoration project was visited in October. The project appears to have been completed. Dams and ponds have been leveled and the floodplain and stream have been restored. Pictures were taken during a rain event. The site will continue to be monitored by Commission staff.

X. PUBLIC EDUCATION

Most of the restrictions in place due to the COVID-19 pandemic, lifted allowing staff to once again communicate our public health message. Most outdoor festivals and educational opportunities resumed; however, school visits for presentations did not resume until later in the 2022-2023 school year.

A. Literature/Poster Distribution

Files with handouts on pesticides, general mosquito control, ticks, etc. that are commonly requested are kept on hand in the office and in each of the vehicles for easy access and distribution to concerned residents.

B. Community/School Presentations/Displays

The Commission offers *Mosquito & Ticks: An Interactive Approach* to all fourth grade classes in Warren County. Fliers outlining the program are periodically emailed to all fourth-grade teachers in the County. The program includes PowerPoint presentations covering ticks, mosquito biology and control and hands-on learning stations. The learning stations include live mosquitoes and fish, preserved ticks and mosquitoes, a preserved dog heart with heartworm disease, activity sheets and games. A microscope, insect eye viewers and molded mosquito life cycle models were added to the program.

The Commission has a table-top tri-fold display that is used for inside venues and generally left on display for extended periods of time. The information on the display is developed and changed periodically by Ms. Fisher. Our staffed displays are generally for one-to-two-day events with the exception of the Warren County Farmers' Fair, which is an eight-day event. These displays familiarize the public with the Commission's activities and teach the public to recognize mosquito larvae in their own backyards.

In October, while Ms. Fisher was compiling the fourth-grade teacher email list, she received an email from Oxford Township Elementary School requesting a presentation. Initially, unsure whether the emails would find the schools receptive to inviting visitors back on school premises, the contact from the Oxford Township teacher was felt to be a sign the schools are ready.

Also, several posts were prepared for the Warren County Facebook and Twitter pages, which were shared with townships for their Facebook pages and websites to promote several community awareness days.

In 2022, the presentations that were made regarding mosquitoes and mosquito control are as follows:

Presentation/Display List:

Warren County Farmer's Fair
Nature Day at Shippen Manor

The Warren County Farmer's Fair display theme for 2022 was *Picnics are Fun but Mosquitoes are No Joke!* The display featured information on mosquito-borne and tick-borne diseases. The display was created by seasonal employee, Kristina Wahl, for internship credit, with guidance from Ms. Fisher. For Ms. Wahl's, Professional Practice Internship she needed to assume responsibility for an educational program. Educational fliers, pens, repellent wipes and mosquito swatter handouts, as well as the photo board, Albo Annie, and the all-time favorite mosquito eating fish, were available in the display booth.

School Presentation List:

Oxford Elementary School

C. Office/Truck Files

Files with commonly requested handouts on pesticides, general mosquito control, ticks, etc. were maintained in each of the vehicles for easy access and distribution to concerned residents. This collection of handouts includes a flier on mosquito control in Spanish. These files were revamped in 2020 and continued to be available in 2022.

D. Ticks/Lyme Disease

A presentation on ticks and prevention of Lyme disease is included in the Commission's program that is offered to county schools, *Mosquitoes & Ticks: An Interactive Approach*. One of the four hands on station includes preserved ticks of various species and life stages so that the children can appreciate

their small size and varying appearances. Children are also provided with tick identification cards and worksheets to assist in their education. The Commission includes tick information with other educational handouts for the public during routine inspections as well as at educational events. Prevent Tick Bites trail signs were ordered from the CDC and were placed on walking trails in the Frelinghuysen Forest Preserve and provided to staff at several other locations to alert the public to protect themselves due to the high populations of ticks in the area. Also, Prevent Tickborne Disease bookmarks were also received from the CDC to hand out at public education events.

E. Presentations/Publications

No additional presentations/publication (aside from school presentations) were made by Commission staff in 2022.

F. Internet Presence

In 2005, the Commission arranged for its own website utilizing the domain name www.warrencountymosquito.org. The domain name www.warrencountymosquito.com also continues to be registered. Information for the Warren County Mosquito Extermination Commission was updated on the Rutgers hosted website within NJ Mosquitoes: Biology and Control at www.njmosquito.org. A link to this site is provided on the general web page for Warren County <http://www.co.warren.nj.us/>.

The Commission's original website content was finalized in February 2006. Minor modifications were made to the website following subsequent review and comment from the public. The website was updated in 2015 to be more compatible with current handheld devices and with current browser technology and web standards, to allow Commission staff to update more areas of the website, and to give the website an updated appearance. In 2021, the website had to be moved to a new host server since the current server could no longer support the outdated code it was written in. Since the cost of migrating to a new platform was above the quote threshold, it was temporarily moved, along with the staff email, until a more permanent solution could be found. Quotes and proposals for redesigning the website were sought and the quote from Computer Images Web was approved in December 2021. The website redesign and transfer took place and went live in 2022.

Unfortunately, in October 2022, the website was blacklisted by Google due to security issues. Although a specific cause was not determined, it was thought that the website or email addresses were hacked. Amitech Computer Services, the company that provides IT services for the commission, recommended My Corporate Hosting Solutions be contacted to handle the website and email addresses. The current website and email were reviewed, security suggestions were made, a quote received and accepted. My Corporate Hosting Solutions placed the website and email addresses on separate servers for the most security, Wordfence security was added to prevent intrusion attacks and allow MCHS to block other countries from accessing the website, also Wordpress semi-annual updates are run to keep the website's WordPress core, themes, and plugins up-to-date, and the email system was changed to Office 365.

Adulticide treatment information has been provided on the Commission website for County residents to access since 2006. A link to this information is predominately displayed on the main page of our website. In 2018, a link to the municipal information packet was added to the main page of the website. In 2020, a link to the aerial larviciding treatment information was added to the main page of the website.

G. Media Coverage

Several radio interviews with WRNJ were conducted throughout the season. A phone interview with the Ridge View Echo about the Asian tiger mosquito resulted in an article, "Invasive Mosquitoes on

the Rise”, which was published August 2, 2022.

Notices were supplied to townships where aerial larviciding and adult mosquito control took place for posting on their websites and Facebook pages. The municipalities of Allamuchy, Alpha, Belvidere, Blairstown, Frelinghuysen, Hackettstown, Hardwick, Harmony, Hope, Independence, Liberty, Phillipsburg, Washington (Borough and Township), and White supplied with notices for posting on their website and Facebook pages regarding aerial larviciding, WNV activity, and/or adult mosquito control. The County mass notification system, Rave, was used to send alerts to send an alert to the entire county following a significant rainfall event to ask residents to dump any standing water on their property.

H. National Week Observance

Unfortunately, due the Covid-19 pandemic our usual displays for Heartworm Awareness Month/Malaria Day and National Mosquito Control Awareness Week were not exhibited at the Administration Building because the building was closed to the public.

In April, Malaria Day was promoted by sharing an interactive Dump and Drain message from Miami-Dade County, Florida and a CDC message “*Malaria is a Plane Ride Away*” message on the County Facebook and Twitter pages. In May, Tickborne Disease Awareness Month was promoted by sharing a NJMCA post of a link from the NJDOH with instructions on how to best remove an attached tick on the County Facebook and Twitter pages. In August, a Dump and Drain message was shared on the County Facebook and Twitter pages after a rainfall event of up to 5” of rain fell in the County.

ACKNOWLEDGEMENTS: The following staff members contributed to the text and/or figures included in this report: Jennifer Gruener, Christine Fisher, Stephanie Oliphant, Anastasia Giordano, Ryan Hagerty, and John Necina.

LIST OF ABBREVIATIONS

AEMCNJ	Associated Executives of Mosquito Control in New Jersey
AIMS	Army insecticide measurement system
AMCA	American Mosquito Control Association
ATM	Asian Tiger Mosquito (<i>Aedes albopictus</i>)
ATV	All terrain vehicle
BG	BioGents
BMP	Best Management Practices
BTI	<i>Bacillus thuringiensis israelensis</i>
CDC	Center for Disease Control and Prevention
CHIKV	Chikungunya virus
CO ₂	Carbon dioxide
COA	Certificate of Authorization
CoCoRaHS	Community Collaborative Rain, Hail, & Snow Network
CWA	Clean Water Act
DENV	Dengue virus
DWGNRA	Delaware Water Gap National Recreation Area
EEE	Eastern equine encephalitis
ELC	Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases
ESA	Entomological Society of America
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHAGP	Flood Hazard Act General Permit
FWWGP	Fresh Water Wetlands General Permit
GIS	Geographic Information System
GPS	Global Positioning System
GT	Gravid Trap
IPM	Integrated Pest Management
IR	Insecticide Resistance
JCV	Jamestown Canyon virus
KDR	Knockdown Resistance

LAC	La Crosse virus
LCD	Liquid Crystal Display
MSI	Municipal Software Incorporated
MWA	Musconetcong Watershed Association
NEVBD	Northeast Regional Center for Excellence for Vector-borne Diseases
NJDEP	New Jersey Department of Environmental Protection
NJDOH	New Jersey Department of Health
NJIIF	New Jersey Intergovernmental Insurance Fund
NJLT	New Jersey Light Trap
NJPDES	New Jersey Pollutant Discharge Elimination System
NMCA	Northeast Mosquito Control Association
PCP	Pesticide Control Program
PDMP	Pesticide Discharge Management Plan
PGP	Pesticide General Permit
PESP	Pesticide Environmental Stewardship Program
PCFA	Pollution Control Finance Authority
PHEL	Public Health Environmental Laboratory
PMA	Pennsylvania Manufacturers Association Insurance Group
SLE	Saint Louis encephalitis
SMCC	State Mosquito Control Commission
UAS/UAV	Unmanned Aviation System/ Unmanned Aviation Vehicle
USFWS	United States Fish & Wildlife Service
ULV	Ultra-low volume
VBDWG	Vector-borne Disease Working Group
WNV	West Nile virus
ZIKV	Zika virus

FIGURE INDEX – 2022

<u>Figure</u>	<u>Title</u>
1	Budget Report
2	Treasurer's Report
3	Disease Surveillance Trapping Schedule
4	Disease Response Guidelines
5	NJ Vector Surveillance Summary
6	WNV Cumulative Positive Map
6a	Mosquito Samples by Species
6b	Disease Trap Locations
7	Surveillance Stations
7b	NJ Light Trap Yearly Comparisons
7a	Surveillance Synopsis- Routine Surveillance
8	Surveillance Synopsis - Disease, Complaint and Field Study
9	NJ Light Trap Collections
10	<i>Aedes albopictus</i> Distribution Map
10a	<i>Aedes albopictus</i> Distribution Map; Phillipsburg, Alpha & Belvidere
11	10 year Rainfall Comparison-Oxford, NJ
12	Activity Summary (Inspections, Treatments etc.)
13	NJ Species List
14	Ground Larviciding Inspection Districts & Site Breakdown
15	Airspray Site Treatments
15a	Summary of Aerial Applications
16	Routine Tick Surveillance Site Map
16a	Tick Surveillance Summary

Expenditure Budget GENERAL FUND

Activity to 12/31/2022

* ACTIVITY = Budget - (Balance + Encumbered) (You can include the break out by journal from the report options)

Account Number	Description	Budget	Activity	Encumbered	Balance	% of Budget
105010	M-01 Salaries/Wages	475,193.00	454,764.15	-	20,428.85	95.7%
105020	M-02 Benefits	269,752.00	261,759.42	-	7,992.58	97.0%
105030	M-03 Insurance	21,869.00	21,869.00	-	-	100.0%
105040	M-04 Telephone/Internet	4,360.00	2,887.87	-	1,472.13	66.2%
105050	M-05 Legal Ads/Advertising	2,768.00	1,253.71	-	1,514.29	45.3%
105060	M-06 Meetings/Memberships	11,631.00	10,982.95	-	648.05	94.4%
105070	M-07 Professional Services	3,805.00	2,488.57	-	1,316.43	65.4%
105080	M-08 Permits/Eng/Water Mgmt	875.00	264.77	-	610.23	30.3%
105090	M-09 Contract Services	57,120.00	48,268.71	-	8,851.29	84.5%
105100	M-10 Fish/Insecticides/Licenses	52,322.00	52,132.87	-	189.13	99.6%
105110	M-11 Vehicle/Equipment Maint	38,300.00	37,925.30	-	374.70	99.0%
105120	M-12 Office Supplies	3,700.00	3,515.38	-	184.62	95.0%
105130	M-13 Shop Supplies	1,000.00	979.80	-	20.20	98.0%
105140	M-14 Lab/Field Supplies	9,725.00	7,581.74	-	2,143.26	78.0%
105150	M-15 Equipment Purchase	43,200.00	18,313.01	-	24,886.99	42.4%
105230	Reimbursable Expenses	-	10,800.00	-	(10,800.00)	
TOTALS		995,620.00	935,787.25	-	59,832.75	94.0%

Figure 1
Budget Report

Grant Expenses
GENERAL FUND
Activity to 12/31/2022

* ACTIVITY = Budget - (Balance + Encumbered) (You can include the break out by journal from the report options)

Account Number	Description	Budget	Activity	Encumbered	Balance	% of Budget
106108	GRANT - TICKS SURVEILLANCE PROJECT	-	(9,806.34)	-	9,806.34	
TOTALS						
		-	(9,806.34)	-	9,806.34	

Figure 1
Budget Report

100001 Pnc Bank - Regular

From 12/01/2022 to 12/31/2022

Date	Source	PO#	Contract#	Check #	Vendor #	Vendor/Description	Budget	Debit	Credit	P0 Encumber	P0 Payment	Balance (DR)
=====												
12/13/2022	DJ 424	11144		132786	410	WARREN CO. MOSQUITO EXT. COMM Blanket PO						199,116.35
12/13/2022	DJ 425	11313		374264	410	WARREN CO. MOSQUITO EXT. COMM			14,102.20			185,014.15
12/14/2022	DJ 426	11135		5969	373	T MOBILE Blanket PO			17,761.25			167,252.90
12/14/2022	DJ 427	11136		5970	23	ALL SEASONS AUTOMOTIVE LLC Blanket PO			54.80			167,198.10
12/14/2022	DJ 428	11310		5970	23	ALL SEASONS AUTOMOTIVE LLC			1,279.91			165,918.19
12/14/2022	DJ 429	11142		5971	118	DIGIT PAYROLL CORPORATION Blanket PO			105.00			165,813.19
12/14/2022	DJ 430	11152		5972	94	COMCAST Blanket PO			117.98			165,695.21
12/14/2022	DJ 431	11246		5973	30	AMITECH ON-SITE COMPUTER SERVI			208.07			165,487.14
12/14/2022	DJ 432	11291		5973	30	AMITECH ON-SITE COMPUTER SERVI			10,551.93			154,935.21
12/14/2022	DJ 433	11300		5973	30	AMITECH ON-SITE COMPUTER SERVI			150.50			154,784.71
12/14/2022	DJ 434	11260		5974	83	CHARLES ZELLARS			545.00			154,239.71
12/14/2022	DJ 435	11285		5975	92	CM AUTO PARTS			60.00			154,179.71
12/14/2022	DJ 436	11286		5976	96	COMPUTER IMAGES WEB, LLC			18.99			154,160.72
12/14/2022	DJ 437	11288		5977	323	ROCKY'S HARDWARE INC			240.00			153,920.72
12/14/2022	DJ 438	11290		5978	150	FRANK RYMON & SONS INC.			16.72			153,904.00
12/14/2022	DJ 439	11292		5979	89	CLARKE MOSQUITO CONTROL PRODUC			26.22			153,877.78
12/14/2022	DJ 440	11293		5979	89	CLARKE MOSQUITO CONTROL PRODUC			277.50			153,600.28
12/14/2022	DJ 441	11294		5980	192	JENNIFER GRUENER			140.27			153,460.01
12/14/2022	DJ 442	11308		5980	192	JENNIFER GRUENER			47.97			153,412.04
12/14/2022	DJ 443	11314		5980	192	JENNIFER GRUENER Reimbursement			163.59			153,248.45
12/14/2022	DJ 444	11296		5981	330	RUTGERS CENTER FOR GOVERNMENT			96.87			153,151.58
12/14/2022	DJ 445	11297		5982	435	WILSON PRODUCTS			821.00			152,330.58
12/14/2022	DJ 446	11298		5983	440	John Necina Reimbursement			12.00			152,318.58
12/14/2022	DJ 447	11301		5984	408	WAL-MART COMMUNITY			175.00			152,143.58
12/14/2022	DJ 448	11304		5985	434	WEX BANK			6.28			152,137.30
12/14/2022	DJ 449	11309		5986	455	Washington Diner			722.45			151,414.85
12/14/2022	DJ 450	11311		5987	366	STEPHANIE OLIPHANT			126.00			151,288.85
12/14/2022	DJ 451	11312		5988	292	PETTY CASH			74.86			151,213.99
12/31/2022	DJ 457	11325		12312022	457	PNC BANK			26.55			151,187.44
12/31/2022	DJ 458	11323		6001	389	TRACTOR SUPPLY			33.00			151,154.44
12/31/2022	DJ 459	11322		6000	100	CORY BROTHERS			29.99			151,124.45
12/31/2022	DJ 460	11321		5999	33	ANASTASIA GIORDANO			983.45			150,141.00
12/31/2022	DJ 461	11320		5998	456	My Corporate Hosting Solutions			82.45			150,058.55
12/31/2022	DJ 462	11319		5997	84	CHRISTINE A. FISHER			1,872.00			148,186.55
12/31/2022	DJ 463	11317		5996	192	JENNIFER GRUENER			85.29			148,101.26
12/31/2022	DJ 464	11316		5995	435	WILSON PRODUCTS			64.25			148,037.01
12/31/2022	DJ 465	11324		5995	435	WILSON PRODUCTS			50.50			147,986.51
12/31/2022	DJ 466	11315		5994	150	FRANK RYMON & SONS INC.			12.00			147,974.51
12/31/2022	DJ 467	11307		5993	425	WB MASON			63.71			147,910.80
12/31/2022	DJ 468	11305		5992	92	CM AUTO PARTS			22.35			147,888.45
12/31/2022	DJ 469	11302		5991	323	ROCKY'S HARDWARE INC			15.49			147,872.96
12/31/2022	DJ 470	11306		5991	323	ROCKY'S HARDWARE INC			26.79			147,846.17
12/31/2022	DJ 471	11289		5990	25	AMAZON.COM CORPORATE CREDIT			27.57			147,818.60
12/31/2022	DJ 471	11289		5990	25	AMAZON.COM CORPORATE CREDIT			273.97			147,544.63
=====								1,336,368.42	1,137,252.07	=====		

Figure 2
Treasurer's Report

100001 Pnc Bank - Regular

From 12/01/2022 to 12/31/2022

Date	Source	P0#	Contract#	Check #	Vendor#	Vendor/Description	Budget	Debit	Credit	P0 Encumber	P0 Payment	Balance (DR)
12/31/2022	DJ 472	11299		5990	25	AMAZON.COM CORPORATE CREDIT			37.66			147,506.97
12/31/2022	DJ 473	11303		5990	25	AMAZON.COM CORPORATE CREDIT			46.23			147,460.74
12/31/2022	DJ 474	11318		5990	25	AMAZON.COM CORPORATE CREDIT			28.01			147,432.73
12/31/2022	DJ 475	11135		5989	373	T MOBILE Blanket PO			54.80			147,377.93
12/31/2022	RJ 75					Interest-Dec		1.46				147,379.39
RANGE												
							-	1.46	51,738.42	-	-	147,379.39
							-	1,336,369.88	1,188,990.49	-	-	147,379.39

Figure 2
Treasurer's Report

100002 PNC Bank - Payroll

From 12/01/2022 to 12/31/2022

Date	Source	PO#	Contract#	Check #	Vendor#	Vendor/Description	Budget	Debit	Credit	PO Encumber	PO Payment Balance (DR)
						ACTIVITY/BALANCE BEFORE 12/01/2022	-	909,900.12	889,289.84		20,610.28
12/01/2022	DJ 420			2147483647	446	Digit Pay- Net Payroll PR 2022-25 DD			10,878.23		9,732.05
12/05/2022	DJ 421			12052022	446	Digit Pay- Net Payroll PR 2022-25 Taxes			4,266.43		5,465.62
12/05/2022	DJ 422			33511786	285	PERS PERS & CLI November			2,861.56		2,604.06
12/13/2022	RJ 73					PR 2022-26 TF		17,761.25			20,365.31
12/13/2022	RJ 74					SHBP Dec billing		14,102.20			34,467.51
12/15/2022	DJ 452			12192022	446	Digit Pay- Net Payroll 2022-26- DD			10,878.79		23,588.72
12/19/2022	DJ 453			12192022	446	Digit Pay- Net Payroll PR 2022-26 Taxes			4,266.61		19,322.11
12/22/2022	DJ 454			354000467	360	STATE HEALTH BENEFITS PROGRAM SHBP -Dec- Reti			4,808.79		14,513.32
12/22/2022	DJ 455			354000471	360	STATE HEALTH BENEFITS PROGRAM SHBP -Dec- Acti			11,439.57		3,073.75
12/30/2022	DJ 456			36390775	285	PERS PERS & CLI December			2,861.28		212.47
RANGE							-	31,863.45	52,261.26	-	212.47
							-	941,763.57	941,551.10	-	212.47

100003 Fulton Bank - SUI

From 12/01/2022 to 12/31/2022

Date	Source	P0#	Contract#	Check #	Vendor#	Vendor/Description	Budget	Debit	Credit	P0 Encumber	P0 Payment Balance (DR)
12/31/2022	RJ	76				Interest-Dec					
						ACTIVITY/BALANCE BEFORE 12/01/2022	-	6,370.03	42.58		6,327.45
								0.05			6,327.50
							-	6,370.08	42.58	-	6,327.50

100004 Fulton Bank Retirement Pay

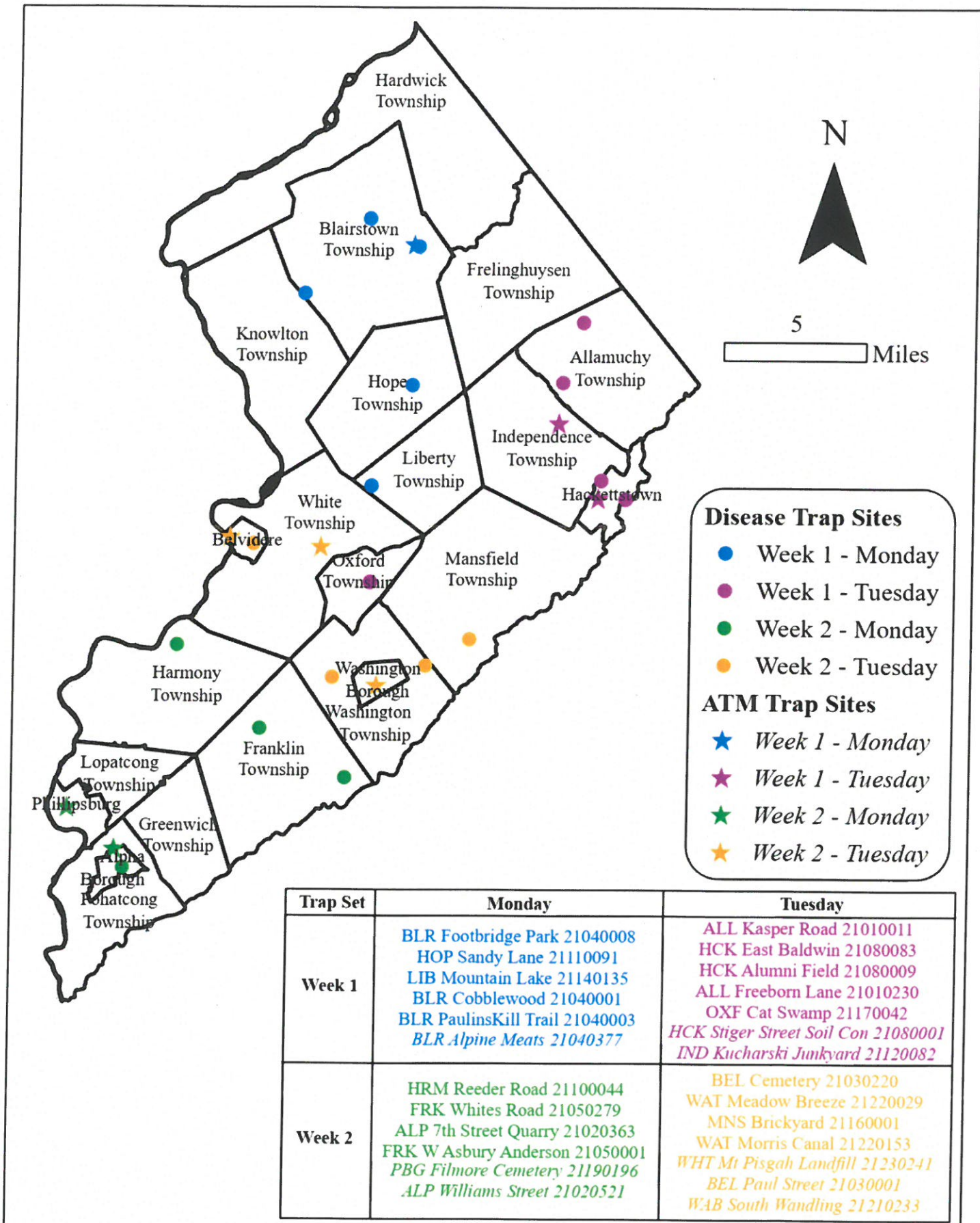
From 12/01/2022 to 12/31/2022

Date	Source	P0#	Contract#	Check #	Vendor#	Vendor/Description	Budget	Debit	Credit	P0 Encumber	P0 Payment Balance (DR)
12/31/2022	RJ	76				Interest-Dec					
						ACTIVITY/BALANCE BEFORE 12/01/2022	-	15,858.51	5,000.09		10,858.42
								0.09			10,858.51
							-	15,858.60	5,000.09	-	10,858.51

Figure 2
Treasurer's Report

Warren County Mosquito Control Commission 2022 Disease Surveillance/Trapping Schedule

WNV, EEE, SLE, LAC, & JCV



WARREN COUNTY MOSQUITO EXTERMINATION COMMISSION
MOSQUITO-BORNE DISEASE RESPONSE GUIDELINES

PURPOSE

This is to serve as a guideline for a course of action to be taken in the event of the known presence of any mosquito-borne disease through either identification of the presence of the disease in mosquito populations or as evidenced by the illness or death of an animal/human from a mosquito borne disease within Warren County. While the focus is primarily on Eastern Equine Encephalitis (EEE) and West Nile Virus (WNV), other diseases that would be responded to include but are not limited to La Crosse Encephalitis, St. Louis Encephalitis, Malaria, Dengue Fever, and concentrated cases of Dog Heartworm.

PROCEDURE

- A. In the event of positive disease test results from mosquitoes, sentinel chickens or the resident wild bird population (taking into consideration the migratory habits and nesting behavior of the particular bird species involved) the following procedures, as appropriate, will be implemented:**
1. Notify Commissioners promptly.
 2. Communicate with NJAES, Center for Vector Biology Director.
 3. Communicate with the Office of Mosquito Control Coordination Administrator.
 4. Disseminate information to employees regarding the disease situation and necessary precautions.
 5. Increase adult mosquito surveillance efforts in the area utilizing available traps and baits/lures as appropriate for the target mosquito species (such as portable traps, NJ Light Traps, resting boxes etc.). The object is to collect additional species for virus testing within and adjacent to known mosquito breeding site in the areas.
 6. Submit subsequent collections for virus testing either through the State Surveillance Program or another source, depending on what services are available (including testing at our facility).
 7. Based on surveillance data, larvicide and/or adulticide by ground and/or by air, if warranted.
 8. Discuss disease situation at next monthly Commission meeting.
 9. Relay disease related information at next monthly meeting of Associated Executives of Mosquito Control Work in NJ.
 10. Public notification is to be implemented as appropriate for the particular situation.

Continued...

WARREN COUNTY MOSQUITO EXTERMINATION COMMISSION
MOSQUITO-BORNE DISEASE RESPONSE GUIDELINES

Page 2

- B. In the event that the illness or death of a human, horse or other domesticated animal (including pets, livestock, zoo animal etc.) is confirmed to be due to a mosquito borne disease of public health importance and suspected to have been contracted in Warren County, the following procedures, as appropriate will be implemented.**
1. Notify Commissioners promptly.
 2. Communicate with the NJAES, Center for Vector Biology Director.
 3. Communicate with the Office of Mosquito Control Coordination Administrator.
 4. Disseminate information to employees regarding the disease situation and necessary precautions.
 5. Increase adult mosquito surveillance efforts in the area utilizing available traps and baits/lures as appropriate for the target mosquito species (such as portable traps, NJ Light Traps, resting boxes etc.). The object is to collect additional species for virus testing from:
 - a. known and potential mosquito breeding sites in the immediate and adjacent areas and,
 - b. in the vicinity of the original virus isolation and/or detection of animal illness/death.
 6. Increase larval mosquito surveillance and control methods in the area.
 7. Coordinate activities with other counties and state departments/agencies as appropriate.
 8. Communicate with the Warren County Health Department and any other Warren County agencies involved.
 9. Notify the Warren County Board of Chosen Freeholders.
 10. Based on surveillance data, larvicide/adulticide by ground and if warranted, by air.
 11. Continue surveillance and testing to further assess the disease situation. Submit post treatment collections for virus testing either through the State Surveillance Program or another source, depending on what services are available.
 12. Prepare a news release with review by the Mosquito Commission Chair, the Warren County Health Officer and the Director of the Public Information Department if available. Coordinate information details to be released with the NJ Health Department and SMCC and direct any inquiries regarding human case information to the NJ Health Department. Do not include any identifiable information in the release (address or municipality, detailed health information, etc.). Refer to the EEE Protocol approved by the Associated Executives of Mosquito Control in NJ when preparing the press release. Refrain from using language that might be alarming (i.e. no scare tactics). Suggest the use of repellent and avoidance (staying indoors, maintaining screens on doors and windows etc.) and let the public know that the Commission is fully aware and is responding accordingly.
 13. Seek guidance from Rutgers regarding assessment and response in area of the disease threat.
 14. If the situation becomes more than we can handle with our own adulticiding equipment and personnel, ask for assistance from the State Mosquito Control Commission and the use of the State Airspray Program.
 15. Request emergency funds from the Warren County Board of Chosen Freeholders if the Commission budget is not sufficient to continue needed response and reserve funding has already been expended.
 16. Discuss disease situation at next monthly Commission meeting.
 17. Relay disease related information at next monthly meeting of Associated Executives of Mosquito Control Work in New Jersey.

NJ VECTOR SURVEILLANCE SUMMARY 2022

REPORT TO THE NEW JERSEY STATE MOSQUITO CONTROL COMMISSION

"THE SURVEILLANCE OF VECTOR-BORNE ARBOVIRUSES IN NEW JERSEY"

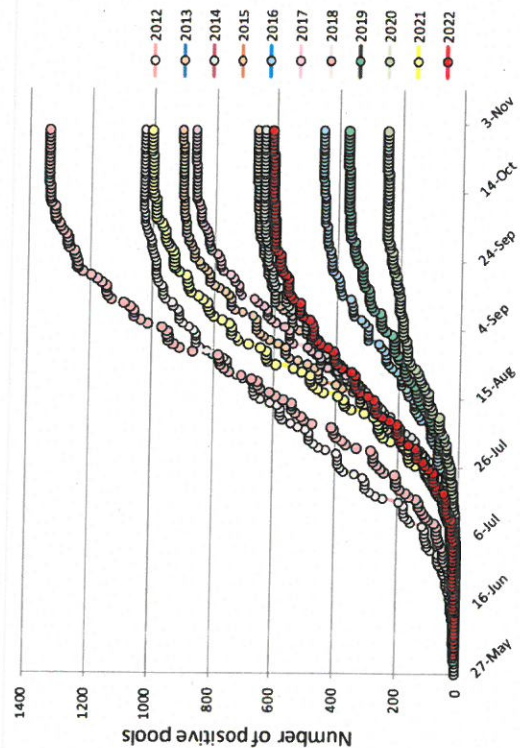
Excerpts from 2022 weekly reports with updated numbers from NJ DOH "Vector-Borne Surveillance Report: 2022 Season Ending Report"

Prepared by:

Lisa Reed, PhD & Dina Fonseca, PhD
Center for Vector Biology
180 Jones Avenue
New Brunswick, NJ 08901
Tel 732/932-9565
E-mail lreed@rci.rutgers.edu

The full report can be found at:

<http://vectorbio.rutgers.edu/surveillance.php>



The above graph shows cumulative WNV positive pools for the previous 11 years, including the most active (2018) and least active (2020) years.

Mosquito-borne Disease Summary

Eastern equine encephalitis (EEE)

- Very inactive EEE year in NJ in 2022. The lowest number of EEE positive mosquito pools in the past 5 years
- Four (4) EEE positive mosquito pools. The first positive pool was *Culex* Mix collected from Morris County on August 17th, the remaining three positive pools were *Cs. melanura* collected in October from Atlantic (1) and Burlington(2) Counties.
- No equine cases of EEE in NJ in 2022
- No human cases of EEE in NJ in 2022

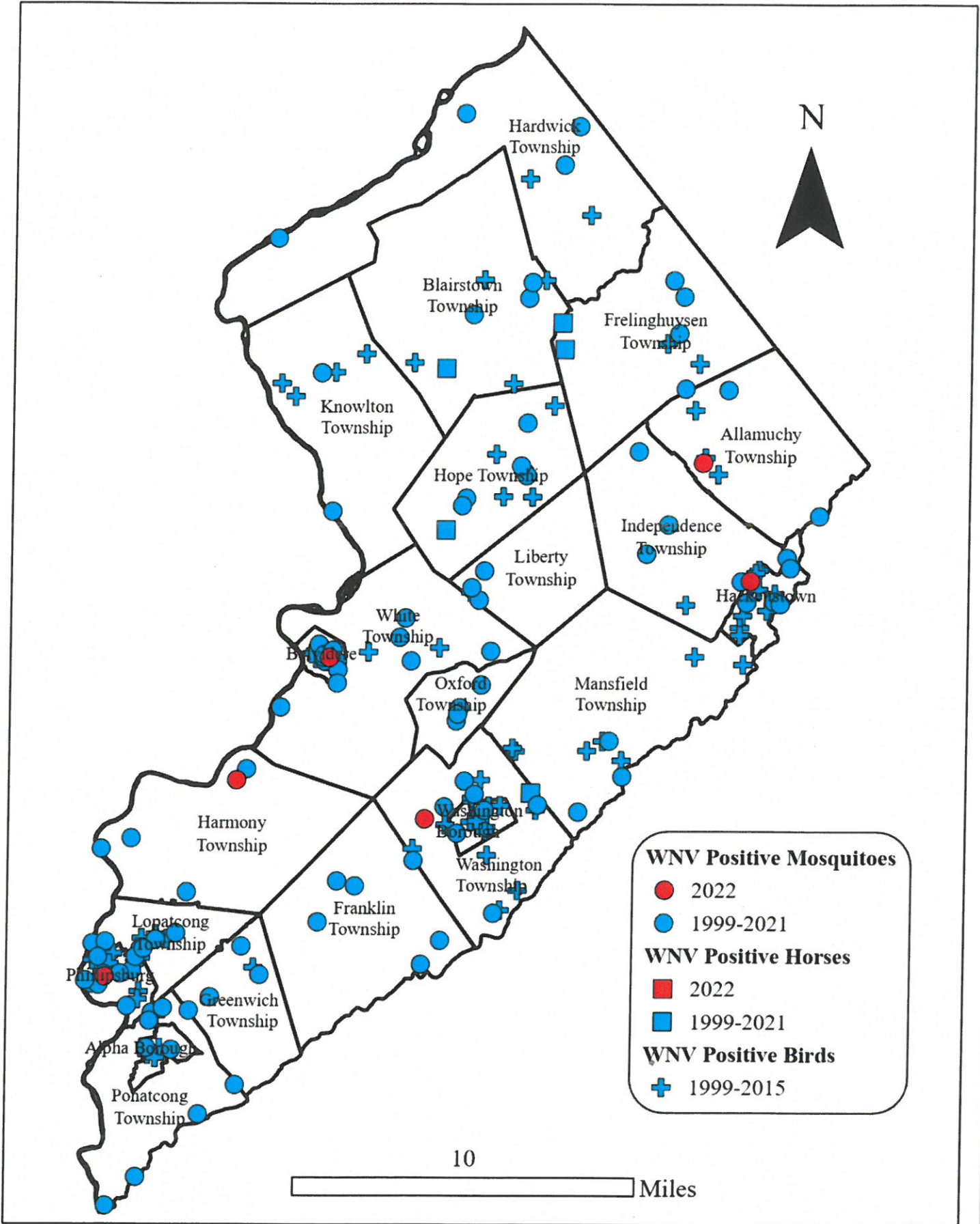
West Nile virus (WNV)

- 609 WNV positive pools; 550 *Culex* mix, 21 *Culex pipiens*, 14 *Aedes albopictus*, 11 *Ae. japonicus*, 3 *Cx. restuans*, 2 *Ae. triseriatus*, 2 *Cx. erraticus*, 1 *Ae. vexans*, 1 *An. punctipennis*, 1 *Cq. perturbans*, 1 *Ae. canadensis*, 1 *Ae. cantator*, and 1 *An. quadrimaculatus*,
 - All counties collected positive WNV mosquitoes.
- No horses reported confirmed positive for WNV in 2022
- 7 WNV positive birds were reported from Essex, Morris, Passaic, and Somerset Counties. Five of the seven were red-tailed hawks, one was a Cooper's hawk, and one was a blue jay.
- 20 human cases from Bergen (3), Burlington (2), Camden (3), Middlesex (1), Monmouth (5), Morris (1), Ocean (2), Somerset (1), and Union (2) counties. Thirteen of the twenty human WNV cases were classified as neuroinvasive disease. Four of the twenty resulted in death.
- There were two viremic blood donors reported in 2022.

Other mosquito-borne viruses

- 3 Jamestown Canyon virus (JCV) positive pools; 2 *Aedes cantator* (Bergen) and 1 *Anopheles punctipennis* (Sussex)
- One (1) human case of Jamestown Virus from Sussex County was reported in 2022. That human was co-infected with Powassan Virus (tickborne)
- No positive pools for LaCrosse encephalitis (LAC), Saint Louis encephalitis (SLE), Dengue virus (DENG), Chikungunya virus (CHIK), Zika virus (ZIKA)

Warren County Mosquito Control Commission Cumulative WNV Positives Through 2022



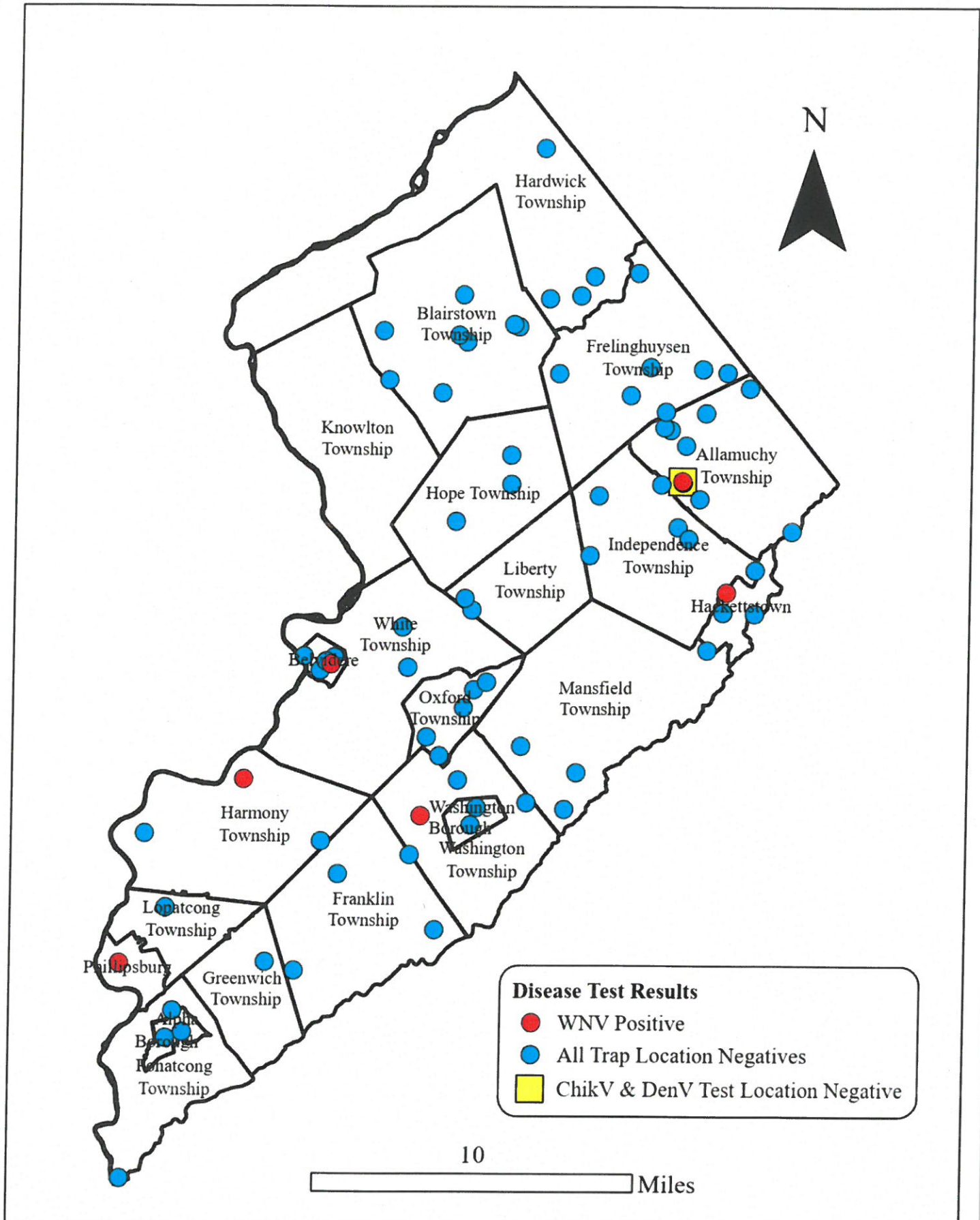
Mosquito Samples by Species Submitted to PHEL for Mosquito-borne Diseases Testing

Figure 6a

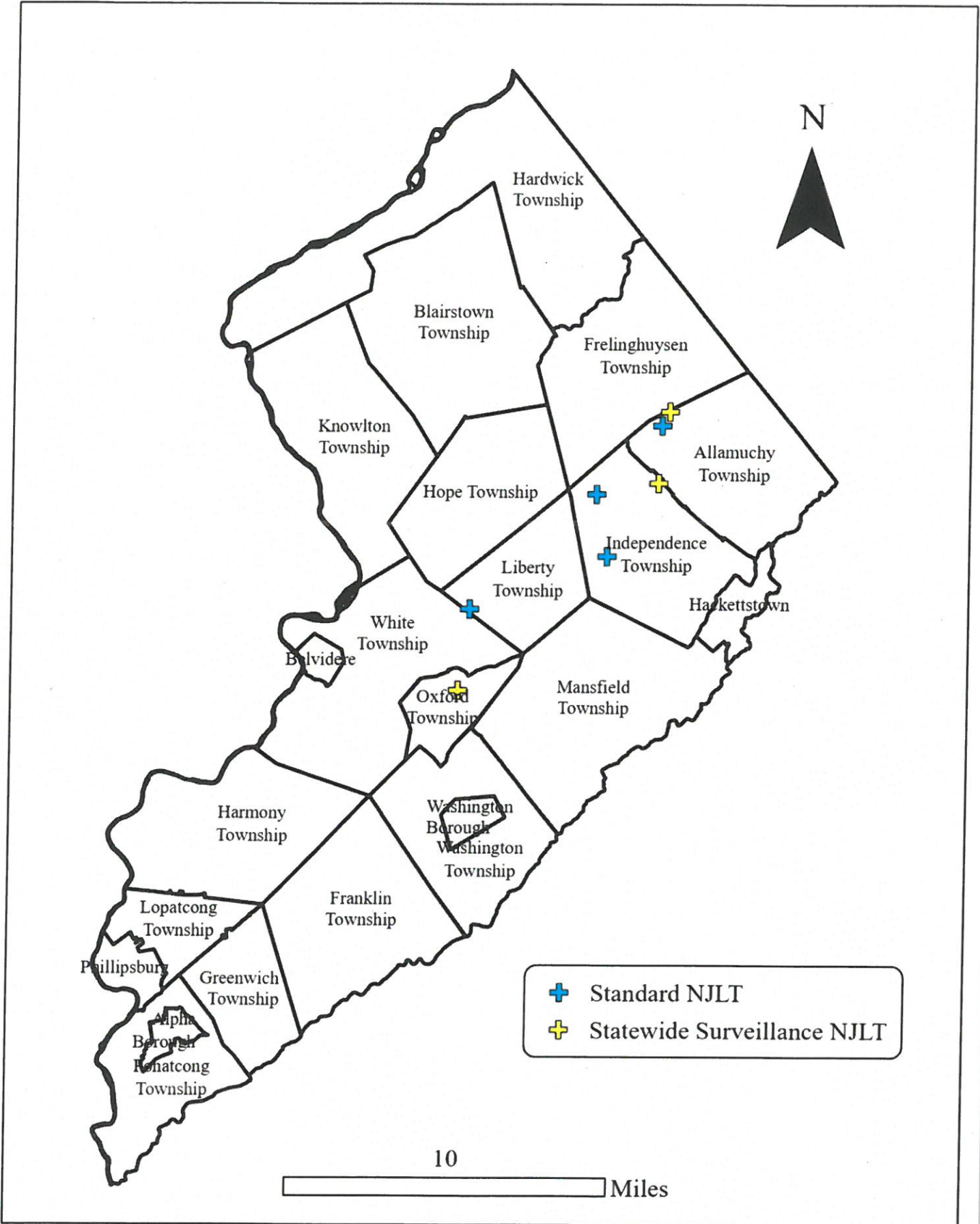
Species	# Pools	# Mosquitoes	WNV+	EEE+	SLE+	JCV+	LAC+
<i>Culex pipiens/restuans/salinarius</i>	226	6,156	5	0	0	0	0
<i>Culex restuans</i>	27	947	0	0	0	0	0
<i>Culex pipiens</i>	29	911	1	0	0	0	0
<i>Aedes japonicus</i>	69	533	2	0	0	0	0
<i>Coquillettidia perturbans</i>	23	467	0	0	0	0	0
<i>Aedes albopictus</i>	15	213	0	0	0	0	0
<i>Anopheles punctipennis</i>	23	185	0	0	0	0	0
<i>Aedes sticticus</i>	4	128	0	0	0	0	0
<i>Anopheles quadrimaculatus</i>	10	108	0	0	0	0	0
<i>Aedes triseriatus</i>	37	101	0	0	0	0	0
<i>Aedes canadensis</i>	19	83	0	0	0	0	0
<i>Aedes cinereus</i>	3	47	0	0	0	0	0
<i>Aedes stimulans</i>	2	31	0	0	0	0	0
<i>Culex</i>	3	18	0	0	0	0	0
<i>Aedes aurifer</i>	5	15	0	0	0	0	0
<i>Aedes trivittatus</i>	3	3	0	0	0	0	0
<i>Orthopodomyia signifera</i>	1	1	0	0	0	0	0
Total	499	9,947	8	0	0	0	0

Warren County Mosquito Control Commission 2022 Disease Trap Locations

WNV, EEE, SLE, LAC, JCV, CHIKV, & DENV



Warren County Mosquito Control Commission 2022 Surveillance Stations



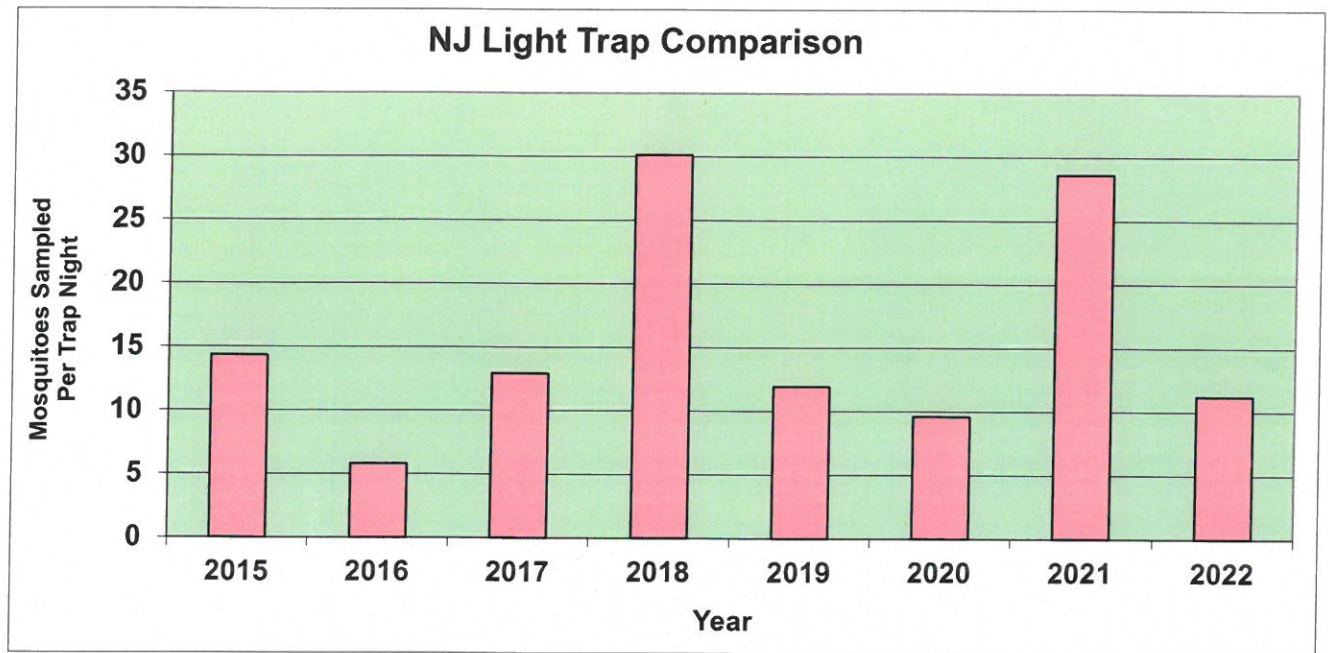
ROUTINE SURVEILLANCE FIVE YEAR SUMMARY

NJ LIGHT TRAPS		2018	2019	2020	2021	2022				
Mosquitoes Caught		30.11/Trap Nigh	11.94/Trap Night	16,607	9.60/Trap Night	10,817	28.60/Trap Night	32,465	11.24/Trap Night	12,666
Species Caught										
Ae. vexans	42.0%	Cx. spp.	26.4%	Cx. spp.	26.07%	Ae. vexans	37.67%	Ae. vexans	31.97%	Ae. vexans
Cx. spp.	15.5%	Ae. vexans	22.5%	An. walkeri	24.35%	Culex spp.	22.64%	Culex spp.	26.11%	Culex spp.
An. walkeri	9.6%	An. walkeri	12.8%	Ae. vexans	12.88%	An. walkeri	10.12%	An. punctipennis	11.52%	An. punctipennis
An. punctipennis	6.2%	An. punctipennis	6.9%	An. quadrimaculati	7.65%	An. punctipennis	7.63%	An. quadrimaculati	8.93%	An. quadrimaculati
Ae. trivittatus	6.7%	Cs. melanura	6.0%	Cq. perturbans	7.65%	An. quadrimaculati	3.50%	Ae. trivittatus	5.11%	Ae. trivittatus
Ae. cinereus	3.2%	Cq. perturbans	5.7%	An. punctipennis	5.84%	Ae. trivittatus	3.04%	Cq. perturbans	4.84%	Cq. perturbans
Ps. ciliata	2.7%	Ur. sapphirina	4.2%	Cs. melanura	5.20%	An. brad/cru	3.02%	Ur. sapphirina	3.58%	Ur. sapphirina
Ur. sapphirina	2.7%	An. quadrimaculati	3.6%	Ur. sapphirina	4.32%	Ps. ciliata	2.73%	An. walkeri	1.82%	An. walkeri
An. quadrimaculati	2.6%	Ae. trivittatus	2.6%	An. brad/cru	1.98%	Ps. howardii	2.57%	Cs. melanura	1.37%	Cs. melanura
Ae. sticticus	2.3%	Ae. cinereus	2.0%	Ps. ciliata	0.80%	Cq. perturbans	1.97%	Ae. japonicus	1.35%	Ae. japonicus
Ae. stimulans	1.4%	An. brad/cru	1.5%	Ae. japonicus	0.78%	Cs. melanura	1.29%	Ae. cinereus	0.87%	Ae. cinereus
Cs. melanura	1.4%	Ae. japonicus	1.3%	Ps. howardii	0.42%	Ur. sapphirina	1.19%	Ae. stimulans	0.55%	Ae. stimulans
Cq. perturbans	0.8%	Ae. stimulans	1.2%	Ae. cinereus	0.37%	Ae. sticticus	0.84%	Ae. sticticus	0.42%	Ae. sticticus
Ps. ferox	0.5%	Ae. sticticus	1.0%	Ps. columbiae	0.36%	Ps. ferox	0.48%	Ae. triseriatus	0.39%	Ae. triseriatus
Ae. japonicus	0.5%	Ps. ciliata	1.0%	Ae. canadensis	0.36%	Ae. japonicus	0.46%	Ps. ciliata	0.35%	Ps. ciliata
Ps. columbia	0.4%	Ps. howardi	0.3%	Ae. stimulans	0.34%	Ae. stimulans	0.31%	Ps. howardii	0.20%	Ps. howardii
Ps. howardi	0.4%	Damaged	0.3%	Ae. trivittatus	0.18%	Ps. columbiae	0.27%	Or. signifera	0.17%	Or. signifera
				Damaged	0.16%	Ae. canadensis	0.06%	Ps. ferox	0.12%	Ps. ferox
				Ae. triseriatus	0.10%	Ae. cinereus	0.05%	Ae. canadensis	0.11%	Ae. canadensis
				Ps. ferox	0.04%	Ae. triseriatus	0.05%	Ps. columbiae	0.08%	Ps. columbiae
				Ae. cantator	0.04%	Ae. aurifer	0.02%	Ae. aurifer	0.05%	Ae. aurifer
				Ae. sticticus	0.04%	Ae. cantator	0.02%	Ae. excrucians	0.03%	Ae. excrucians
				Ae. aurifer	0.03%	Ae. tormentor	0.02%	An. brad/cru	0.03%	An. brad/cru
				Or. signifera	0.03%	Damaged	0.01%	Damaged	0.02%	Damaged
				Ae. albopictus	0.02%	Or. signifera	0.01%	Ae. albopictus	0.01%	Ae. albopictus
				Ae. excrucians	0.01%	Ae. gross, Ae. infir	0.02%	Ae. tormentor	0.01%	Ae. tormentor

Figure 7a

Figure 7b

NJ LIGHT TRAP YEARLY COMPARISONS



DISEASE, COMPLAINT and FIELD STUDY SURVEILLANCE SYNOPSIS - FIVE YEAR SUMMARY

GRAVID TRAPS Mosquitoes Caught Mosquito Species	2018		2019		2020		2021		2022	
	63.28/Trap Night	14,996	85.65/Trap Night	18,672	42.181/Trap night	9,786	58.97/Trap night	12,148	38.01/Trap night	10,452
	Cx. spp	85.19%	Cx. spp	94.00%	Cx. spp	92.19%	Culex spp.	91.88%	Culex spp.	88.40%
	Ae. japonicus	11.24%	Ae. japonicus	4.10%	Ae. japonicus	4.41%	Ae. japonicus	5.64%	Ae. japonicus	8.01%
	Ae. triseriatus	1.47%	An. punctipennis	1.00%	Ae. triseriatus	1.15%	Ae. triseriatus	0.90%	An. punctipennis	1.23%
	An. punctipennis	0.75%	Ae. triseriatus	0.40%	Ae. albopictus	0.87%	An. punctipennis	0.46%	Ae. triseriatus	0.92%
	Ae. albopictus	0.62%	Ae. albopictus	0.10%	An. punctipennis	0.62%	Ae. trivittatus	0.36%	Ae. albopictus	0.46%
	Ae. vexans	0.25%	Ae. vexans	0.08%	An. quadrimaculatus	0.35%	Ae. albopictus	0.32%	Ae. vexans	0.38%
	Ae. trivittatus	0.15%	An. quadrimaculatus	0.07%	Ae. trivittatus	0.18%	An. quadrimaculatus	0.14%	An. quadrimaculatus	0.32%
	Ae. cantator	0.06%			Ps. ferox	0.10%	Ps. ferox	0.12%	Ae. trivittatus	0.09%
	An. quadrimaculatus	0.05%			Ae. vexans	0.05%	Ae. sticticus	0.08%	Ae. canadensis	0.06%
	Ps. ferox	0.05%			An. walkeri	0.02%	Ae. vexans	0.07%	Ae. cinereus	0.06%
					Or. signifera	0.02%	Ur. sapphirina	0.02%	Ps. columbiae	0.02%
					Ae. canadensis	0.01%	Ae. tormentor	0.01%	Ur. sapphirina	0.02%
					Ps. columbiae	0.01%	Or. signifera	0.01%	Or. signifera	0.01%
					</					

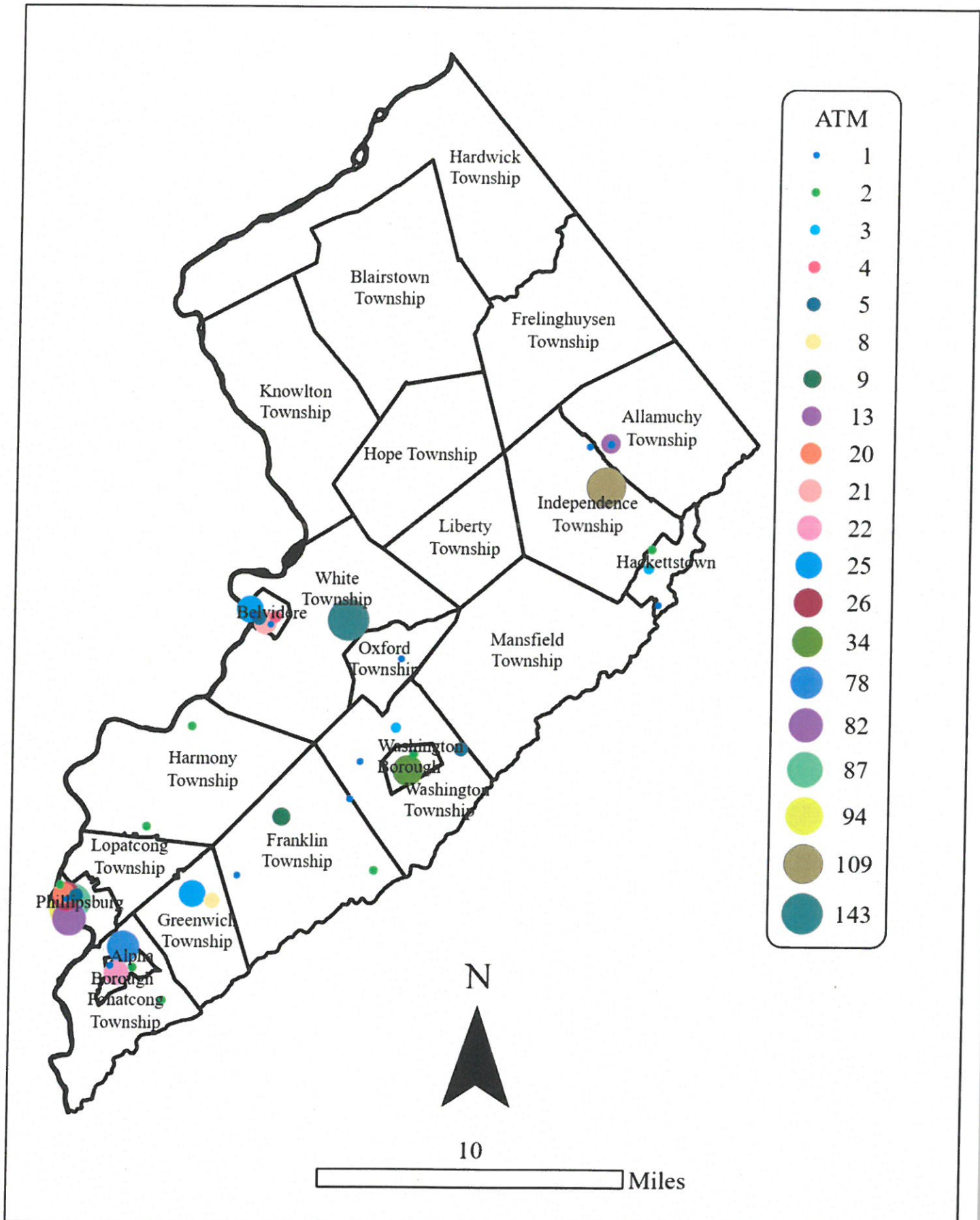
NEW JERSEY LIGHT TRAP COLLECTIONS
2022
Warren County Mosquito Extermination Commission

LOCATION (site no.)	AEDES										ANOPHELES				CQ.	CX.	CULISETA			OR.	PSOROPHORA				UR.	TOTAL							
	<i>Ae. albopictus</i>	<i>Ae. aurifer</i>	<i>Ae. canadensis</i>	<i>Ae. cantator</i>	<i>Ae. cinereus</i>	<i>Ae. excrucians</i>	<i>Ae. grossbecki</i>	<i>Ae. infirmatus</i>	<i>Ae. japonicus</i>	<i>Ae. sticticus</i>	<i>Ae. stimulans</i>	<i>Ae. tormentor</i>	<i>Ae. triseriatus</i>	<i>Ae. trivittatus</i>	<i>Ae. vexans</i>	<i>An. punctipennis</i>	<i>An. quadrimaculatus</i>	<i>An. walkeri</i>	<i>An. bradleyi/crucians</i>	<i>Cq. perturbans</i>	<i>Cx. spp</i>	<i>Cs. inornata</i>	<i>Cs. melanura</i>	<i>Cs. morsitans</i>	<i>Or. signifera</i>		<i>Ps. ciliata</i>	<i>Ps. columbiae</i>	<i>Ps. ferox</i>	<i>Ps. howardii</i>	<i>Ur. sapphirina</i>	Damaged	
Woronowicz; Pequest Road, Oxford (2A)			1		1		1		39			10	6	40	58	31				8	24				2					28	249		
Independence Road Department (3A)						1			64			2	21	138	114	224	2			26	110				1				1	6	710		
Schulster; Bear Creek Road, Allamuchy (4A)					3				3	15		3	184	1026	33	38	32			14	78			2			10	1		1	22	1465	
Zellers; Bear Creek Road, Allamuchy (4B)					3				12	12	2	5	137	923	355	299	36	1	62	1832				12			8		2	7	194	3903	
Ivaseczko; Post Lane, Independence (5)	1				5	2			43	14	7	1	25	166	1146	264	293	26	1	46	566			1		1	25	6	13	12	8	3	2675
Mountain Lake Fire Company, Liberty (7)		6	7		8				7	3		1	1	67	463	65	32	2	145	235			157			17					51	1267	
Kelsey; Shades of Death Road, Independence (20)					90				3	9	61	3	132	709	172	181	102			312	462			2			1	3		4	145	2397	
TOTAL	1	6	14	0	110	4	0	0	171	53	70	1	49	647	4049	1459	1131	230	4	613	3307	0	174	0	22	44	10	15	25	454	3	12666	
% OF TOTAL CATCH	0.01%	0.05%	0.11%	0.00%	0.87%	0.03%	0.00%	0.00%	1.35%	0.42%	0.55%	0.01%	0.39%	5.11%	31.97%	11.52%	8.93%	1.82%	0.03%	4.84%	26.11%	0.00%	1.37%	0.00%	0.17%	0.35%	0.08%	0.12%	0.20%	3.58%	0.02%	100%	

Figure 9

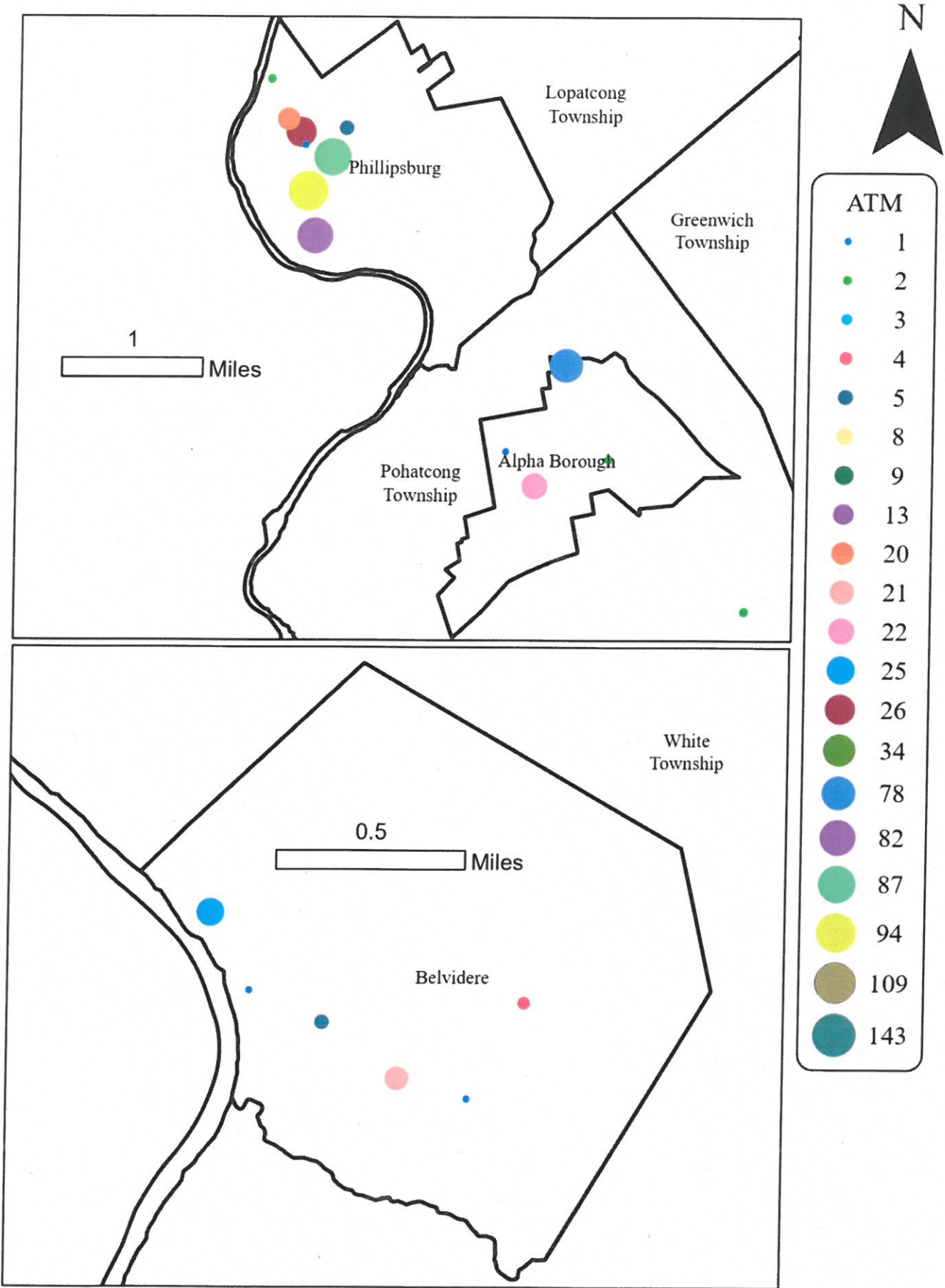
Warren County Mosquito Control Commission

2022 *Aedes albopictus* Distribution



Warren County Mosquito Control Commission

2022 *Aedes albopictus* Distribution

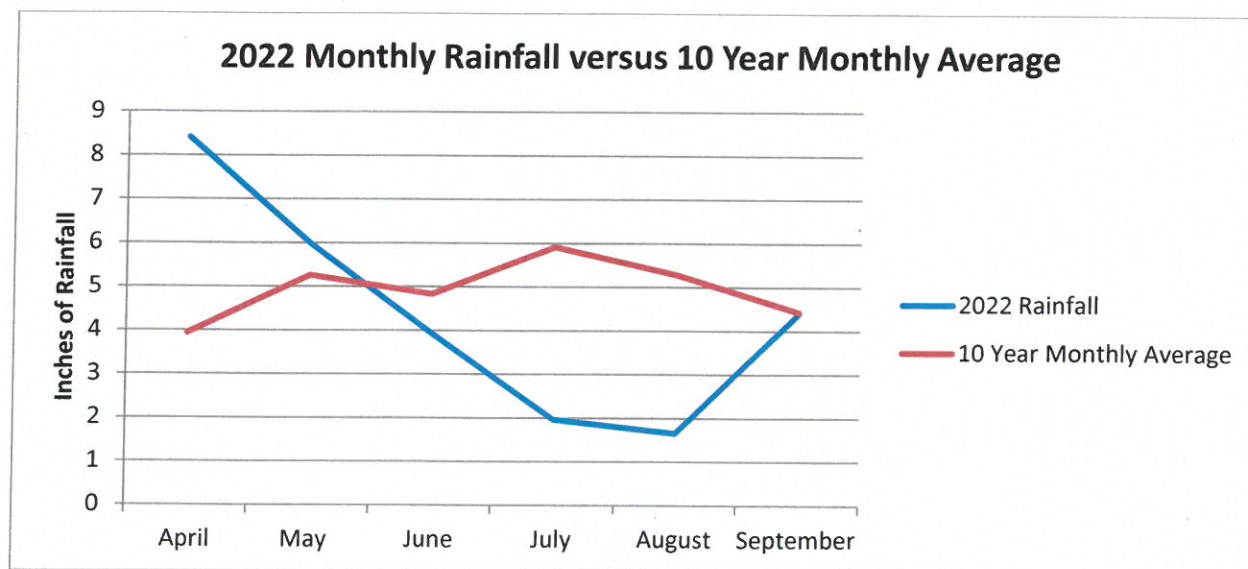


Oxford Rainfall Comparison over Ten Year (April – September)

Figure 11

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
April	2.81	4.73	2.58	2.61	3.87	4.49	4.28	3.74	1.91	8.42
May	5.68	6.50	1.60	3.29	4.98	4.81	10.46	4.57	4.70	5.98
June	8.14	5.56	8.66	3.21	4.13	3.57	4.92	3.07	3.11	3.94
July	5.56	7.60	3.96	2.87	8.34	6.54	9.55	6.00	6.83	1.97
August	5.42	2.55	4.76	4.20	4.89	8.23	5.33	8.34	7.45	1.66
September	2.89	2.40	5.14	2.50	3.40	6.77	1.56	3.91	11.35	4.4
TOTAL	30.50	29.34	26.70	18.68	29.61	34.41	36.10	29.63	35.35	26.37

2022 Seasonal Rainfall vs. Ten Year Average



2022 Activity Summary

Figure 12

MUNICIPALITY	Catch Basin Treatments	Routine Larval Inspections	Larval Samples	Service Requests Received	Service Request Adult Samples	Larvicide/Pupicide Applications	Number of Fish Site Stockings	Water Management	Tires Collected	Brush Cutting	Adulticide Applications	Total
ALL	141	525	20	15	11	154	7	15	0	6	12	906
ALP	13	41	3	3	6	14	0	0	0	0	2	82
BEL	81	77	3	5	4	14	0	0	0	0	3	187
BLR	45	631	9	11	9	80	8	1	0	0	1	795
FRK	61	221	7	6	3	33	0	1	0	0	0	332
FRL	3	665	20	29	15	79	4	3	0	1	25	844
GRN	216	111	1	2	2	7	0	3	4	1	0	347
HCK	459	324	16	2	1	42	0	5	28	17	1	895
HDW	15	322	9	10	8	36	11	2	0	0	4	417
HRM	10	315	6	5	3	60	2	0	0	1	5	407
HOP	4	589	5	5	2	46	5	1	0	0	2	659
IND	196	893	47	12	9	147	11	11	0	16	6	1,348
KNL	22	722	6	3	1	64	10	0	0	1	0	829
LIB	30	465	3	3	1	22	6	0	0	1	2	533
LOP	160	222	3	2	1	41	0	4	0	0	0	433
MNS	253	458	0	6	0	65	1	3	0	8	0	794
OXF	64	559	33	4	3	97	8	1	0	5	1	775
PBG	44	3	1	5	3	3	0	0	0	0	1	60
PHT	120	295	9	2	1	43	2	3	0	1	0	476
WAB	167	71	4	5	2	15	0	0	0	1	1	266
WAT	287	485	11	4	1	72	3	2	11	1	2	879
WHT	57	762	23	5	1	56	5	7	0	13	1	930
TOTAL	2,448	8,756	239	144	87	1,190	83	62	43	73	69	13,194

* indicates at least one area-wide application for *Aedes albopictus* control

NEW JERSEY'S MOSQUITOES – 2022
Bolded Species - Sampled in Warren County

Genus Aedes (Meigen)

1. *Aedes abserratus* (Felt and Young)
2. *Aedes atlanticus* (Dyar and Knab)
3. *Aedes albopictus* (Skuse)
4. *Aedes atropalpus* (Coquillett)
5. *Aedes aurifer* (Coquillett)
6. *Aedes canadensis canadensis* (Theobald)
7. *Aedes cantator* (Coquillett)
8. *Aedes cinereus* (Meigen)
9. *Aedes communis* (De Geer)
10. *Aedes dorsalis* (Meigen)
11. *Aedes dupreei* (Coquillett)
12. *Aedes excrucians* (Walker)
13. *Aedes fitchii* (Felt and Young)
14. *Aedes flavescens* (Miller)
15. *Aedes grossbecki* (Dyar and Knab)
16. *Aedes hendersoni* (Cockerell)
17. *Aedes implicates* (Vockeroth)
18. *Aedes infirmatus* (Dyar and Knab)
19. *Aedes intrudens* (Dyar)
20. *Aedes japonicus* (Theobald)
21. *Aedes mitchellae* (Dyar)
22. *Aedes provocans* (Walker)
23. *Aedes punctor* (Kirby)
24. *Aedes sollicitans* (Walker)
25. *Aedes spencerii spencerii* (Theobald)
26. *Aedes sticticus* (Meigen)
27. *Aedes stimulans* (Walker)
28. *Aedes taeniorhynchus* (Say)
29. *Aedes thibaulti* (Dyar and Knab)
30. *Aedes tormentor* (Dyar and Knab)*
31. *Aedes triseriatus* (Say)
32. *Aedes trivittatus* (Coquillett)
33. *Aedes vexans* (Meigen)

Genus Anopheles (Meigen)

34. *Anopheles atropos* (Dyar and Knab)
35. *Anopheles barberi* (Coquillett)
36. *Anopheles bradleyi* (King)
37. *Anopheles crucians* (Weidemann)
38. *Anopheles earlei* (Vargas)
39. *Anopheles punctipennis* (Say)
40. *Anopheles quadrimaculatus* (Say)
41. *Anopheles walkeri* (Theobald)

Genus Coquillettidia (Dyar)

42. *Coquillettidia perturbans* (Walker)

Genus Culex (Linnaeus)

43. *Culex erraticus* (Dyar and Knab)
44. *Culex pipiens* (Linnaeus)
45. *Culex restuans* (Theobald)
46. *Culex salinarius* (Coquillett)
47. *Culex tarsalis* (Coquillett)
48. *Culex territans* (Walker)

Genus Culiseta (Felt)

49. *Culiseta inornata* (Williston)
50. *Culiseta melanura* (Coquillett)
51. *Culiseta minnesotae* (Barr)
52. *Culiseta morsitans* (Theobald)

Genus Orthopodomyia (Theobald)

53. *Orthopodomyia alba* (Baker)
54. *Orthopodomyia signifera* (Coquillett)

Genus Psorophora (Robineau-Desvoidy)

55. *Psorophora ciliata* (Fabricius)
56. *Psorophora columbiae* (Dyar and Knab)
57. *Psorophora cyanescens* (Coquillett)
58. *Psorophora discolor* (Coquillett)
59. *Psorophora ferox* (von Humboldt)
60. *Psorophora howardii* (Coquillett)
61. *Psorophora mathesoni* (Belkin & Heinemann)

Genus Toxorhynchites (Theobald)

62. *Toxorhynchites rutilus septentrionalis* (Dyar and Knab)

Genus Uranotaenia (Lynch- Arribalzaga)

63. *Uranotaenia sapphirina* (Osten Sacken)

Genus Wyeomyia (Theobald)

64. *Wyeomyia smithii* (Coquillett)

46 species in Warren County

*Most recent addition 7/7/21

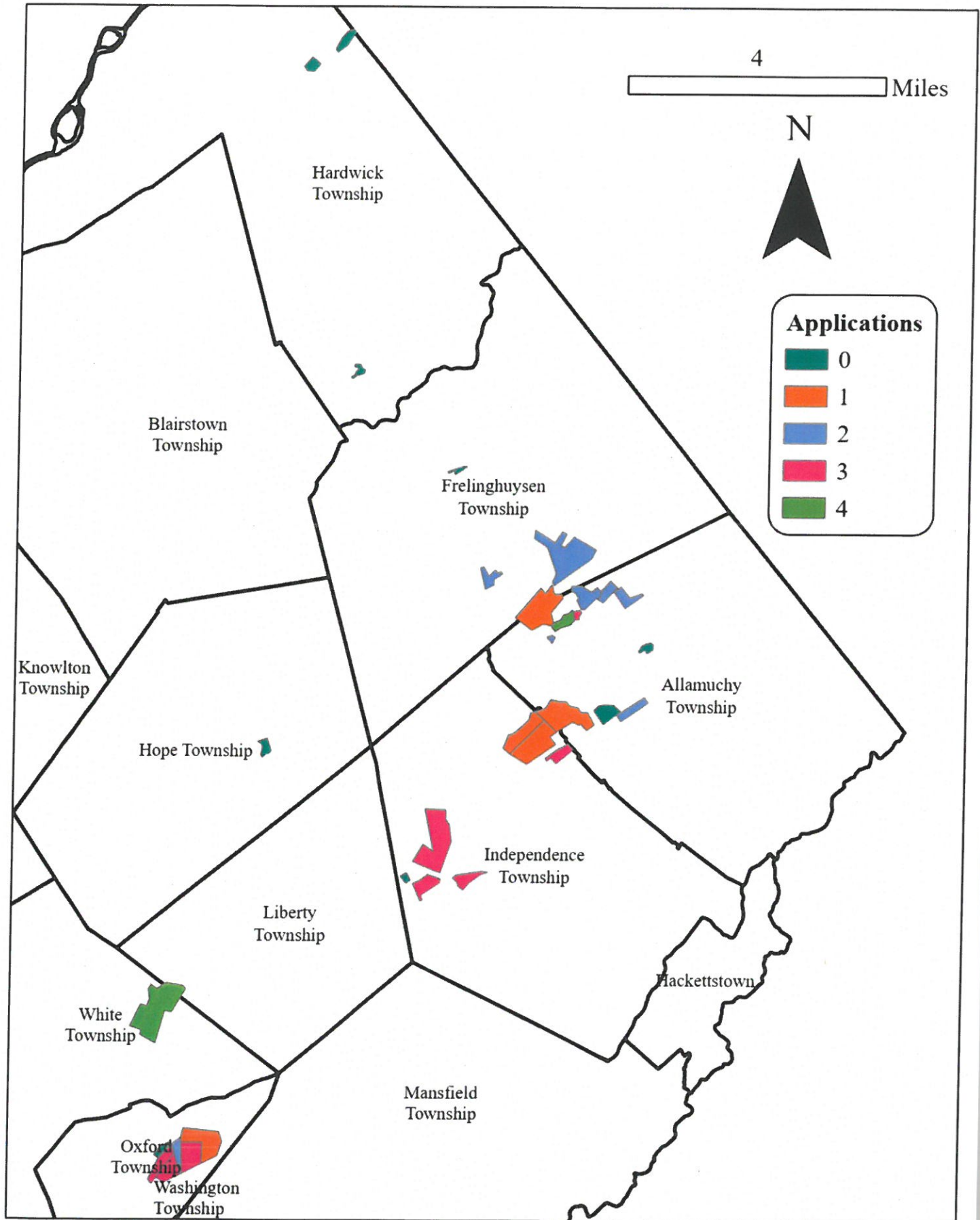
Figure 14

2022 INSPECTION DISTRICTS & SITE BREAKDOWN
Known Mosquito Production Sites by Control Approach

DISTRICT 1 (North)							
Township	Regular Sites	Ext Release Briquets	Fish Sites	2 Person Sites	Aerial Sites	Untreated Sites	TOTAL
Blairstown	66	7	13	0	0	0	86
Hardwick	30	6	18	0	2	16	72
Knowlton	64	3	18	0	0	0	85
Total	160	16	49	0	2	16	243
DISTRICT 2 (East)							
Township	Regular Sites	Ext Release Briquets	Fish Sites	2 Person Sites	Aerial Sites	Untreated Sites	TOTAL
Allamuchy	58	1	7	6	18	2	92
Hackettstown	22	4	4	0	0	16	46
Independence	60	13	27	5	11	0	116
Mansfield	33	1	9	1	0	0	44
Total	173	19	47	12	29	18	298
DISTRICT 3 (Central)							
Township	Regular Sites	Ext Release Briquets	Fish Sites	2 Person Sites	Aerial Sites	Untreated Sites	TOTAL
White	45	4	19	0	4	0	72
Hope	52	5	17	2	1	0	77
Liberty	35	1	8	0	1	0	45
Frelinghuysen	61	7	9	3	6	0	86
Total	193	17	53	5	12	0	280
DISTRICT 4 (South)							
Township	Regular Sites	Ext Release Briquets	Fish Sites	2 Person Sites	Aerial Sites	Untreated Sites	TOTAL
Alpha	13	0	0	0	0	0	13
Belvidere	9	0	1	2	0	0	12
Franklin	21	2	1	0	0	0	24
Greenwich	9	0	1	0	0	0	10
Harmony	37	0	6	1	0	0	44
Lopatcong	24	1	1	0	0	0	26
Oxford	35	4	9	3	15	0	66
Phillipsburg	0	0	1	0	0	0	1
Pohatcong	25	18	3	0	0	0	46
Washington Boro.	7	1	2	0	0	0	10
Washington Twsp.	38	6	7	0	0	0	51
Total	218	32	32	6	15	0	303
GRAND TOTAL	744	84	181	23	58	34	1,124
DISTRICTS 1, 2, 3 & 4 Catch Basins							
Catch basins throughout the county, inspected and treated bimonthly							1800+
Swimming pools (abandoned/unused) constantly changing status							70+

KEY:	Regular Sites	Inspected regularly by one or more inspectors
	Ext Release	Use of an extended release product for season long control- -primarily for safety concerns & visited only periodically
	Fish	Sites where fish are regularly used for larval/pupal control -sites visited periodically to check on status of fish
	2 Person	Sites where inspection in pairs (2 people) is advisable -primarily due to either size of the flooded area or a safety issue
	Aerial	Parcels of land inspected seperated and larvicided using aircraft
	Untreated	While periodically monitored for breeding theses sites are left untreated -primarily due to lack of human population or large size.

Warren County Mosquito Control Commission 2022 Airspray Site Treatments



Summary of 2022 Aerial Applications

Figure 15a

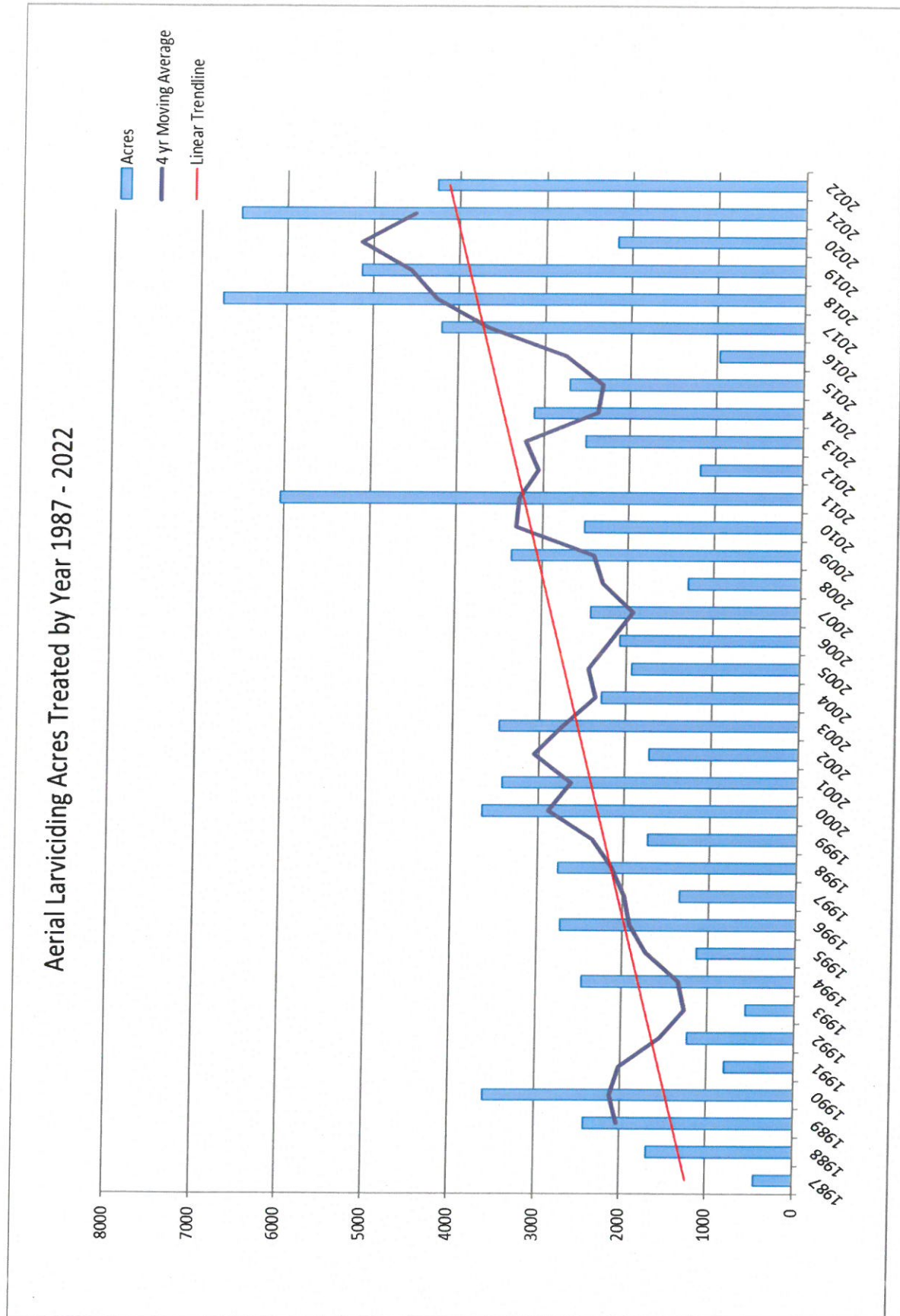
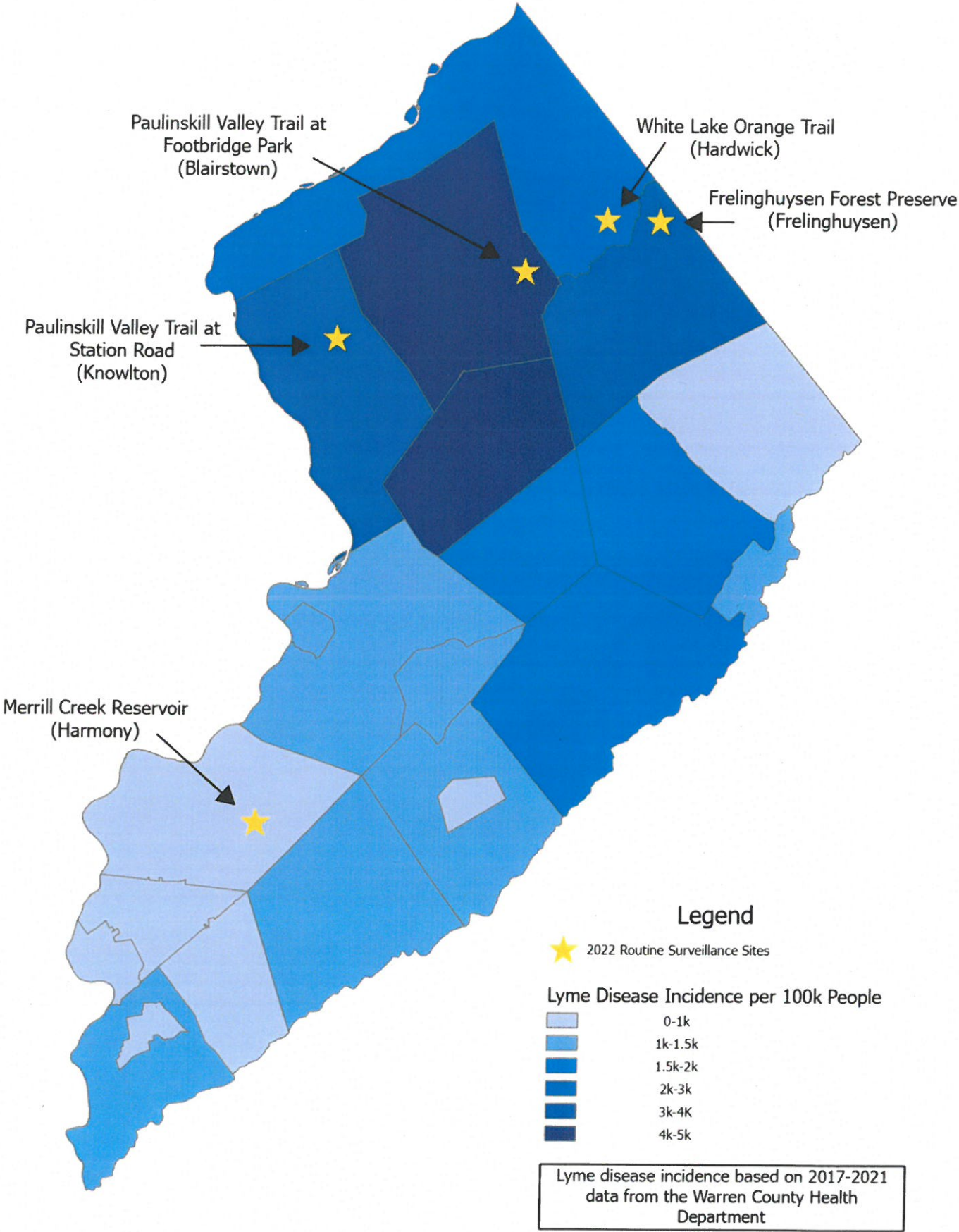


Figure 16

2022 Warren County Routine Tick Surveillance Sites



2022 Spring Collection Season														
Site Name	Township	# Visits	Ixodes scapularis			Ixodes		Dermacentor variabilis			Haemaphysalis longicornis			TOTAL
			Adult Female	Adult Male	Nymphs	Larvae	Adult Female	Adult Male	Nymph	Adult Female	Adult Male	Nymph		
Paulinskill Valley Trail at Footbridge Park	Blairstown	7	9	8	10	2	7	4	0	0	0	0	0	40
Frelinghuysen Forest Preserve	Frelinhuysen	8	1	2	88	342	0	0	0	0	0	0	0	433
White Lake Orange Trail	Hardwick	4	0	1	20	1	2	0	0	0	0	0	0	24
Merrill Creek Reservoir	Harmony	8	0	0	160	7	1	0	0	1	0	0	0	169
Paulinskill Valley Trail at Station Road	Knowlton	5	18	13	8	0	11	3	0	0	0	0	0	53
TOTALS		32	28	24	286	352	21	7	0	1	0	0	0	719

2022 Fall Collection Season														
Site Name	Township	# Visits	Ixodes scapularis			Ixodes		Dermacentor variabilis			Haemaphysalis longicornis			TOTAL
			Adult Female	Adult Male	Nymphs	Larvae	Adult Female	Adult Male	Nymph	Adult Female	Adult Male	Nymph		
Paulinskill Valley Trail at Footbridge Park	Blairstown	4	3	5	0	0	0	0	0	0	0	0	0	8
Frelinghuysen Forest Preserve	Frelinhuysen	5	1	4	0	0	0	0	0	0	0	0	0	5
White Lake Orange Trail	Hardwick	4	9	10	0	0	0	0	0	0	0	0	0	19
Merrill Creek Reservoir	Harmony	3	1	0	0	0	0	0	0	0	0	0	0	1
Paulinskill Valley Trail at Station Road	Knowlton	4	13	14	0	0	0	0	0	0	0	0	0	27
TOTALS		20	27	33	0	0	0	0	0	0	0	0	0	60

Figure 16a