SprayDays: Cutting School Pesticide Exposures

Final Report

Pacific Nut Producer, 2020

CE 105, UC Berkeley

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Team mission statement

We aim to create a functional and user-friendly pesticide notification system that is accessible to students, teachers, parents, and community members.

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1. Introduction

California holds the title of the world's largest almond producer (FAS Press, 2024). Notably, nearly all commercially bought almonds found in American grocery stores come from California, making almonds– and more broadly agriculture– essential for the economic growth of the state.

Stanislaus County is amongst the many regions of California whose economy heavily depends on agriculture, with its gross agricultural production value at almost $3.2 billion for 2024, of which $824 million came from almond production (Pinfold, 2024). Despite the negative impacts associated with many pesticides, Stanislaus County continues to heavily rely on pesticides like 1,3-dichloropropene, commercially known as Telone, for the production of crops like almonds. The use of Telone and other restricted pesticides results in a higher risk for people to develop health conditions such as pancreatic cancer, respiratory issues, chronic headaches, and neurological disorders due to long-term exposure to pesticides (Shekhar et al., 2024). As of 2025, in the United States, one in three people have an incident related to cancer, and in

Stanislaus County, the risk is higher. The lung cancer rate in Stanislaus County is 22% higher than California's average rate (National Cancer Institute, 2025). With cancer as a particularly high concern for Stanislaus County and emerging air quality concerns, reducing the amount of pesticide exposure within the community is a necessity.

In 2025, California implemented a statewide pesticide notification system called SprayDays. SprayDays serves as a notification system that alerts subscribers to restricted pesticide use within a preset 1 square mile block. This is a website that shares intended pesticide applications by farmers 24 hours in advance of a pesticide's use, but with a four-day grace period (Department of Pesticide Regulation, 2026). To receive these notifications, a user must register on their website, which can be difficult to navigate. Schools are not notified automatically; rather, they would have to be aware of the existence of the website, where one would have to sign up for the website, and then later communicate the information with the rest of the students and staff. This is a tedious process that schools are not legally required to do, making it difficult to encourage all schools across Stanislaus County to sign up. Even if a school is signed up to receive these notifications, farmers have a 4-day window to spray the pesticide they intend to spray, so it is difficult to predict the exact time at which these pesticides are sprayed.

As the first notification system in the country to notify users of pesticide applications, there are still many issues with SprayDays that need to be addressed. As long-term exposure to these pesticides (even in small amounts) can increase health risks of illnesses like cancer, it is important to reduce exposure to these pesticides starting from a person's earliest years. Thus, this project aims to connect schools to the SprayDays notification system and provide data to support community groups on advancing legislation that could improve the accuracy of the notification system and its effectiveness.

2. Our Vision for 2031 and Beyond

In an ideal future, California's agriculture industry will be celebrated not just for its productivity and economic output, but for pioneering the path to socially equitable regulations that prioritize the safety of people and the environment over sheer profit.

Currently, California has some of the most restrictive pesticide measures in the country. However, even with these baseline regulations in place, there are still improvements needed to increase public health, transparency, and data accessibility. Though DPR publishes multi-year strategic plans and semiannual revaluation reports, finding these documents is difficult, and the verbiage used is rarely accessible to those without a background in pesticides. Tracking the progress of these strategic plans is a tedious process, which discourages public engagement, as information is more likely to be utilized when it is readily available and easy to retrieve (Shah and Oppenheimer, 2008).

With this in mind, we hope the future of California's agriculture regulating departments, like DPR and agricultural commissioners, will prioritize true accessibility to information on pesticide use. In turn, this transparency can then segue into public engagement and awareness, empowering people to analyze public data and advocate based on the patterns they can see.

As depicted in Figure 1 below, for a future where members of Stanislaus County can live longer, healthier lives with less exposure to pesticides like Telone, the SprayDays notification system must be improved to give more precise information on pesticide applications and an easier system for enrollment that directly notifies schools of the time and day on which pesticides are sprayed. Additionally, in this new system, school districts will be required to sign up to receive notifications of pesticide applications. These notifications would then be communicated to all schools and parents immediately.

With improved communication and awareness within the community regarding pesticide exposure and its negative impact on one's health, replacing pesticides with safer alternatives will garner stronger support from the community. Residents will be more encouraged to participate in community advocacy, e.g., supporting the expansion of the buffer zone around schools, led by Valley Improvement Projects. Residents can also directly contact the Agriculture Commissioner or local representatives to let them know of their concern for pesticide use in the county. As the concern from the community increases, the Agriculture Commissioner and policymakers will move to tighten pesticide policies. Our vision for the future includes school buffer zones of 5 miles and the prohibition of hazardous chemicals like Telone.

More broadly, our future vision includes an enhanced notification system that will display the health effects pesticides have on the community in a way that connects with them on a more personal level. There will be a notification system in place that clearly states the active ingredients of a pesticide and their associated short-term and long-term health risks. There may also be resources available to link incidents in which pesticide exposure has affected people. The website will have different media forms communicating what vulnerable populations can do to help protect themselves from exposure. With more individual understanding and connection to the issue, more people in the community are likely to speak out against pesticide use and ask for stricter regulations. This will encourage the end of pesticide use in the county, with farmers switching to more environmentally friendly alternatives like organic farming.

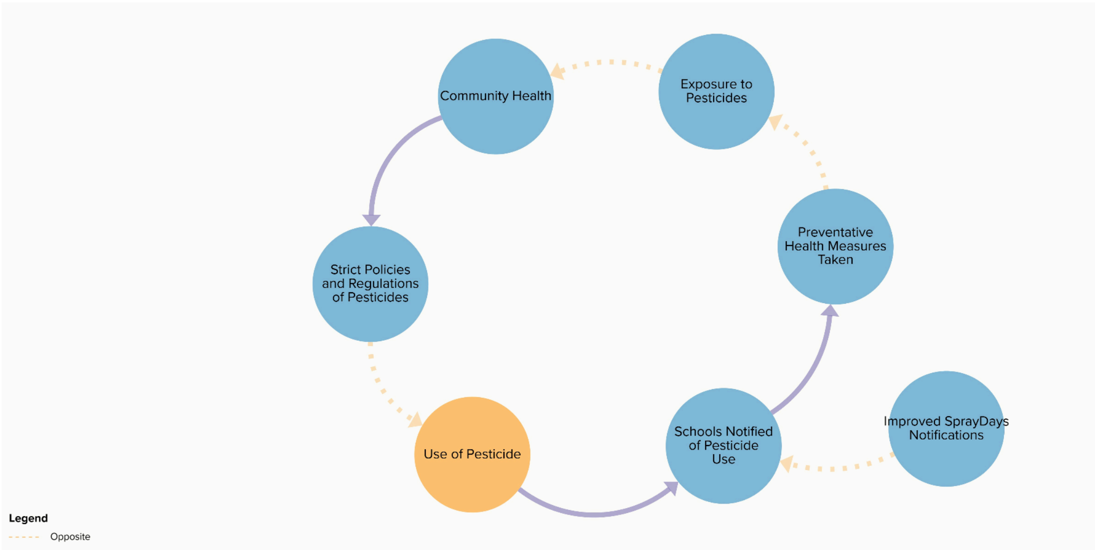

Figure 1. This system map showcases an updated SprayDays notification system that improves community awareness and health by providing timely alerts to schools.

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3. Key Areas of Concern

The main problem to consider when it comes to pesticide use is that the financial incentive of using pesticides is very high, and there is a lack of government regulation currently in place to limit use. Pesticides are connected to many long-term health effects, with pesticides like Telone II being a cancer-causing agent. Telone II was subsequently banned in the US in 1990 due to the aforementioned risks and was banned in the EU in 2011. However, Telone is very effective at getting rid of pests like nematodes and was allowed again in 1995 (Sellen, 2019).

Nematodes are soil-dwelling roundworms that target plant roots and can act as harmful parasites. As a soil fumigant, Telone provides a targeted approach that is extremely effective at getting rid of nematodes. Unfortunately, there are currently no cost-effective alternatives, which further incentivizes governmental protection of these pesticides, meaning farmers have no incentive to change to safer practices.

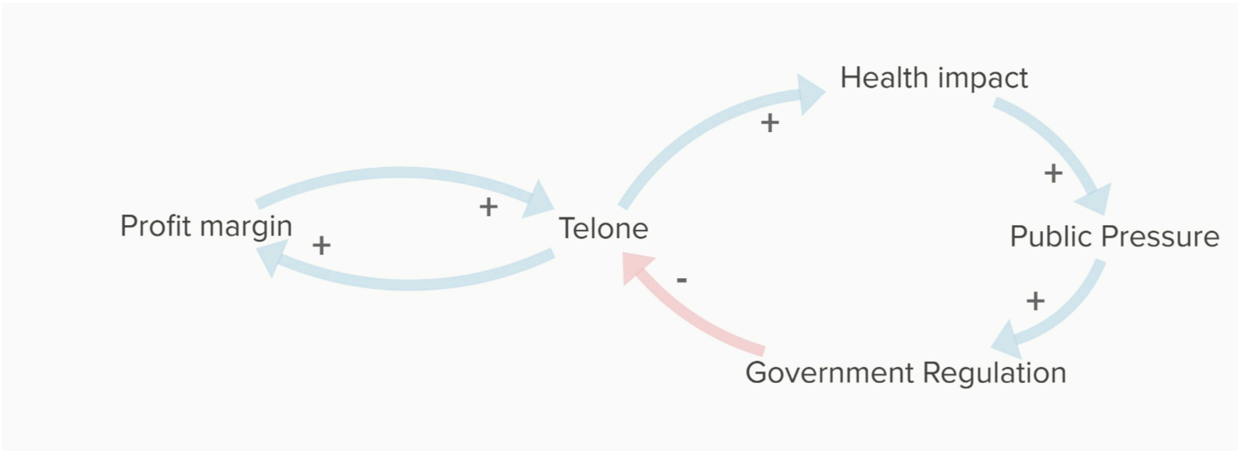

Figure 2. This system map shows how government regulation is needed to decrease the usage of pesticides like Telone. Otherwise, farmers would continue using Telone, incentivised by the profit motive.

So far, regulations have been instituted regarding Telone's usage, like state regulation ENF 01-31, requiring a buffer zone of 100 ft for occupied residences, schools, hospitals, etc. This was then increased to ¼ of a mile buffer zone to schools and daycares. The buffer zones are there to help increase the distance from application areas to sensitive receptors, mitigating their effects.

These buffer zones are important as they help protect children, whose developing organs are highly vulnerable to toxins. However, more can be done to properly protect children from pesticide exposure, like expanding the buffer zone and closing the current notification gap. Presently, growers are only required to provide schools and daycares within ¼ mile an annual list of pesticides they expect to use, which does not include specific dates or times of application. This leaves schools just outside the radius entirely unaware, and those within it without the ability to properly prepare a safety plan. Furthermore, despite the current restriction of pesticide applications from Monday to Friday, 6 AM to 6 PM, the safety distance for each pesticide application varies drastically. High drift fumigants like 1,3-Dichloropropene (Telone) require a ¼ mile buffer zone, but low drift tractor applications are only restricted to 25 feet, and greenhouse applications have no restrictions (R*egulation to Address Pesticide Use near Schools and Child Day Care Facilities*, 2017). Because schools never receive actual application dates, students are routinely and unknowingly exposed to pesticides during the school day, or during after-school activities, highlighting the real need for real-time transparency and larger protective boundaries.

The current pesticide notification and monitoring system for California, SprayDays, also lacks clarity, precision, and transparency. It provides a four-day window during which pesticides may legally be applied. This wide time range makes it unclear when exposure actually happens.

Because different pesticides have different health effects—such as respiratory irritation, neurological harm, endocrine disruption, or potential cancer risk—the absence of detailed chemical information on their website prevents the public from understanding the specific health risks they may face. In addition, only certain categories of the most harmful or highly volatile pesticides are actively regulated and monitored. Other pesticides that may still pose health risks are not consistently tracked or included in publicly accessible data systems (i.e., SprayDays). This creates an incomplete picture of total pesticide use in the county.

Overall, these gaps in timing accuracy, chemical disclosure, monitoring capacity, and public data access reduce transparency and make it difficult for communities in Stanislaus County to fully understand and respond to pesticide exposure risks. As depicted in Figure 3 below, the economic drive created by the agricultural industry in California has encouraged the use of pesticides in communities like Stanislaus County, which are already vulnerable to many other pollutant sources. With the current state of policy regulations for pesticides, there exists no real barrier for these farmers to limit their use of these harmful pesticides, leading to their continuous use with no reliable form of communicating these applied pesticides to the public. Despite SprayDays' existence, the notification system is difficult to navigate, confusing to sign up for, and is not well-known to many. Without knowledge of when these pesticides are applied, how they spread, or even how harmful they could be in the long run, the Stanislaus Community is left to unknowingly be exposed to these harmful chemicals, increasingly putting their health at risk.

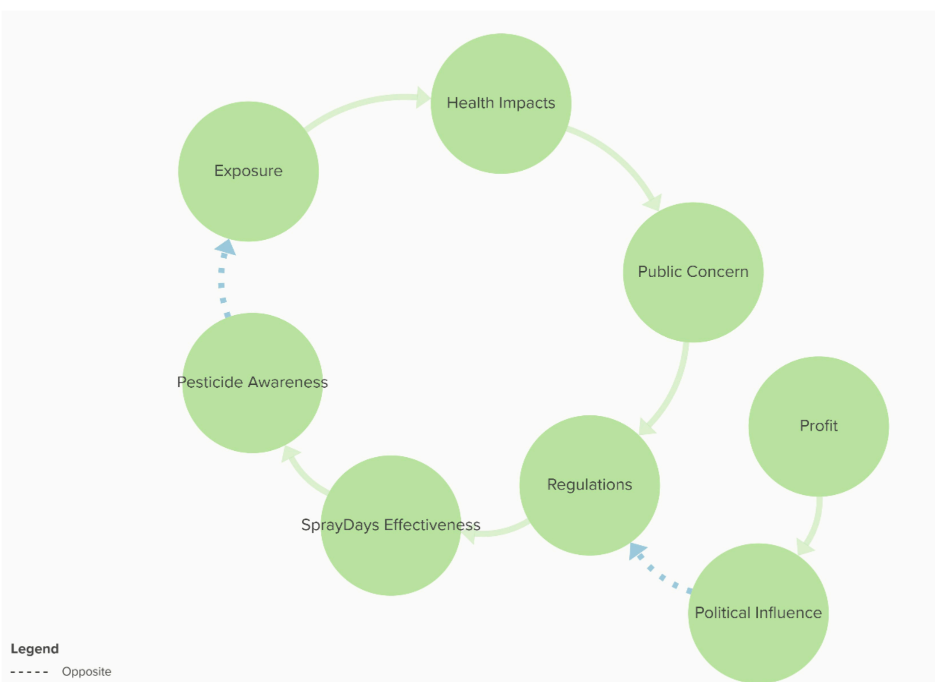

Figure 3. This system map depicts the correlation between pesticide use and health issues in the Stanislaus community, as well as the role of political influence.

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4. Data Visualization and Analysis

To understand/visualize the underlying issue of pesticide exposure, many data visualization techniques were used. These techniques include spatial analysis platforms (ex. QGIS, ArcGIS Pro) and Python to aggregate data from various sources to our preferred format. However, the platforms and data used for these visualizations require the comprehension of various complicated terms, which are explained in the following sections.

Understanding Use of PLSS

PLSS is an acronym standing for Public Land Survey System. It is a way of subdividing and describing land in the US. Its 4 units of measurement are meridians, townships, ranges, and sections. Meridian is the representative of the starting point; a township is a 6-mile row of land measured north or south of the baseline. Range is a 6-mile row of land measured east or west. A section is a 1-mile by 1-mile cell within a township. This locational data is then used in tandem with NOIs and PURs.

NOI stands for Notice of Intent. These are submitted in advance by farmers when they are using restricted chemicals. They are required to tell us the product being used, the active ingredient, the relative time they are being used, and the location of usage. PUR stands for pesticide use report and has many of the same data fields as NOI, but there are differences. PUR is a report for all pesticides that were applied, submitted after the fact, and includes the application start and end times as well as dates. This is in contrast with NOIs, which only list start time and date with no corresponding end date, as well as the fact that NOIs are only submitted for restricted pesticides. NOIs are submitted at least 48 hours in advance of soil fumigant applications and 24 hours in advance of other restricted pesticide applications, while the List of PURs is submitted at the end of the year (DPR, 2025). The NOIs and PURs are submitted using the PLSS system, which is then used to determine the amount of overlap between pesticide spray zones and school grounds to estimate potential exposure levels.

To analyze the data, we first plotted school coordinates on each corresponding PLSS grid and its adjacent grids, as shown in Figure 4. This allowed us to observe the distribution of schools (in blue) and the surrounding PLSS grid cells (green).

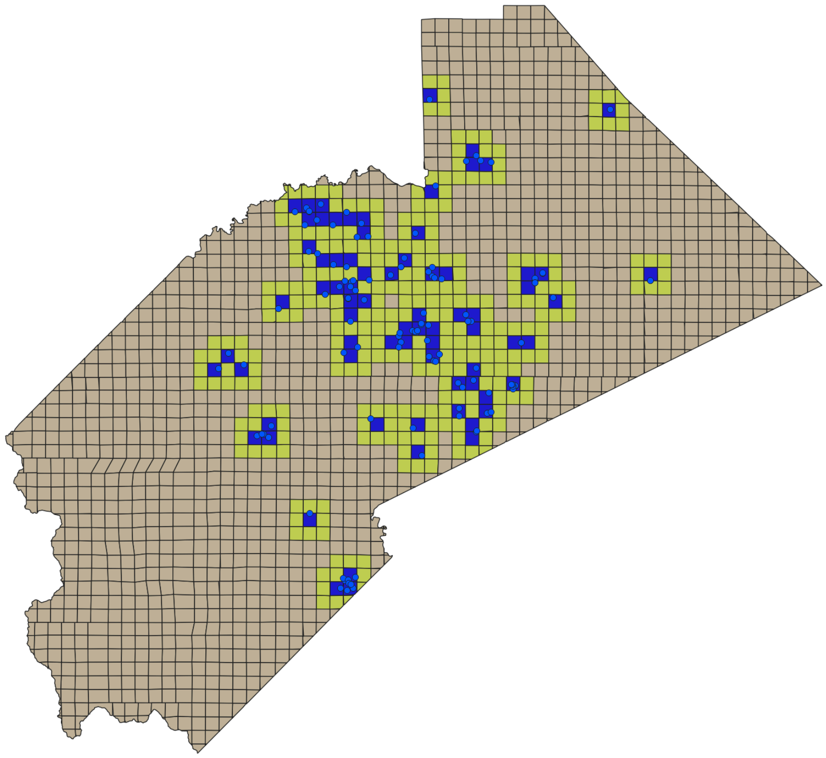


Figure 4. Location of schools in blue (blue dots and blue grid squares) and PLSS grid cells adjacent to schools in light green, for Stanislaus County.

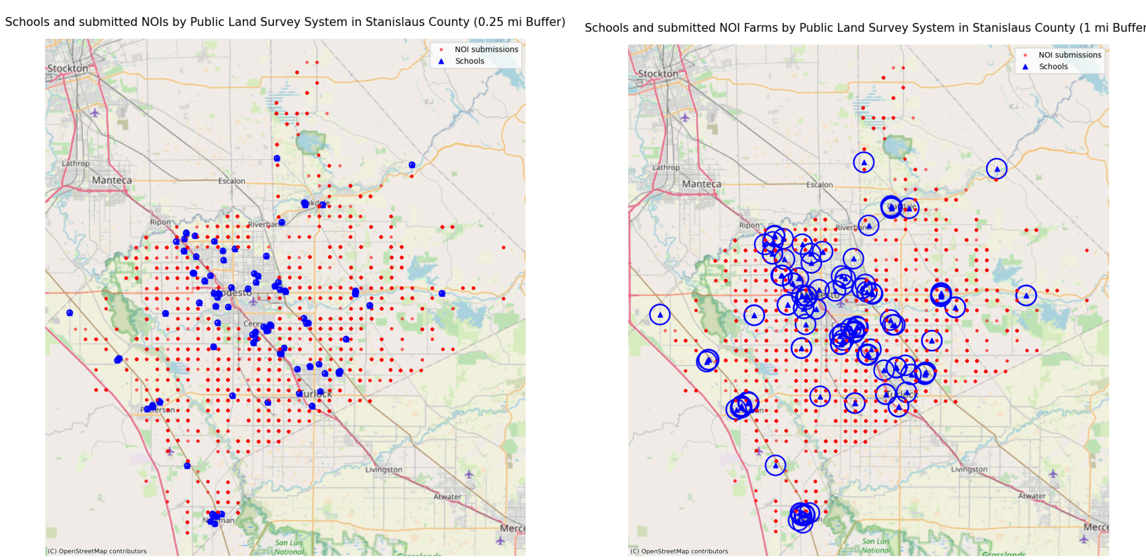


Figure 5, 6. Maps plotting PLSS NOI submission in comparison to schools for Stanislaus County, where the left figure has a ¼ mile buffer zone around each school and the right figure has a 1 mile buffer zone. The red dots represent the center of the PLSS grid cell and the blue dots are schools, with the blue circle representing the buffer zones.

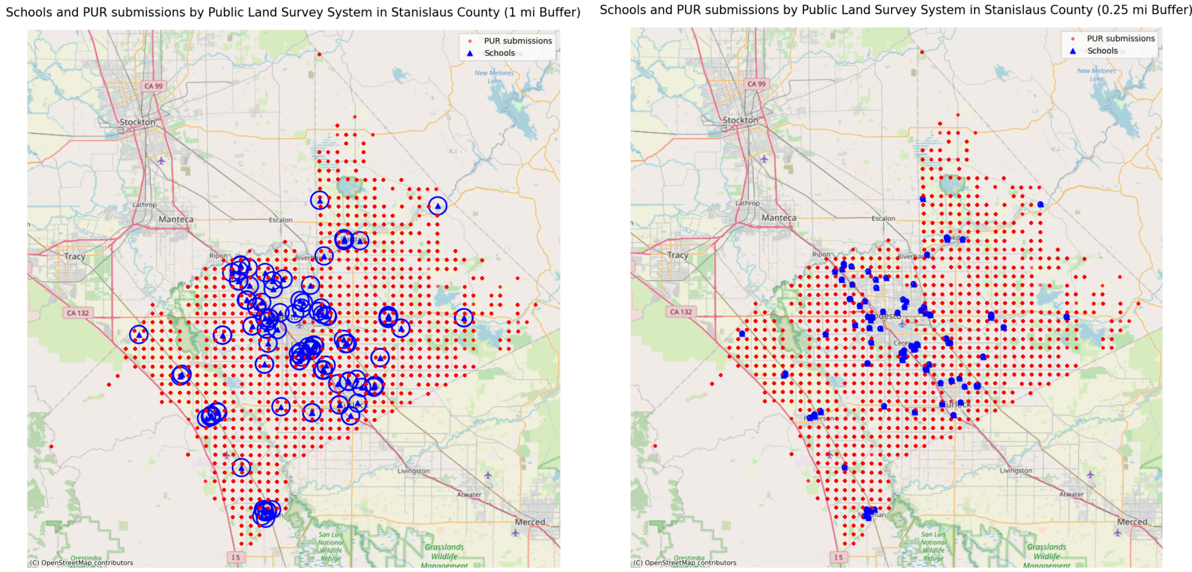


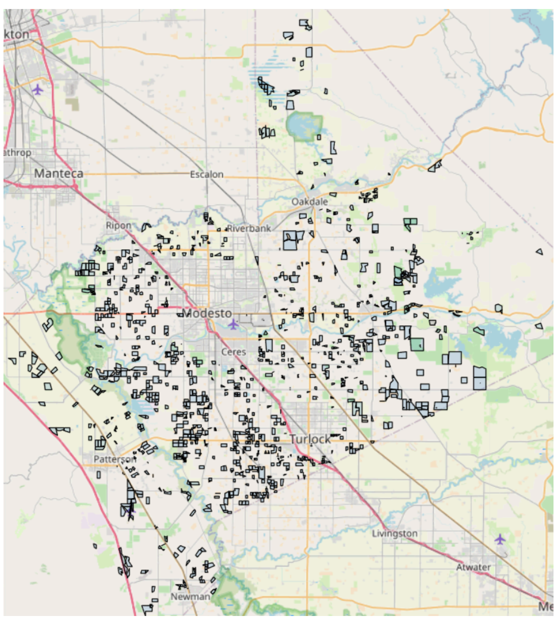
Figure 7, 8. Maps plotting PLSS PUR submission in comparison to schools and a ¼ mile buffer zone (left) and a 1-mile buffer zone (right). The red dots represent the center of the PLSS grid cell, and the blue dots are schools, with the blue circle representing the buffer zones.

The plots above from figures 6-8 depict NOI and PUR submissions from 2025 January 2025 to May, graphed by the public land survey system as red dots. These plots also contain the locations of schools that have received notifications during the 2025 school year as blue dots. These were plotted in ArcGIS Online using the coordinates from *California Private Schools 2023-24* and *California Public Schools 2024-25* for some of the schools, where we connected the CA private school, public school data, and manually input coordinates for other schools not listed in the CA database. We also manually added, combined, and removed schools for those that were closed, had the same site location, or had multiple campuses.

Though this method is the best one available at the moment, given the way PUR and NOI data are collected, many issues with it have arisen. This single coordinate method and the PLSS submission were not precise enough. With this system, the real school boundary can intersect farmlands within a 0.25-mile boundary that don't intersect in real life. This is because the PLSS for the NOIs and PURs are graphed in the middle of each square mile grid, regardless of its true location within the square. Thus, the submissions farmers are required to send to schools on an annual basis may be inaccurate not only because of the lack of timely notifications but also due to location. This is concerning, given that the PLSS system is also used for the only existing notification system: Spray Days. Community members have a right to know the exact time and location of the application, so we decided to aggregate different sets of data to get the entire geometries for both the schools that were notified and the farms that have submitted an NOI.

To begin this process, we gathered additional data. Datasets like the PURs and NOIs were kept, and boundaries/geometries of land parcels were added. During the process of adding new boundaries, a dataset of Stanislaus County Crop boundaries was found. With these crop boundaries, we were now able to connect NOI submissions to specific parcels by joining the two datasets with the Site ID as the connector between crop boundaries and NOIs submitted using Python.

After joining the NOI and Crop Boundaries datasets, the result was a dataset containing the geometries of the farms within the NOI submissions as depicted in Figures 9 and 10. Though some of the NOIs did not match the crop boundaries, the new geometries improved the visualization of farms. With this improvement, we can now apply buffer zones more effectively around most of the farm site locations. Additionally, these geometries often allow for a more expansive buffer that does not place all points in the center of a square grid and more effectively relays instances of restricted pesticide use within varying buffer distances.



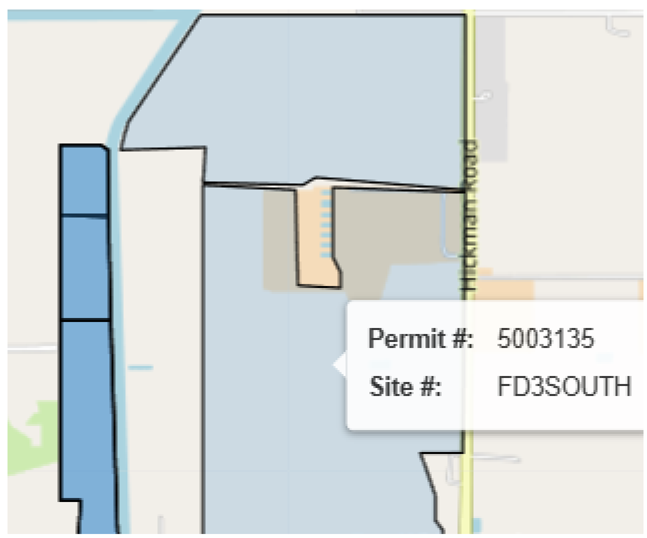


Figure 9, 10. Maps plotting NOI submissions for January to May of 2025 linked to crop boundaries in Stanislaus County. Whole view (left). Closer view example showing the permit number and site number of a specific crop boundary(right).

While obtaining the geometries for the farms within the NOI submission, we also obtained the boundaries for the schools that were notified for each NOI. Initially, a CA school boundary dataset was found, but this dataset only included about 70 of the schools that were notified out of the 130 schools listed as schools who should have received a list of intended pesticide applications at the beginning of the year. The missing school could be due to the data only including public schools, the school list including daycares, or due to some schools sharing the same location. Due to this, we connected the notified schools' datasets to the CA Statewide

Parcel Public by CAL FIRE, which separates every parcel of land by ownership (in California and within ownership censored). This parcel data served to be useful when wanting to find the school boundaries, as we were able to overlay this parcel data (in ArcGIS Online) filtered to Stanislaus County on top of the notified schools dataset. We then merged any intersecting points, resulting in the school boundaries. However, this process was not 100% fool proof because there was at least one instance where a school coordinate and parcel intersection did not result in the whole school boundary, as the parcels of the schools were listed separately. Therefore, the parcels and coordinates had to be adjusted manually to consider the entire school boundary.

With the boundaries/geometries for both of the farms and the schools identified, we plotted both sets of geometries in Python and created buffer zones around the farms that were present in the NOIs. The goal was to determine how many farm buffer zones intersected with school boundaries. This helped show many schools farms may need to notify annually, as well as how many schools farms would affect at different buffer zones.

We tested several buffer distances: 100ft, 500ft, 1000ft, ¼ mile, ½ mile, and 1 mile. These distances vary because different chemicals have different required buffer zones depending on the type of chemical, amount applied, and the quantity per acre. The reason as to why there is a large buffer range is due to limitation in data where there is very little clarity and organization in buffer distance information that is not in one clean easy to use file. By using multiple distances, we were also able to show how many schools could possibly fall within the range of pesticide exposure. The buffer zones shown here, Fig. 11 & 12, are 100 ft and ¼ mile, respectively.

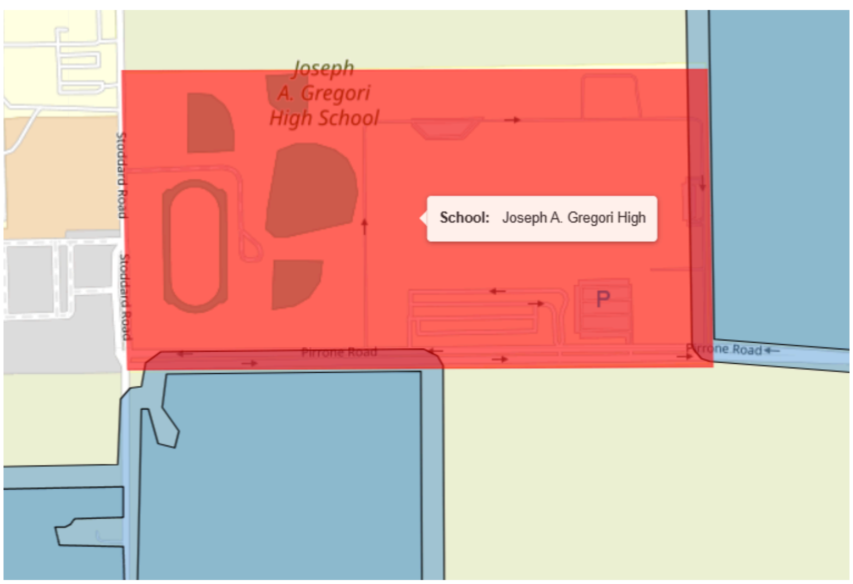


Fig 11. Light blue represents the 100 ft buffer zone around farms (darker blue). This 100 ft buffer overlaps with school boundaries in some cases.

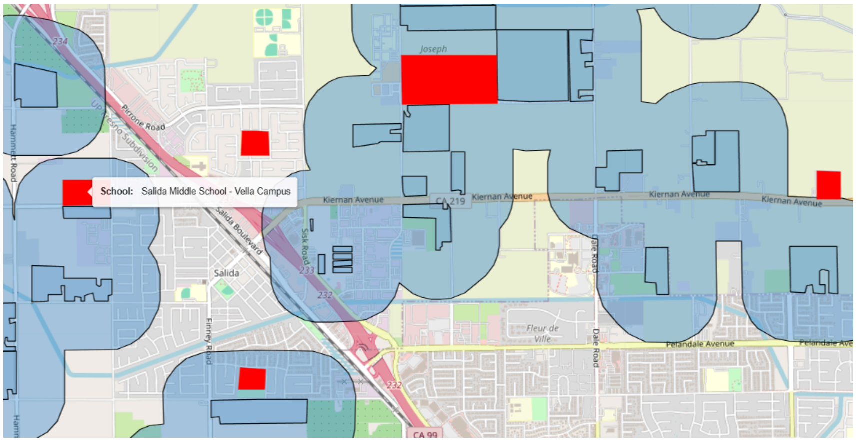


Fig 12. Light blue shading represents a ¼ mile buffer zone around the farms (darker blue). Some schools (red) are within multiple buffer zones.

At the same time, we also conducted a similar process by creating buffer zones around schools to help identify which schools may be the most affected and should be prioritized for notifications. For this analysis, we used the same school geometry dataset and a similar farm dataset containing 2025 NOI submissions with crop boundaries. However, this analysis was conducted in ArcGIS Pro instead of Python. We created buffer zones around each school to determine how many NOI submissions fell within each buffer area.

To create the buffer zones in ArcGIS, we used the **Buffer** analysis tool with the school boundary layer as the input feature. We adjusted the buffer distance based on the distance being tested and used US Survey Miles as the unit of measurement. All other parameters were kept to the default setting.

After the buffer zones, we used the **Spatial Join** analysis tool to get the count of how many NOI submissions fell into each buffer area. For this step, the school buffer layer was used as the target feature, and the NOI boundary layer was used as the join feature. All other parameters were kept to the default setting. This join created a new column called Join_count, which recorded the count of NOI submissions at each school.

The data were then exported as an Excel file and analyzed in Python to calculate the average count of NOI submissions across all schools for each buffer distance (Figure 14). The buffer distances used in Figure 14 were ¼ mile, 1 mile, and 2 mile. Currently, application of restricted pesticides within 0.25 mi of a school is limited to evening and weekend hours. If the buffer zone were extended to 1 mi, then the number of notifications to schools would go up by at least a factor of 10 and these (170,000+) applications would also be limited to evening and weekend hours, thus greatly reducing exposure to schools.

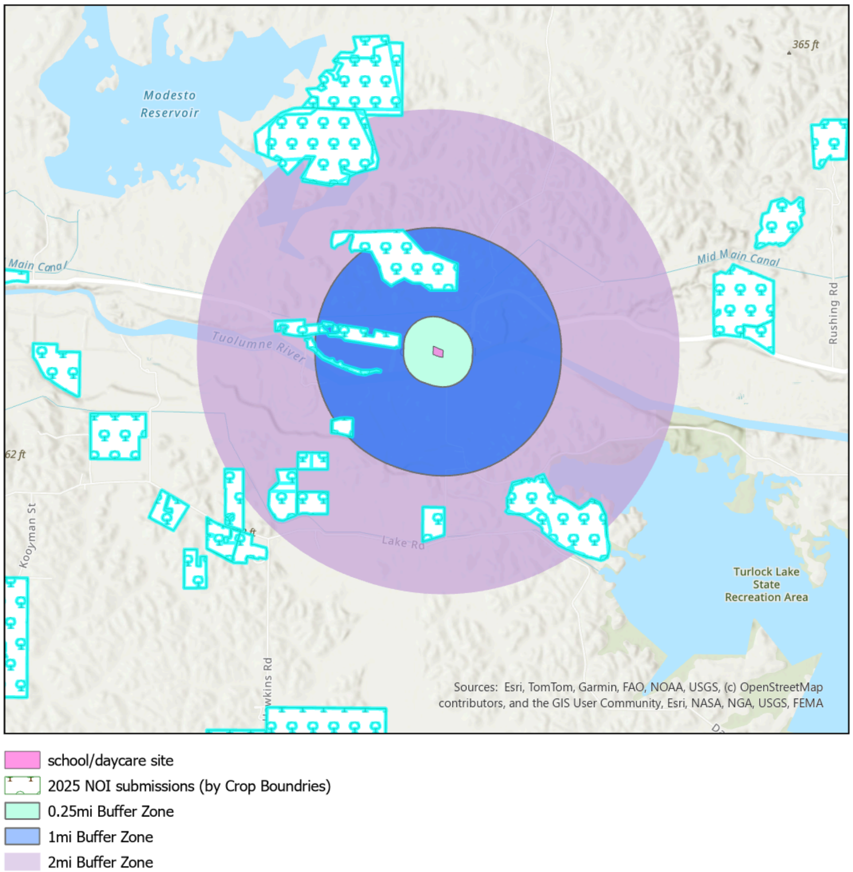


Figure 13: Map of a school site, buffer zones, and NOI submissions by crop boundaries. (¼ mi, 1 mi, 2 mi buffer)

Buffer (mi)	Average NOI Submissions Within a School	Total NOI Submissions (2025)
0.25	42.3	10878
1.00	678.4	174355
2.00	2517.6	647012

Figure 14: Count of intersections between School Buffer zones and NOI submissions for different buffer distances.

5. Design Plan for Stockton 2031

Overall design plan

In the preferred state of 2031, pesticide use reporting and public awareness should be significantly enhanced through stronger regulatory policies and the improvement and/or creation of user-centered digital platforms. This vision will be achieved through the main areas of improvement to digital platforms like SprayDays, increased data transparency, and strengthened regulatory policies.

In an ideal world, SprayDays features an updated, highly customizable user interface that is tailored to one's needs and demands. The cap on subscribed squares will be lifted, allowing users to monitor an unlimited number of areas. Furthermore, users can now edit the names of their subscribed squares directly on the website, which resolves the current process of tediously removing and re-adding locations with the proper name. Notifications now display these custom names as well, so you will no longer see only the section number, minimizing the time needed to pinpoint spray location on the actual website.

As SprayDays evolves, the platform will no longer only rely on a pre-designated square grid system, but rather will allow users to define a custom notification radius centered on their chosen location or stay with the preset, with the addition of buffer zone customisation to allow users to expand as needed based on their personal preferences.

Beyond spatial improvements, SprayDays's catalog of notified pesticides increases. It will now notify for the use of all pesticides, such as restricted pesticides and large-scale non-restricted pesticides. This large-scale number will be set by a team of experts in order to reduce strain from community members and farmers alike.

Transparency is also the foundation of this upgraded system, as well as now the expected practice of all pesticide use; information from DPR and SprayDays will be fully transparent and accessible to download separately. SprayDays will now have the ability to share the DPR data from the farmer on their website, with the site location and planned pesticide shown publicly. With this, the real start and end times will be recorded and included within SprayDays data, notification details, PURs, and NOIs. Additionally, the real-time specifics will be sent directly to schools and daycare facilities (and community members if requested) in the area by email, text, calendar, and/or emergency alerts, as it is vital to protect children from the negative impact of pesticide exposure. These times and their advisories must also be altered depending on how long the specific pesticide is expected to linger in current conditions, meaning that the SprayDays alert must notify for a continuous amount of time until the possibility of exposure is low to none.

With a plan of SprayDays and the data being more transparent, it is also reflected in the DPR and the counties themselves. Farmers would also be stripped of the 4-day grace period that is currently allotted to them. They must submit a new intent to spray and act within a shorter time period.

Restrictions towards pesticide use will be more regulated, and NOIs need to be submitted frequently since now, the 4-day grace period has been reduced to 2 days, with notification of application start date and time being reported by the farmers to SprayDays or another interface. Additionally, counties will now have criteria and formats for the way to report pesticide use, including unrestricted pesticides, so the state-wide reporting/notification system stays consistent throughout every county to ensure all relevant information is reported. SpraysDays and DPR will now both have a filterable column regarding pesticide, location, and health effects, so if the community wants to look at past and present information in a certain area, they could see the frequency of each pesticide sprayed in that location, as well as the dangerous side effects each one can cause.

By 2031, the policies need to change. As mentioned in the problem statement, our current policies are band-aid solutions for the problem of pesticide emissions, so in a preferred system, new policies would be in place to make sure this doesn't happen. To this end, two major policies should be implemented: forcing the usage of pesticides to be better documented/reported, and adding policies that increase restrictions on harmful pesticides like Telone, if not outright banning them. The banned pesticides would be ones with overtly harmful effects: Telone or Chloropicrin are two examples.

Currently, PUR and NOI data geometries aren't very well organized. It is difficult to know exactly where at the site location they applied the pesticide because the location is given through street address and miles away from those streets. An example of this is "S/S MURPHY 1/4M E FINNEY" and "13242 CA-108". The former gives us a much more accurate location, but it is far more difficult to find, while the latter is just the home address without any data on where the pesticide was applied. This is then compounded by the fact that both their location data are formatted completely differently. Ideally, it would be a geometry dictating the latitude and longitudes of the location. This would be far easier to interpret and would allow for more precise buffer zones. This is all very easy to implement being that farmers have access to Google Maps.

The strengthening of regulations or the outright banning of these pesticides would offer the best results. This is the simplest method to get to our preferred state. The problem with this method is its feasibility. A lot of restricted pesticides like Telone II and Chloropcrin have very specific effects that are difficult to emulate with their unrestricted counterparts. Switching from our current pesticide to other ones could be less powerful at killing nematodes than decreasing crop yield. This would be resisted by farm owners, who would want as high a profit margin as possible and would lobby against it.

That being said, this idea is not impossible to implement. The EU has banned the use of Telone II for a long time already. In places like France, the ban had limited success, with them still using Telone II in farming, but in places like the Netherlands, they only use Metam Sodium. The Netherlands is one of the world's largest agricultural producers, so the fact that they are able to use alternatives to Telone II with great success means it is very possible in California.

Website Implementation

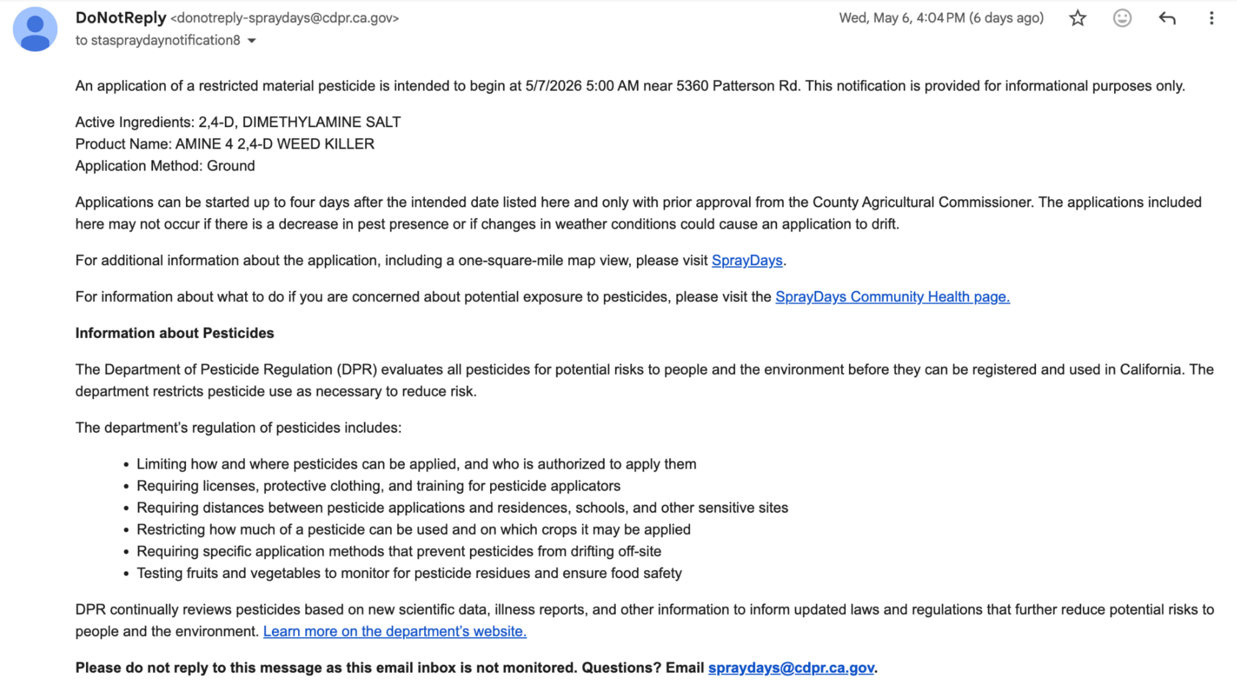
A website that keeps data transparent is crucial for raising awareness among residents and schools. By 2031, websites similar to this will serve as public pesticide transparency maps that allow families in Stanislaus County to quickly find out *what was sprayed near them, when, which active ingredient was used, how it was applied, and how it affects their health.* The design uses a split-screen view of map and list layout to enable fast understanding, plus location-based discovery, radius control, date browsing, and ingredient filters.

Data Gathering

Data gathering began with the foundational task of collecting pesticide notification data relevant to school communities in Stanislaus County. To support this process, a complete list of official public and private schools in the county was first compiled, along with their corresponding email subscription addresses and coordinates.

List of Schools: all official public/private schools in STA County.
Email Subscription: List of Email addresses and coordinates that they subscribe to.

Using this information, we created new email accounts in a Google Workplace and manually subscribed to SprayDays for every one-mile grid cell that either contains a school or is directly adjacent to one. Each subscription location is tied to the centroid coordinates of the corresponding cell. This allows the system to automatically receive SprayDays notification emails for locations that may affect nearby schools.



DoNotReply <donotreply-spraydays@cdpr.ca.gov> Wed, May 6, 4:04 PM (6 days ago)
to staspraydaynotification8

An application of a restricted material pesticide is intended to begin at 5/7/2026 5:00 AM near 5360 Patterson Rd. This notification is provided for informational purposes only.

Active Ingredients: 2,4-D, DIMETHYLAMINE SALT
Product Name: AMINE 4 2,4-D WEED KILLER
Application Method: Ground

Applications can be started up to four days after the intended date listed here and only with prior approval from the County Agricultural Commissioner. The applications included here may not occur if there is a decrease in pest presence or if changes in weather conditions could cause an application to drift.

For additional information about the application, including a one-square-mile map view, please visit SprayDays.

For information about what to do if you are concerned about potential exposure to pesticides, please visit the SprayDays Community Health page.

Information about Pesticides

The Department of Pesticide Regulation (DPR) evaluates all pesticides for potential risks to people and the environment before they can be registered and used in California. The department restricts pesticide use as necessary to reduce risk.

The department's regulation of pesticides includes:

- Limiting how and where pesticides can be applied, and who is authorized to apply them
- Requiring licenses, protective clothing, and training for pesticide applicators
- Requiring distances between pesticide applications and residences, schools, and other sensitive sites
- Restricting how much of a pesticide can be used and on which crops it may be applied
- Requiring specific application methods that prevent pesticides from drifting off-site
- Testing fruits and vegetables to monitor for pesticide residues and ensure food safety

DPR continually reviews pesticides based on new scientific data, illness reports, and other information to inform updated laws and regulations that further reduce potential risks to people and the environment. Learn more on the department's website.

Please do not reply to this message as this email inbox is not monitored. Questions? Email spraydays@cdpr.ca.gov.

Fig 15. Example of a SprayDays opt-in email notification received for a location.

The email received from SprayDays provides key pesticide notification details in a consistent format, including intended start time, nearby address, active ingredient, product name, and application method. This format makes it a message suitable for structured data extraction.

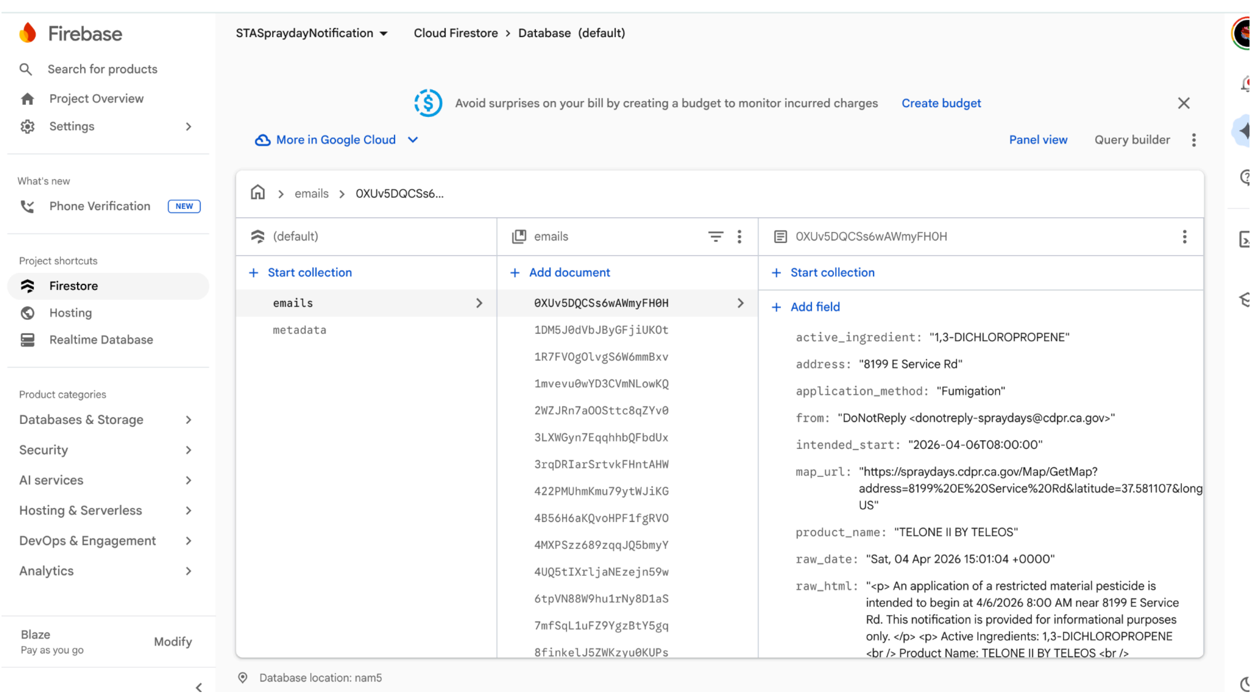


Fig 16. Example of pesticide notification data after being processed and stored in Firebase Firestore.

After the emails are collected, a Python script processes all unread messages and sends the extracted information to a Firebase database. The Python file reads unread SprayDays emails, removes duplicates, and extracts relevant fields such as active ingredient, address, application method, intended start time, map URL, product name, raw date, and raw HTML. During this stage, duplicate entries that have the same time and location are removed, and the contents of each email are categorized into structured fields.
This process converts raw email notifications into a clean and searchable database that serves as a foundation for the website's mapping, filtering, and display functions.

Website Functionality

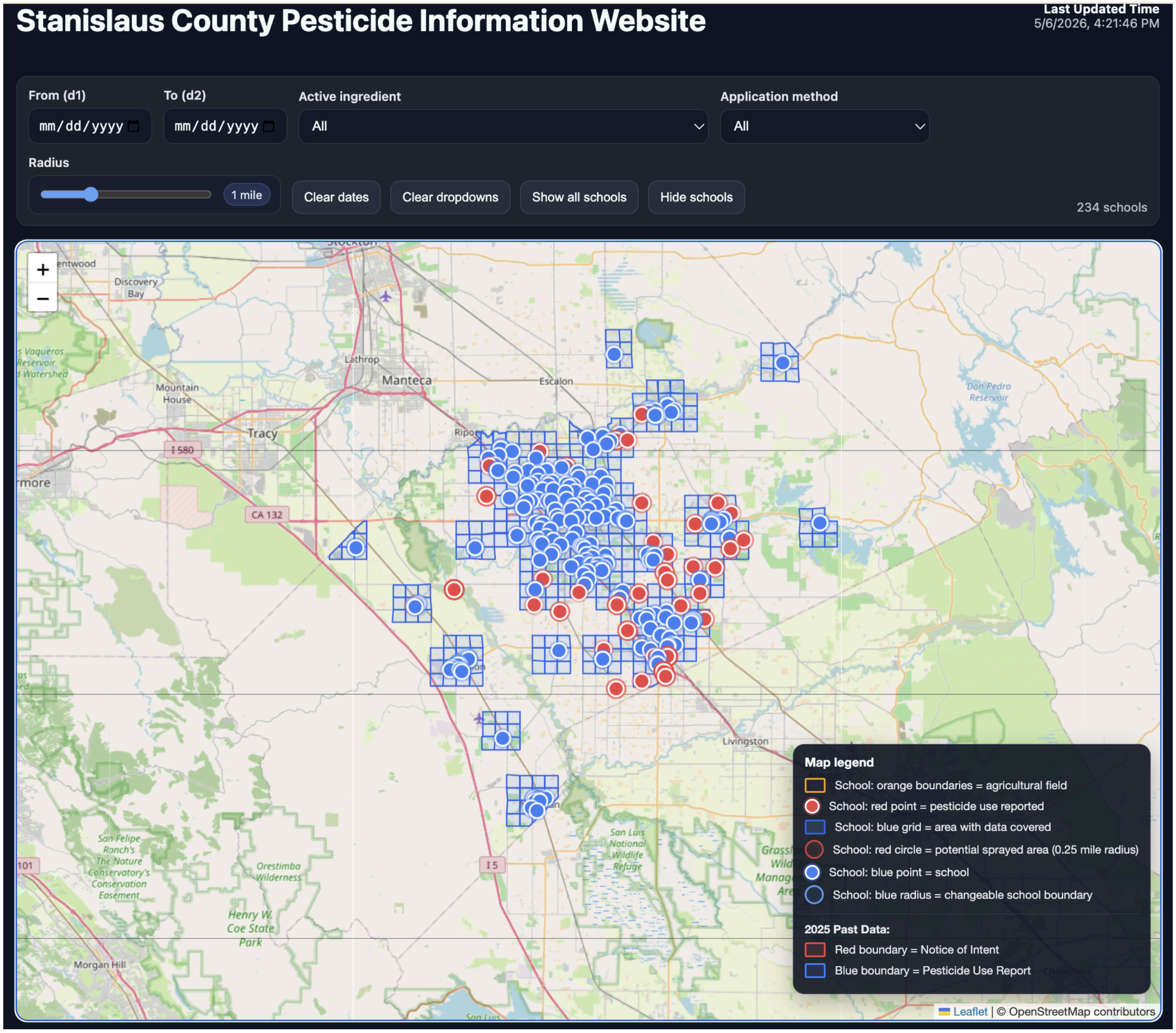


Fig 17. Main Interface of the Stanislaus County Pesticide Information Website

Figure 17 shows a screenshot of the main view of the website. Blue points represent school locations, red points represent pesticide spray records collected from SprayDays email notifications, and blue grid cells represent the subscribed one-mile notification areas used for data collection.

The timestamp in the upper-right corner shows the most recent time at which notification data was extracted and updated from incoming emails.

Users can filter the displayed data by date range, active ingredient, and application method, allowing the website to present pesticide information in a more searchable and user-friendly format.

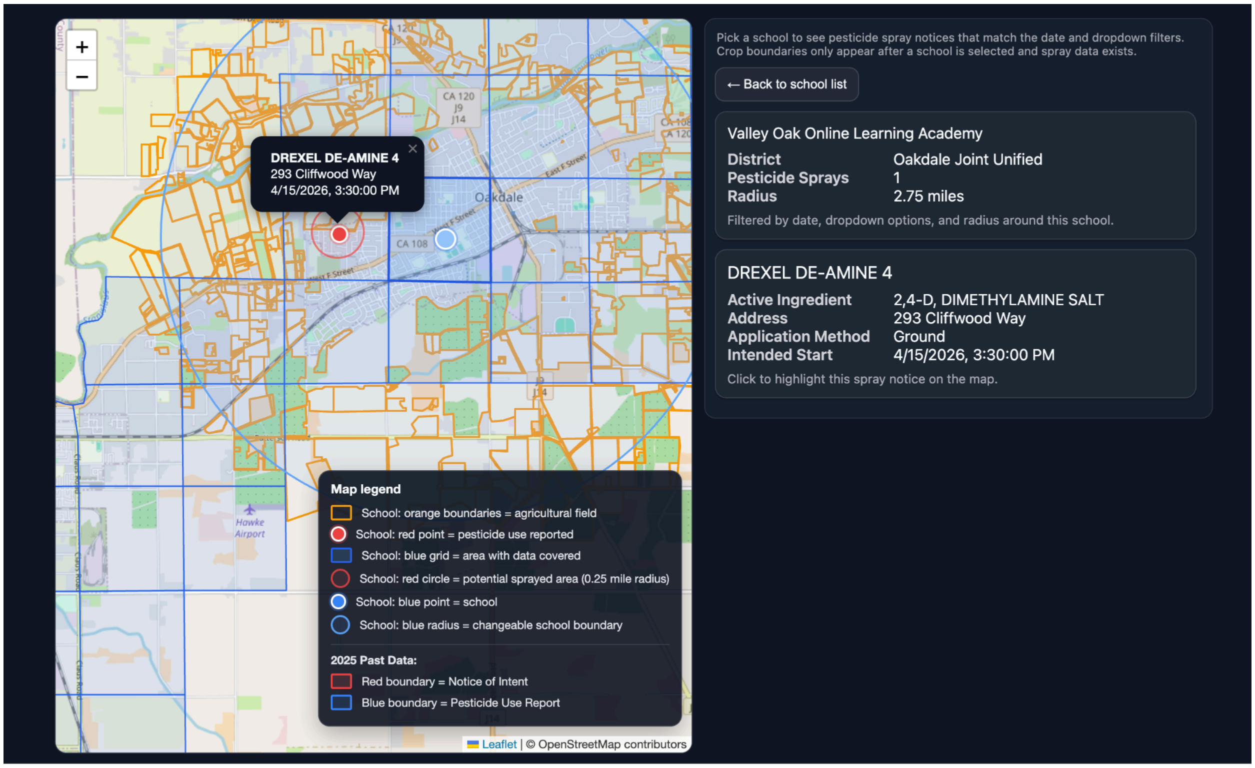


Fig. 18. Example of the website interface after a school has been selected.

After a school has been selected by clicking on it, Figure 18 shows the map display with agricultural field boundaries (in orange) within the chosen radius around the school, along with pesticide notifications inside the filtered area. The notifications are also shown in the information panel on the right.

Users can adjust the radius boundary around the school from 0.25 miles to 3 miles, allowing the website to display nearby pesticide notifications and surrounding agricultural fields at different spatial scales.

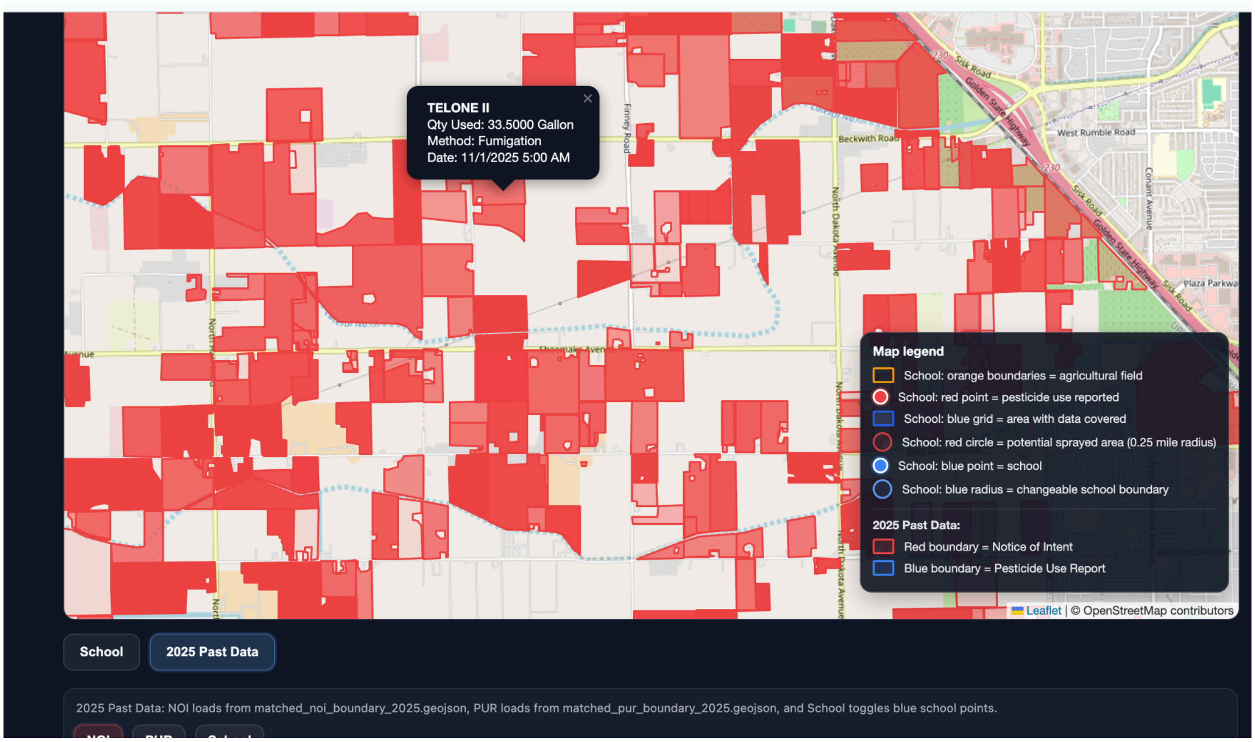


Fig 19. Interface of 2025 Past Data

Figure 19 shows and example of historical data for 2025 which includes both the Notice of Intent (NOI) and Pesticide Use Report (PUR) data which can be displayed through toggleable tabs. The map allows users to switch between two different pesticide datasets to compare and review, while the legend distinguishes boundary types by color. Popup information provides key pesticide application details such as product name, quantity used, application method, and date.

Main Challenges

1. The locations provided by SprayDays emails are only approximate rather than exact. The emails identify a “nearby address”, but they do not reveal the precise point where pesticide application might occur. Because of this limitation, the website can only display an estimated area of concern rather than the exact spray location.
2. The time information is also uncertain. Although each email includes an intended application start time, regulations allow spraying at any time for up to two days after that start time. This means the website cannot confirm the exact timing of pesticide use and can only present a time window.
3. Making the data understandable for the public. Details such as crop boundaries, one-mile notification grids, and pesticide reporting layers are not familiar to most users. As a result, the website needs to present this information in a clearer and more

accessible way so that parents, schools, and community members could interpret it more easily.

4. Although the project successfully extracts and organizes SprayDays data, it currently serves more as a foundation than as a complete notification system. It demonstrates that the data can be collected, structured, and visualized effectively, but it is not a fully developed real-time public warning platform.

Future Updates

1. The Python script should be moved so it runs directly on a server. This allows new SprayDays emails to be processed automatically. At the moment, the data remains in the inbox until the emails are manually read and processed, which limits the system's ability to stay fully up to date. This is because the Python script has to run for the updates to occur.
2. The user interface should be improved. The current website is functional and demonstrates some of the core features, but it is designed mainly to display information rather than provide a polished user experience. Future work should make the interface more visually appealing and intuitive for public use.
3. The mapping system still needs refinement and debugging. Some map behaviors are inconsistent; for example, selecting a school may not always show the related notification immediately unless the radius is changed and then reset. Future updates should focus on improving map accuracy, layer behavior, and overall stability so that the information appears more reliably.
4. A further long-term goal is to build an actual notification system on top of the website. Once the platform is working reliably, notifications could potentially be sent directly to school district officials by email, or to community users through optional SMS text subscriptions. This allows the project to move beyond a data display platform and become a more active public awareness tool. However, before adding these features, the website itself must first be made stable, accurate, and fully reliable.

6. Implementation Plan

The following is an overview of our website's management timeline:

- From 2025 to 2027, the UC Berkeley CE 105 students manage the technical aspects of the website, upload data, update data, and expand on the website's features.

- From 2028 and beyond, Valley Improvement Projects (VIP) and/or SJVair assume full administrative ownership of the platform, with CE 105 providing ongoing technical support as needed.

The goal is for the website to act as an example for DPR to improve their SprayDays portal through the addition of features like timely notifications and more accurate locations for pesticide applications. The website will become a tool to provide evidence for the establishment of stricter regulations, like the legal expansion of buffer zones. These restrictions, as well as increased public awareness of pesticide exposure and associated health risks, will then encourage farmers to switch their farming practices to safer alternatives such as organic farming.

By the end of 2026, all publicly available PUR and NOI data will be easily accessible through our website. Documentation of SprayDays notifications proximate to schools within Stanislaus County will also commence via our website.

By 2027, a more unified way of documenting locational data and time of usage of the pesticide will be in effect. For Notices of Intent (NOIs), this is particularly important for the establishment of more precise buffer zones and for providing timely notifications to schools regarding pesticide applications, allowing them sufficient time to prepare. Additionally, with proof from our website that collecting previous SprayDays notifications is possible, SprayDays will have a feature that allows users to easily view historical data on spray notifications, within any range they desire. Our website will also have improved as it will show the number of farms within a mile radius of each school in Stanislaus County, which will also be easily viewable through our website, and continue to update PUR and NOI data by the hands of future CE 105 students.

By 2028, with a lot more information about the restricted pesticide locations and usage times, as well as the continuous commitment of community groups like VIP, more community members in communities like Stanislaus County will be aware of the need for a more timely pesticide notification system. With increased awareness, more parents and schools will sign up for SprayDays notifications, and DPR will be more committed to making the website more user-friendly. This increased awareness will also lead to stricter regulations, such as an increase in the school buffer zone to 5 miles and added regulations for buffer zones around residential areas, food markets, and other areas. Alongside this expansion in buffer zones, the website we created will expand from focusing on Stanislaus County to becoming a regional dashboard available for other counties to adopt, with DPR eventually absorbing the technical standards we piloted.

By 2030, growers will also be required to schedule non-restricted pesticide applications around school and daycare facility hours. This is already required for restricted pesticides in California, so it will be a familiar process for farmers. With these restrictions, they will no longer be allowed to spray Monday-Friday 6 am-6 pm, regardless of pesticide application type, assumed drift intensity, or status as restricted materials. Advance notification to schools will facilitate the continuous updating of an accessible portal detailing planned pesticide use. This portal should be filterable by restricted and non-restricted pesticides and should incorporate data beyond Stanislaus County.

By 2035, there will be almost a decade of data to prove the risks of pesticide exposure. Thus, advocacy will phase out the most harmful restricted pesticides like Telone, which have strong associations with health issues like cancer and asthma. The CE 105 students will partner with agriculture industry members to showcase success stories of farms that have adopted non-toxic pesticides or biological pest control, creating a roadmap that makes pesticide reduction a viable, profitable choice for farmers.

7. Strategies to Share Beyond California

Despite the issues mentioned earlier in this paper about nontimely notifications and a need for stricter regulations, the program is still an incredible step towards a future where pesticide exposure is not as much of a threat to long-term human health. As the first notification system for pesticide use in the country, Spraydays is not only a pilot program for California, but for the nation. Furthermore, as the first state to mandate Pesticide Use Reports (PUR), the state has effectively digitalized the intersection of agricultural production and public health through what is referred to as CalPIP (it currently has 1970-2023 data). By diligently addressing the issues at hand, the program has the potential to inspire other states facing similar pesticide levels of exposure, like Iowa or Illinois, which, following California, have some of the highest levels of pesticide usage in the country (*Six Opportunities for States to Reduce Unjust Pesticide Exposure and Boost Pollinator Health | National Caucus of Environmental Legislators*, 2024).

Our proposed implementation plan provides a scalable roadmap for these states to improve the accessibility of information on pesticide applications. By adopting California's reporting frameworks, with a few future adjustments, states like Iowa can begin gathering data and making it public. This will help their citizens take preventive measures to protect their health against pesticide applications. As detailed in the Design Plan, our proposed website improves upon the current SprayDays site by collecting available NOI data and mapping out PUR data, replacing the existing Excel-based format. With future improvements, our website can become an open-source model for public health infrastructure by providing accurate, actionable data on pesticide exposure.

Thus, we propose that this model be improved upon and adapted to not just SprayDays, but to a nationwide pesticide transparency program that involves the following:

1. Mandatory Digital Reporting: Create legislation that requires the states to adopt a standardized, electronic reporting system similar to California's PUR and an improved NOI system.
2. Community Centered Notifications: Scaling our prototype website to a nationwide level where schools, daycares, and residents can subscribe to automated alerts based on geographic proximity to high drift application and past concentrations of the most harmful pesticide applications.
3. Evidence-Based Buffer Zones: Using the data collected from these more up-to-date mandatory reports and community-based notification systems, buffer zones around schools can be created based on real effects to human health rather than administrative convenience.

Ultimately, this project proves that transparency is possible and a scalable, low-cost policy lever. By expanding these regulations beyond California, we are not just advocating for better data collection and accessibility; we are advocating for the right of every parent, student, and farmworker to know what they are breathing in. Health equity should not be defined by a state line, and the true cost of our agricultural industry should no longer be hidden from the public whose life and health journey can directly be impacted by pesticides without them even being aware of it.

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