DRAFT

Publication for Wing Beats

Evolution of GPS Mediated Aerial Larviciding;

Lee County Mosquito Control District

By

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Back-in-the-day…, prior to the year 2006, Lee County Mosquito Control District's (LCMCD) aerial mosquito larviciding procedures were generally a 'Show-Me' process. The inspector would ride with the pilot and point out to him where treatment was needed or merely provide verbal instructions with maps. To maximize the payload for larviciding, the inspector would stay at the loading site while the pilot would perform the application. Verbal communication in conjunction with memory can become jumbled resulting in, on occasion, misunderstandings and errors. All too often the question asked was "Where did you spray?" which had the same answer every time "Where you told me to spray!" Although precision of application was good considering the tools available, the pilot had to be a master in multitasking between piloting the aircraft, synchronizing spray on/off trigger with aircraft speed and spray system lag, look for citizens within the treatment area as well as various obstacles associated with tree-top flight. Maintaining correct swath width was a seat-of-the-pants type of determination which worked well with a straight road as a reference (Fig. 1) but was varied in open marsh with no points of reference (Fig. 2).

Prior to the year 2000 accurate location determination by GPS had "Selective Availability" (SA), i.e. only for the military. GPS signals were seriously degraded making them useless in determining an individual's location. In 2000, by Presidential Executive Order, the SA degradation of GPS signals was turned off. This action initiated an onslaught of accurate GPS based industries developing products for all facets of daily living and commercial enterprises including mosquito control.

In the year 2006, LCMCD began exploring the use of GPS tracking in our aerial larviciding program with the installation AG-NAV II GPS pesticide application guidance systems on two of our helicopters. The pilots were asked to turn on the system to merely track where they flew and sprayed. This was a traumatic change in the normal routine. During the 2007 season, the Ag-Nav GUIA units and light-bars were installed in additional aircraft and the pilots were asked to incorporate the swath guidance into their treatment regime. Swath guidance was established by creating an A-B line on one side of the treatment area and entering a non-specific number of swaths. This allowed the guidance system to provide swath lines across the treatment area upon which to line up the aircraft (Fig. 3). At this time the pilot had to manually increment to the next swath while turning the aircraft around.

In 2008 GPS mediated aerial larvicide application and tracking was fully implemented. All larviciding was tracked. However, treatment assignments were still by 'show-me' and swath guidance was from an initial A-B line for each treatment. This season of full GPS mediation brought larviciding record improvements of knowledge of exactly where the application occurred, where the pilot did not spray, confirmation of continued equipment calibration and reconciliation of reported treatments against GPS records. From this new knowledge we were able to answer citizen concerns with precision and maps, confirm correct spray track location, confirm spray swath accuracy and confirm aircraft ground speed. The physical properties of applications steadily improved throughout the season.

Now that we were comfortable with using GPS tracking for our aerial larviciding, in 2009, our Chief pilot (Gene Sutton) suggested using polygons (outlined spray blocks on a map) to define every treatment. This concept was problematic to management as well as inspectors and pilots due to the anticipated increase in workload. Questions developed about the time to create all these polygons. Who will create them? What happens with the polygon when the treatment area expands and shrinks? How will they be identified? When Gene offered to draw all the polygons from his recollection of historical treatments, make them large enough so they would not need to be modified and confirm their accuracy with the inspectors, management relented and agreed to give the concept a try. Google Earth was the platform on which polygons were drawn and they received identification numbers based on the existing treatment zone scheme with two additional levels of precision. Because each polygon was assigned a unique identifier they were not to be changed, however, the treatment did not have to include the entire polygon. Also, no treatment was to be made outside the polygon. With the use of these polygons and parameters of treatment a paradigm shift in how we performed aerial larviciding occurred. The advent of polygon use brought us into the era of precision aerial larviciding. Each treatment was now defined and constrained by the polygon prior to larviciding. The inspector is now fully responsible for the treatment. No maps and no verbal descriptions are necessary. No ambiguity exists. The inspector selects the polygon by number. The selected polygon is loaded into the GUIA by the pilot. The pilot sprays only the polygon. During this season the “Show-me” process of aerial larviciding faded into the history book (Fig. 4).

In 2010 the inspectors and pilots developed a proficiency in the use of polygons. On-the-job training for polygon modification and manipulation within the Google Earth environment gave the inspectors the skills to adjust polygons to reflect the dynamic nature of the larval mosquito habitat. The original large polygons were modified to reflect the larviciding patterns of 2009 which were shown by the spray tracks. Smaller polygons with unique identification numbers were added within the large ones to provide the inspectors with polygons which they could resize and manipulate to create precise treatment polygons (Fig. 5).

The concept of ‘Auto On/Off’ spray (Auto-Boom) was brought into the program in 2011. The improvements seen from this feature were an increase in precision in the placement of larvicide at the perimeters of the polygons and, most importantly, the pilot’s focus was now solely on flying the helicopter, avoiding obstacles and staying on swath. Without auto-boom the pilot has to watch for the beginning or end of the polygon and correctly time the on/off trigger by taking into account aircraft ground speed and spray system lag (Fig. 6). Allowing the GUIA to take over this process required a leap of faith. Initially three set points were needed to be entered into the GUIA, satellite communication lag, spray system pressure buildup lag and spray system pressure down lag. These set points were different for each aircraft and changed as filters or nozzles clogged. With our suggestion, Ag-Nav programmed the computer to perform auto calibration for these lags. With the installation of a flow switch on a single nozzle the computer was provided the lag time between spray trigger on and when the spray came out of the nozzle as well as when it stopped. With this data the software is able to perform the calculations itself and change them as necessary (Fig. 7). The result was that each swath was inside and up to the edge of each polygon.

In 2012 a complete larviciding protocol based on larvicide treatments polygons was developed. The inspector selects the polygons to be larvicided. He modifies the polygons where necessary. The selected polygons are copied to a USB drive and converted to GUIA format. The day’s polygon missions are delivered to the pilot on the USB drive or e-mailed. Upon receiving the polygon missions, the pilot can review the day’s work on his computer and plan the entire day’s flight. Polygons in close proximity can be bundled as a ‘Project’ so they are sprayed as a single mission. The polygon missions can be assigned a treatment sequence number. This relieves the pilot from having to pick and choose in flight the next polygon to spray. The pilot only needs to fly the polygon and line up with the first swath to begin the treatment. When finished he pushes the ‘Next Area’ key and follows the guidance to the next area already lined up with the first swath without any in-flight distractions of mission setup.

The result of developing GPS mediated aerial larviciding has been a tremendous increase in efficiency. The “Show-Me” flight is a thing of the past. The pilot has his day’s flight completely planned without any in-flight mission setup. The pilot leaves at the beginning of the day with his first load and sprays it out before he lands in the field to receive his next load. The inspector can perform ground inspections while the pilot is treating. Treatment accuracy has improved by magnitudes. Application precision is up to the edge of the treatment block. Equipment calibration is continuously verifiable. Treatment records are completely reconcilable as well as inventory records. The spray track records are available for review to solve application issues and citizen concerns. LCMCD is now coloring within the lines with larvicide and is a land of one thousand polygons (Fig. 8, Fig. 9)

Acknowledgment: We thank the staff of AG-NAV for their support in the development of GPS mediated mosquito larviciding.

Figure 1. Guidance free larvicide track using roads as reference.

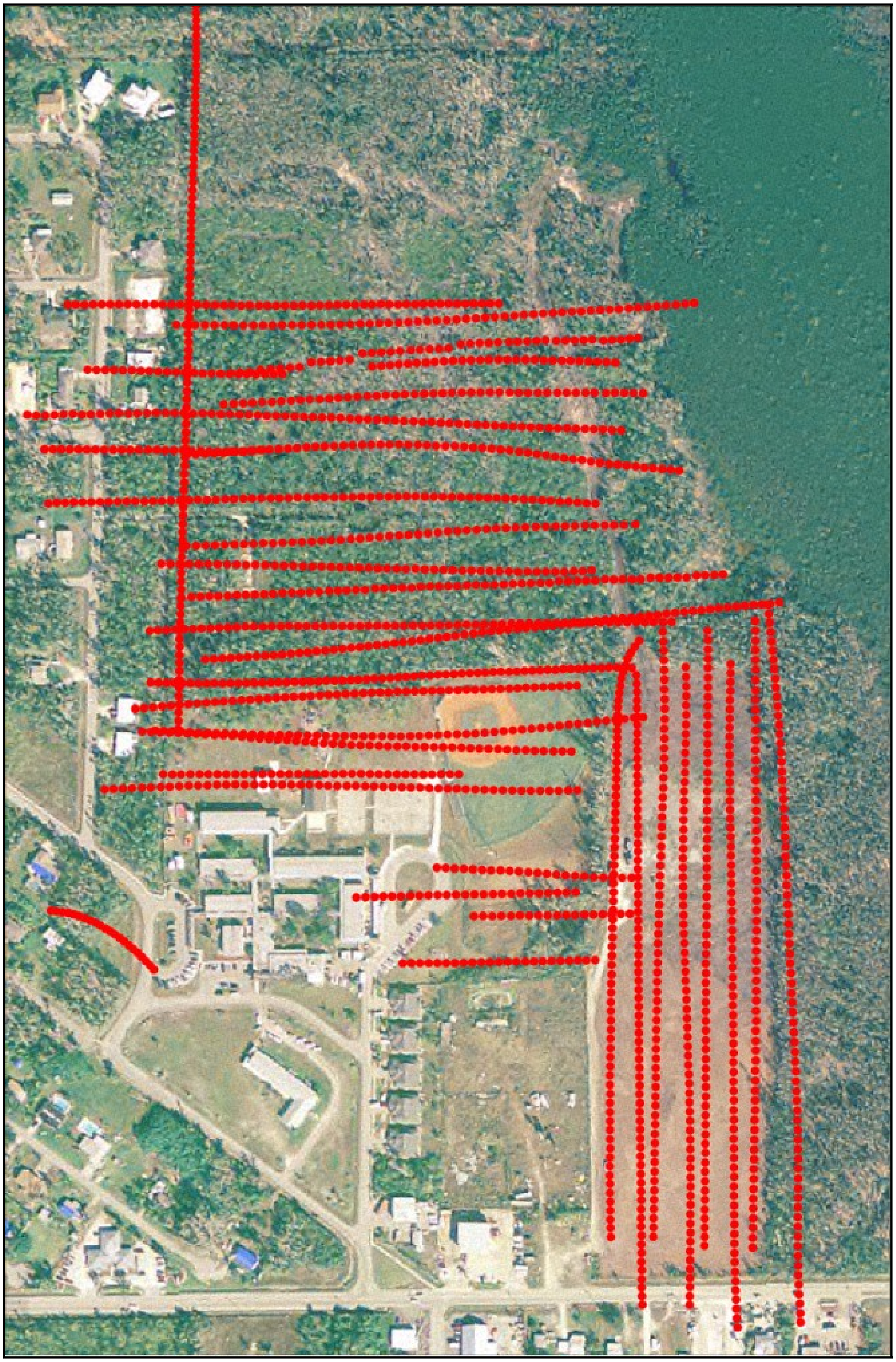

Figure 2. Guidance free larviciding track with no reference, open marsh.

Figure 3. Swath guidance from A-B line use.

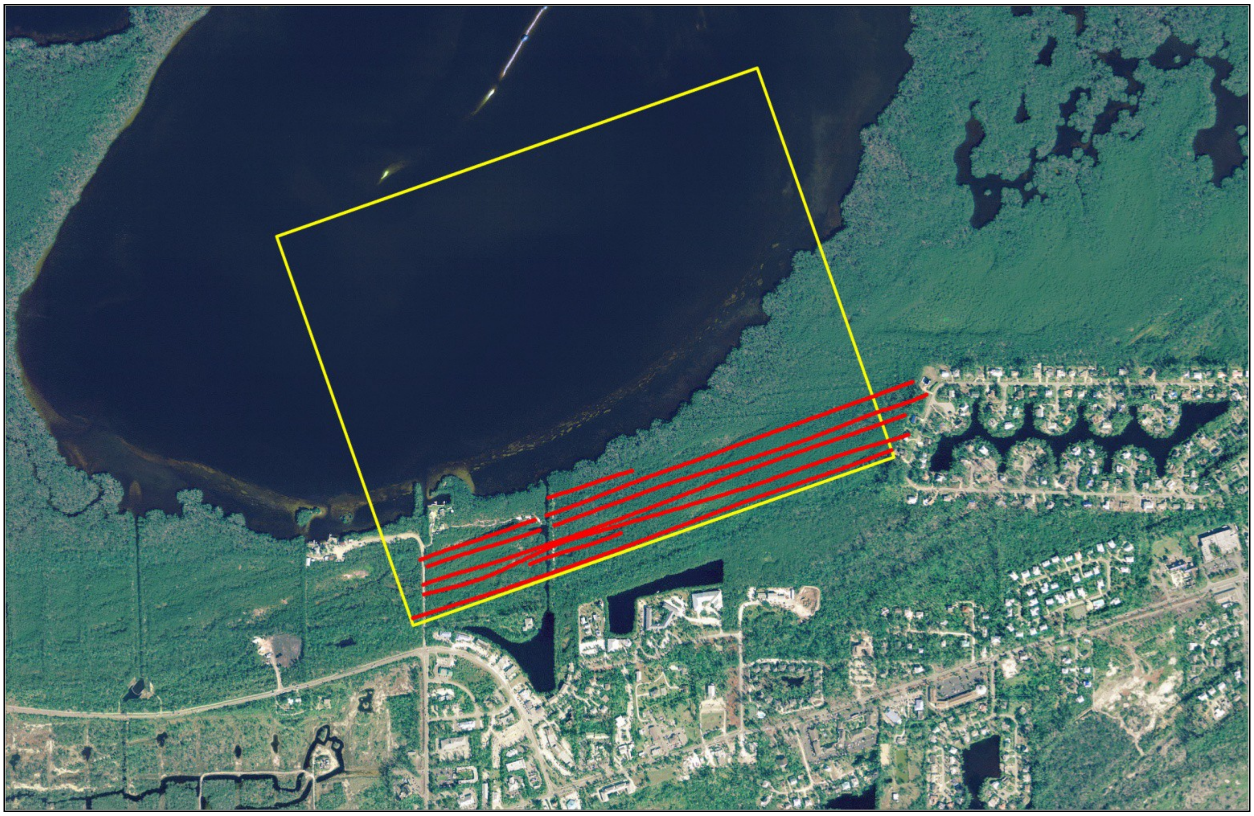

Figure 4. Polygon use for larviciding.

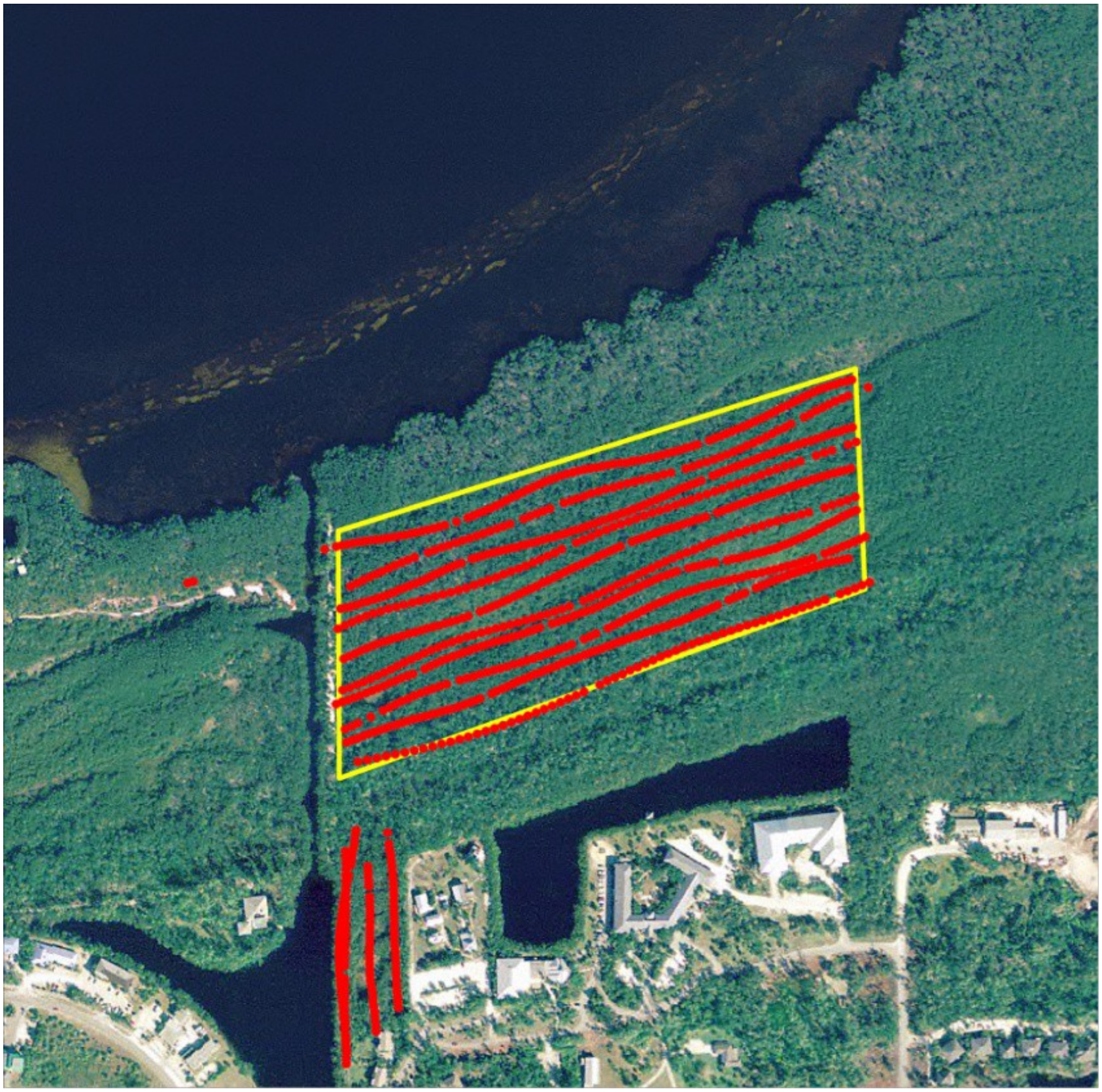

Figure 5. Polygon development with Google Earth.

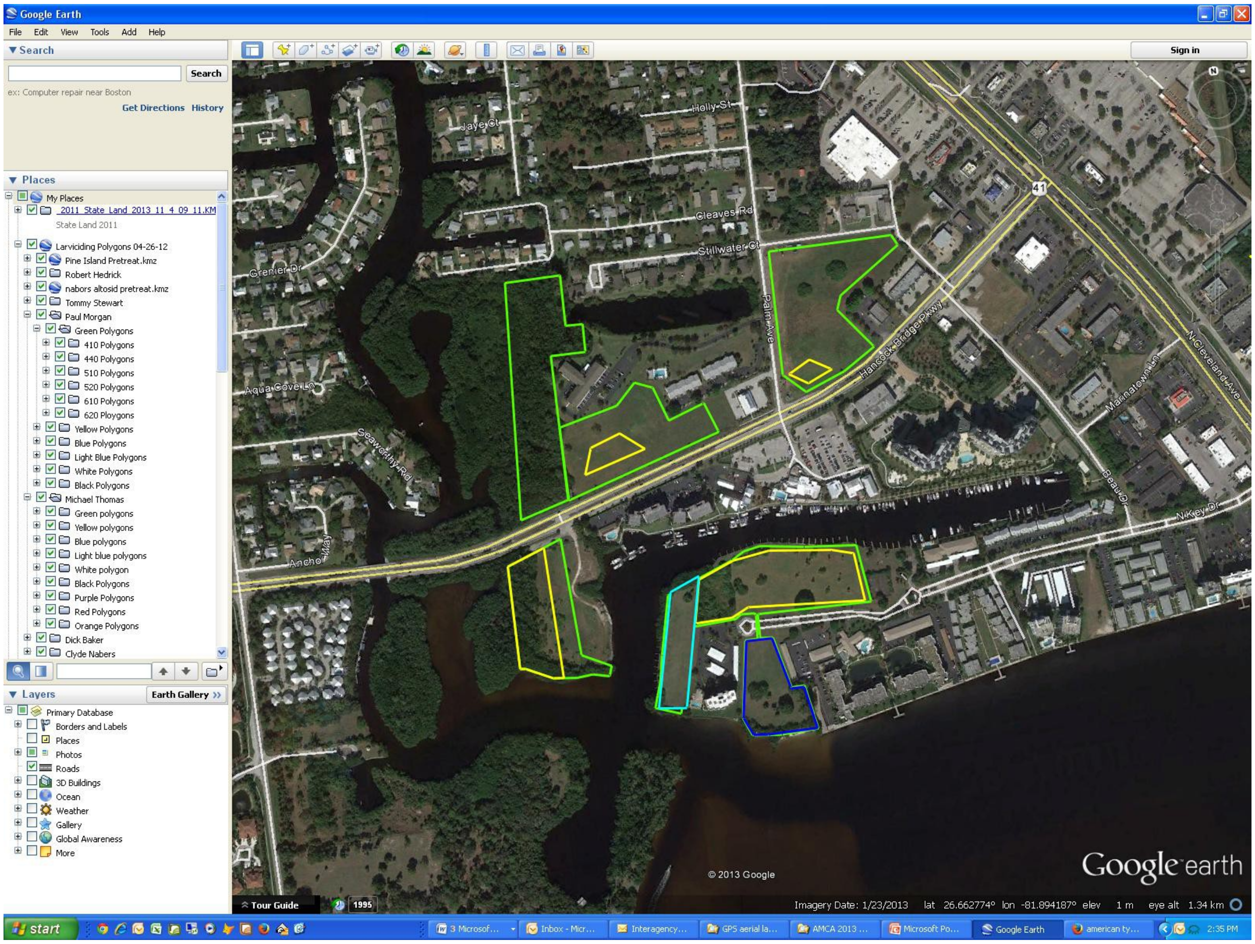

Figure 6. Larviciding without Auto-Booms.

Figure 7. Larviciding with Auto-Booms.

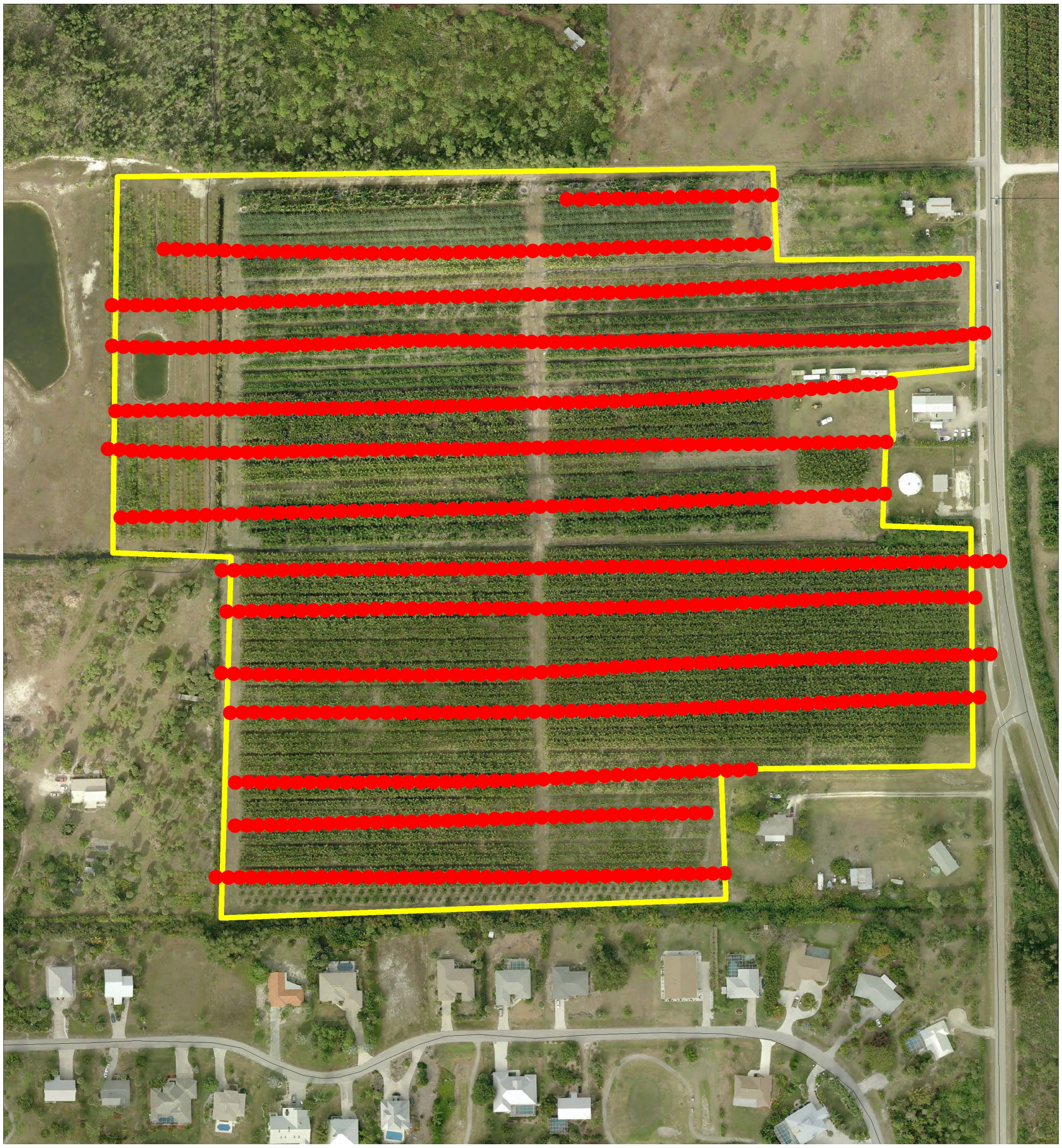

Figure 8. Coloring within the lines with larvicide.

Figure 9. Land of one thousand polygons.