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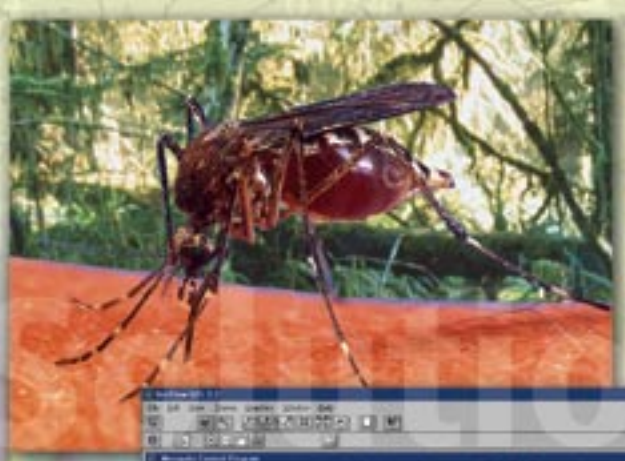
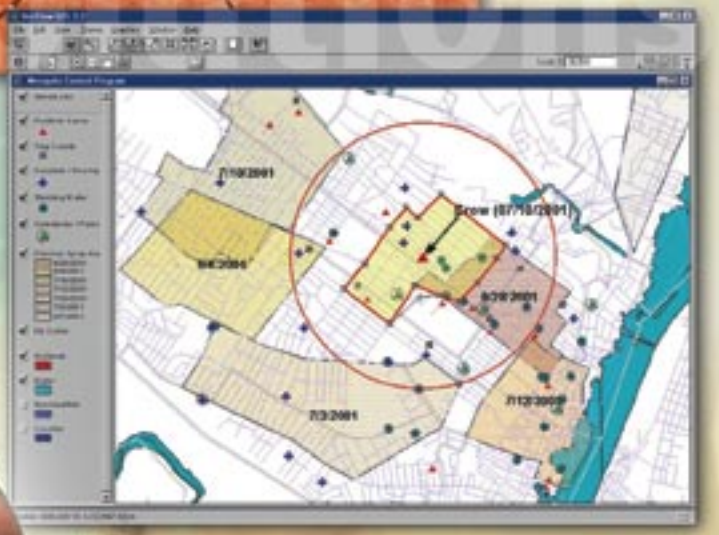
Health Solutions Profile

West Nile Virus Surveillance Control and Reporting





ESRI

Tracking Diseases With GIS

By Eric R. Conrad
Deputy Secretary
Office of Field Operations
Department of Environmental Protection

Editor's Note: In March 2000, the Pennsylvania Department of Health and the Department of Environmental Protection, in cooperation with other state agencies and local governments, finalized plans to monitor the state for potential mosquito and animal carriers of the West Nile (WN) virus. This virus causes an infection of the brain. In 1999 an outbreak of this disease killed seven people in New York City. A comprehensive, statewide plan to detect and respond to a virus outbreak that relies on geographic information system (GIS) technology has been developed by Pennsylvania and is described in this article.

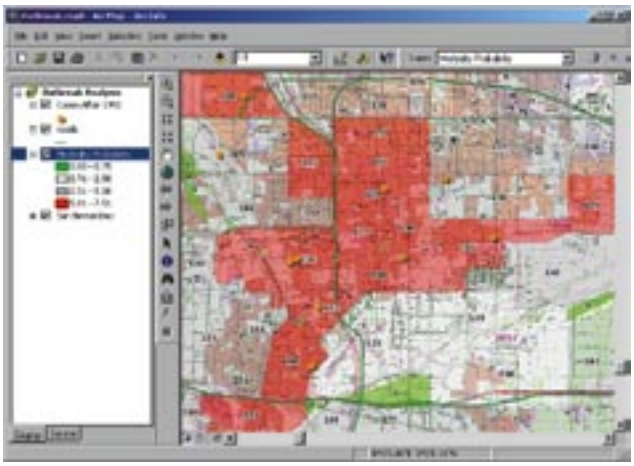
Recent reports by the Centers for Disease Control (CDC) and the General Accounting Office highlight the need for better federal, state, and local disease reporting. These reports indicate that physicians are unsure when or where to report suspicious cases, are unaware of the need to collect and forward clinical specimens, and may not be educated regarding the criteria used to launch a public health investigation. CDC also reported in 1999 that surveillance for important emerging infectious diseases is not comprehensive in all states. This leaves gaps in the nation's surveillance network and, unfortunately, this situation exists worldwide.

Experts consider rapid and reliable communication between national and international public health agencies essential to an effective response to the threat of infectious disease. Communication of disease conditions between public and animal health communities—including those dealing with domestic animals, wildlife, and other animals such as zoo animals—is very weak and hinders tracking of emerging infectious diseases. The 1999 outbreak of WN virus in New York City highlights the validity of these concerns. Poor communication resulted in the public perceiving government response as chaotic and disjointed. This perception led to criticism that the government was uncaring or incapable of protecting people from the disease or the chemicals used to control the outbreak. In fact, given the resources available, government did a superb job. The real failure was in communicating the problem and how government was handling it.

This instance points out the need for better collection of field data, integration of data for decision making, and improved methods for communicating findings and decisions to other agencies and the public. Current systems either do not allow or do not facilitate rapid communication. Information on disease outbreaks is not directly shared between countries, federal agencies, states, or laboratories, whether on the local, state, or regional level, and the private sector has no vehicle for sharing information with human health or veterinary professionals.

Responding to Disease Outbreaks

Although these concerns have been identified, no organization on a national level has stepped to the forefront with a comprehensive response that provides for an integrated reporting structure, enables timely data collection and assessment,



Managing information in an outbreak is critical. This map illustrates how a health department might determine the neighborhoods that should receive priority vaccinations. Locations of reported cases are depicted against neighborhoods that have a high probability of morbidity.

and promotes rapid communication with key organizations and the public. However, the state of Pennsylvania has developed and implemented a system that addresses these issues.

The WN Virus Tracking System is a spatially driven surveillance program for following and responding to the spread of WN virus in the state. The system collects information on the presence of virus in any vector, identifies mosquito breeding areas, and helps target control efforts. Key innovations include field collection of data using handheld computers and ArcPad® software and a Web application that enables data submittal from state laboratories. The system uses ESRI® software to display data for decision makers and the public.

An important feature of the WN Virus Tracking System is the ID number, a unique preprinted, bar coded number that is placed on each sample bottle. This ID number is used when entering data into the handheld computer in the field so that all the information about a sample can be kept together in the database. After the field data is uploaded, a quality assurance/quality control program verifies the accuracy of the data. Only verified data can be added to the central database.

When samples arrive at the laboratory, staff members electronically scan the ID number from the sample bottle into a Web form designed for the project. Mosquito species are identified, the number of mosquitoes are counted, and this data is added to the database. If the sample is sent to another lab for further testing, the transfer is noted in the database, and final results from any other testing are entered in the database by lab workers using Web forms. Consequently, results are available almost instantly.

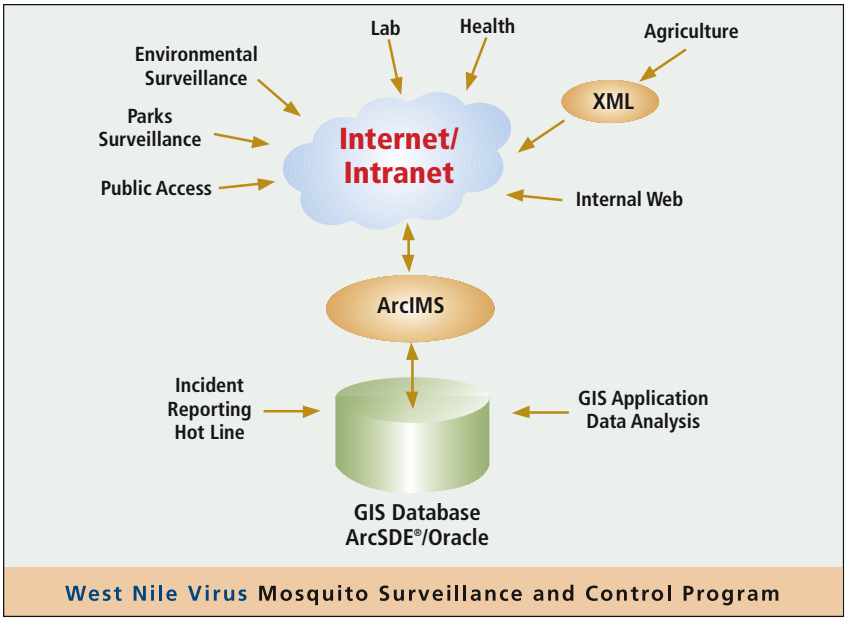
An internal Web server automatically checks the external database and retrieves any new data. E-mails alert decision makers of any new data. Data approved for public release, such as the summary statistics by county, is published on the Pennsylvania West Nile Surveillance Program Web site (www.westnile.state.pa.us). Detailed maps for executive decision making are generated and posted on a secure Web site for review.

Expanding Pennsylvania's System

This system could easily be converted for use in tracking all infectious diseases. The field data collection, laboratory analysis, and data presentation procedures used for WN virus are similar to those used for a myriad of human, animal, and plant diseases that are tracked by many government agencies around the world and across the United States. Currently, there are more than 50 human diseases that are reported to CDC. Equine encephalitis, scrapie, avian influenza, Mediterranean fruit fly infestations, plum pox, and tomato yellow leaf curl virus are just a few of the many reported diseases afflicting plants and animals.

The system integrates computer hardware and software with field and laboratory data in a way that has not been done before on a large scale. It proves that handheld computers using ESRI software can play a significant role in helping governments respond to disease outbreaks by allowing decision makers to determine if response strategies are having the desired effect. It has been estimated that this system reduces throughput process time by 40 to 50 percent.

A system similar to the one used in Pennsylvania shows significant promise for national, state, and local governments; the World Health Organization; the United Nations; and the private sector. An integrated tracking system, such as the one Pennsylvania developed, would enhance a nation's ability to respond to any infectious disease threat, whether natural or intentional. This system enables quick entry of field data, tracking of samples to and between multiple laboratories, conversion of tabular data into information easily understood by professional and lay people, and timely presentation of these results.



West Nile Virus Mosquito Surveillance and Control Program

Pennsylvania Combats West Nile Virus With ArcPad, Internet

By Eric R. Conrad
Deputy Secretary
Office of Field Operations
Department of Environmental Protection

The Commonwealth of Pennsylvania is working with ESRI to develop and implement a system designed to combat the spread of West Nile virus.

Pennsylvania's Department of Environmental Protection (DEP), Department of Health (DOH), and Department of Agriculture (PDA) are collaborating with each other and the ESRI Professional Services Division to build a West Nile virus surveillance system with ArcPad and ArcIMS®. The surveillance system was designed to permit the storage and collection of the various field and lab data that is generated and collected by the three agencies. The objective is to make data immediately available to the staff that collects the data, the key decision makers, and the public so the spread of the virus can be tracked and appropriate decisions can be made.

Background

West Nile virus first appeared in the United States in 1999 on Long Island in New York. Since then it has spread to other counties in Vermont, New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Maryland, Rhode Island, Virginia, North Carolina, and Pennsylvania.

West Nile virus is one of many viruses transmitted by mosquitoes. The virus is spread when infected mosquitoes bite birds and other mammals. Infected birds fly to a new area and die from the virus; dead birds infected with the virus are one of the first indicators of the virus in an area.

To combat the disease in Pennsylvania, once infected dead birds or mosquitoes are found surveillance in an area increases. The enhanced surveillance information directs control efforts.

Pennsylvania System Description

Pennsylvania realized the importance of tracking all the West Nile virus information spatially and chose to use a GIS as the central repository for the data, which includes the results of the analysis of samples taken from sentinel chickens and horses, human beings, dead birds, and mosquitoes. Since the samples must be sent to a laboratory to be analyzed, the locations where the samples were taken must be recorded in case virus control measures must be instituted. To eliminate the delay associated with interpreting and compiling handwritten notes, Pennsylvania chose to use ArcPad software loaded on handheld Compaq Aero computers to record the location and other sample information. Staff members in the field use ArcPad to specify sample locations on a map and enter the other sample information on forms designed for this purpose.

One of the most important of the various pieces of information is an ID number. A unique number is entered on each form. The bottle that contains the sample is labeled with the same number so that all the information about a sample can be kept together in the database.

An internal Web server automatically checks the external database and retrieves any new data. Data approved for public release (e.g., summary statistics by county) is published on the Internet; see www.westnile.state.pa.us.

Using ArcPad in the field

Current Status and Future Plans

As of October 2000, Phase I of the project, which focused primarily on designing and implementing the data collection software and hardware and analyzing and tracking mosquito samples, is nearing completion; the hardware and software for the system have been installed, and the ArcPad and Web user interfaces have been designed. Thirty-one mosquito pools and 29 dead birds have tested positive for the virus as of October 31, 2000.

During Phase II, the system will be refined and expanded. Specifically, ArcPad will be used to report locations and other data for blood samples taken at random from wild birds. Web-based forms with attached drop-down lists of locations will be used to record blood sample data for sentinel chickens and horses, and address geocoding software accessed from a Web interface will be used to determine the locations of infected humans and animals.

This system demonstrates the potential of handheld technology for disease monitoring and control. Eric Conrad of the Office of Field Operations at DEP, which is leading the project, says, "The handheld units enabled timely collection of field data. Web applications enable data submittal from various state and local agencies, and ESRI software provided a vehicle for displaying the data from the database for both information dissemination and management decision making. Because of the versatility of ESRI software, the data could be displayed at varying levels of detail: general for the public, moderately detailed for state and county agencies interested in what was going on, and highly detailed for management decisions."

Internet Map Showing Sample Site Locations in Pennsylvania

Mosquitoes are collected in traps. Inset: Mosquito larva.

For more information

Please visit www.westnile.state.pa.us
or contact Eric Conrad, Pennsylvania Department of Environmental Protection (e-mail: Conrad.Eric@dep.state.pa.us).

Networking Public Health

Reprinted from Good Healthcare Informatics *magazine*

photo courtesy of esri

Using mapping software from ESRI, health agencies can gather West Nile virus data on handhelds.

When there's a health crisis, public health agencies often are caught in a squeeze play: Alerts can't be circulated until the medical cases are confirmed. Disease outbreaks can't be controlled if they can't be adequately tracked—and everybody wants the information right now.

Reducing the time between the first confirmed cases to public alerts relies on an unbroken information chain and faster reporting structures. But much of the data are scattered in disparate silos across agencies or trapped on paper. Now some public health programs are using wireless data input, handheld computers, laboratory networks, and even satellite technology to achieve real-time information exchange.

Since 1999, Pennsylvania has watched the West Nile virus creep down from New York, getting closer every month. When it crossed the border last year, the commonwealth was ready.

Pennsylvania's West Nile surveillance program is a collaboration of three agencies—the Department of Environmental Protection (DEP), the Department of Health, and the Department of Agriculture. Each agency plays a different role in the information chain, but all data go into one database that's accessible online, explains Eric Conrad, Deputy Secretary at the DEP, Harrisburg, Pa.

Since the virus' life cycle involves birds and female mosquitoes, the environmental and agricultural agencies must tag-team: Agriculture monitors birds and animals while the DEP maps potential mosquito breeding sites and collects insect samples from across the commonwealth. Using Compaq handhelds juiced with a global positioning system and ArcPad information mapping software from ESRI, Redlands, Calif., DEP staffers bar code each sample on site and record location and habitat data.

The insect samples are passed to the Department of Health, which tests them for the virus. Lab results are added to the database under each bar coded record and rendered into real-time maps as specific as a street diagram. If needed, location-based health alerts are issued to providers and put on the public Web site.

Armed with highly specific data, the agencies can decide if intervention is needed and how to best educate the public in high-risk areas. "As you take any [health] crisis apart, there are two levels of communication," Conrad says. "One is for the public so they know what's going on, and the other is to facilitate communication between agencies so that we don't have any missteps and we can keep moving forward."

Strong financing for the system came early. The governor's 2001 budget allotted $9.8 million for the West Nile program, most of which went to the DEP for field surveillance. Other states have expressed interest in the system, and Conrad is in discussions with the Centers for Disease Control and Prevention (CDC), Atlanta, on how to arrange database fields so Pennsylvania's data can go straight into the CDC's West Nile surveillance database.

Conrad is already working on how the same system could be used to track hoof-and-mouth disease. "With the data layers and structure we have in place, with a little tweaking, the system can be rolled over and used to track other diseases that have the potential to move and cause significant harm to people," he says.

Networked surveillance efforts also are being used to monitor diseases spread through food, such as Escherichia coli and Salmonella infections. The CDC estimates an annual U.S. occurrence of 76 million cases of foodborne illnesses, and tracking them is tricky and time-sensitive. The hunt usually starts with people who are already sick. Public health agencies must confirm the cases, chase down the cause, and circulate the information before others become ill. One batch of contaminated food might be delivered across the country in a matter of days, adding to the impetus for multistate monitoring.

To solidify the information chain between states, the CDC's Emerging Infections Program developed the FoodNet network. Liaisons in each of the nine participating states keep regular contact with agencies and the clinical labs where the infectious cases are confirmed, collecting information on specific foodborne illnesses and adding it to a single database, explains Thomas Van Gilder, M.D., M.P.H., the CDC's deputy for FoodNet.

The challenge is the multistate scope. Infrastructure is still a big problem, and until recently, investing in IT wasn't a priority at the state and local levels, Van Gilder notes. "In many states, the counties are really the ones who collect the information. If the counties have nothing but a paper-based system, then it's going to be difficult to get a good statewide public health information system, let alone have that state participate at the national level."

Tracking human illnesses also brings up the privacy issue. Even the CDC has to meld its efforts with myriad state laws on public health data collection. "One of the last areas that will be difficult to overcome is the whole issue of confidentiality," Van Gilder says. "So much of this information is difficult to keep anonymous and simultaneously track it in a rapid fashion."

Despite the obstacles, Conrad would like to see a national infectious disease database. "A [virus-carrying] bird that is found in Camden, N.J., is of critical importance to the folks in Philadelphia. But right now, there's no good interstate or intergovernmental communication."

—Pamela Tabar

News Editor

Healthcare Informatics

West Nile Virus and York Region's Response

Since 2001, the Regional Municipality of York (York Region) has been participating in a province-wide West Nile virus (WNv) Surveillance Program in conjunction with other public health units and governments. York Region Geomatics has taken a lead role in developing a GIS response to capture, monitor, analyze, and map information on the spread of the virus. The approach has enabled York Region's Health Services Department to make quick, informed decisions and plans of action.

WNv is a mosquito-borne virus, which was first isolated in the West Nile province of Uganda in 1937. Epidemics subsequently occurred in Israel in the 1950s, Europe in 1962, 1966, and 1999, and the United States in 1999 to present.

WNv is a viral disease that primarily affects birds and can be spread to humans by mosquitoes, which carry the virus after biting an infected bird. Most people infected with WNv do not become ill or show any symptoms. Even when they do, symptoms may be limited to a headache, sore throat, backache or fatigue. Occasionally a skin rash may occur. In more severe infections, which occur in less than 1% of infected people, particularly the elderly and those with weakened immune systems, symptoms may include neck stiffness, muscle weakness, fever, stupor, disorientation, and coma. In rare cases, these symptoms may progress to serious illness involving inflammation of the brain and spinal cord. The time between infection and the onset of symptoms is between 3 and 15 days.

York Region is one of Ontario's regional governments. The Region covers 1,756 square kilometres from Lake Simcoe in the north to Steeles Avenue in the south. It borders Simcoe County and Peel Region in the west and Durham Region in the east. York Region's landscape includes large urban centres, farmlands, wetlands, kettle lakes, the Oak Ridges Moraine, and over 2,070 hectares of regional forest. York Region has a multicultural population of over 800,000 with a growth rate of 40,000 annually – the fastest in the Greater Toronto Area.

York Region Geomatics is responsible for geospatial information management, analysis, business solutions, and map production that anticipate and respond to the needs of the region, its partners, clients, and residents.

GIS projects include WNv Surveillance; Oak Ridges Moraine official plan mapping exercise; Emergency Operations Centre for severe acute respiratory syndrome (SARS); transportation and works applications; social services mapping; police search and rescue mapping and support; emergency management system (EMS) call response volumes mapping and analysis; and many more.

As part of the WNv Surveillance Program, York Region residents have been advised to report any dead or dying crows to the Regional Health Services Department since 2001. The information from the bird and mosquito surveillance component of the program was collected, analyzed, and mapped by the Geomatics. Traditionally, the information was entered on paper forms and in an Excel database which resulted in the need for data cleanup and manipulation in order to map the locations.

In the evolution of the WNv Surveillance Program during 2002 and in preparation for 2003, York Region Geomatics conducted extensive research and communication with other jurisdictions, particularly in the United States, to develop improved understanding of conditions, parameters, data collection, and monitoring methods. No standardized methodology or tool was found for collection or tracking, either in Health or Geomatics organizations. As a response, Geomatics developed comprehensive methodology and an application tool to meet the Region's needs. From the research, experience of previous years, and working closely with Health Services, Geomatics defined the information needs and data collection criteria to develop a Surveillance Database Management System that enables data entry, analysis, and mapping, and a Field Data Collection System to be used in conjunction with a global positioning system (GPS).

The Surveillance Database Management System enables location and tracking information of each case and related test results used by the Health Services Department for birds, mosquitoes, horses, and humans. It is a Microsoft Access database equipped with standardized forms and pull down menus to assist the health inspectors in entering information. Fields in the database include address location and X, Y coordinates, municipality, species identification, condition of specimen, mosquito sample locations, standing water feature type (i.e. catch basin or pond), larval counts, treatment type, application method, sent for testing, test results, and caller information for notification if a positive bird or mosquito pool result occurs.

As part of the Human WNv Surveillance Program, local physicians, hospitals, and long term care facilities were asked to look for signs of human WNv infection and perform blood tests if suspected. The location of humans infected with the WNv cases are entered into the database, excluding names due to privacy issues.

The Surveillance Database Management System enables data entry (location and tracking information for birds, mosquitoes, horses, and humans), analysis, and mapping.

The hand held GPS Field Data Collection System installed on Trimble GeoExplorer CE GPS units acquired for the WNv project by Health Services and their contractor for testing and treatment of mosquito larvae. ArcPad 6 was customized using ArcPad Application Builder and loaded onto each unit.

The WNv Surveillance database is stored on a central server and allows concurrent data entry across the region in the Health Services field offices. The database also enables efficient data extraction by Geomatics staff for the purpose of mapping and analysis with current data. Analysis and mapping requests from Health Services have also included WNv activity in relation to susceptible populations related to long-term care facilities, hospitals, schools, and day-care facilities.

The hand held GPS Field Data Collection System was developed by Geomatics for installation on GPS units that have been acquired for the WNv project by Health Services and their contractor for testing and treatment of mosquito larvae. The GPS units used by York Region are Trimble GeoExplorer CE devices with sub-metre accuracy. ArcPad 6 was customized using ArcPad Application Builder and loaded onto each unit. Users can upload information from the GPS units and populate the database at the end of each day, with the click of a button.

York Region Geomatics has trained all Health Services staff involved in the WNv Surveillance Program to use the Database Management System, Field Data Collection System and GPS, as well as the use of ArcMap™ for the creation of quick maps from customized templates. A map book was also created in ArcMap based on a one-kilometre surveillance grid with streets, catch basins, retention/detention ponds, wetlands, lakes, rivers, forest areas, and environmentally sensitive areas.

Data preparation for the 2003 season included the capture of over 60,000 catch basin locations in addition to retention/detention ponds, ditches, and wetlands through the use of the GPS units, digitizing from 2002 orthophotography, and data sharing from municipalities. Area calculations of natural features and standing water features have also been provided to the Health Services Department for larviciding cost estimates.

Partnerships are key in the creation of various datasets that are incorporated into this program. These partnerships include support and co-operation between various departments within York Region, and the YorkInfo Partnership, which consists of the Region, its nine area municipalities, two school boards, and two conservation authorities.

"GIS and mapping is a critical component of the WNv Surveillance Program. Mapping birds of concern, birds sent for testing, and WNv positive birds give a clear indication of WNv activity," said Kimberly Gray, GIS Analyst, Geomatics Division, Regional Municipality of York. "With the progression of the disease, trends can be analyzed by mapping positive birds, mosquito pools, and humans."

A two-kilometre buffer was created around the bird and mosquito locations to illustrate "hot spots" which are geographical areas that are targeted for larviciding catch basins. Health Services field crews' observations in June and early July 2002 indicated that almost 92% of the catch basins held standing water at one time or another and may have the potential to be productive for mosquito breeding. Ponds were only productive 30% of the time. "The tracking of sampling and treatment in catch basins with the use of GPS and GIS technologies allows for efficient management of resources," added Ms. Gray.

York Region's GIS response has proven to be an invaluable tool and has been integrated as a major component of the West Nile virus Surveillance and Treatment Program. Geomatics has taken a leadership role in developing GIS tools for the York Region WNv program, which has also become a model of GIS response for various counties and regions across Ontario. In response to the interest of numerous health units across Ontario, York Region Geomatics has shared this knowledge by licensing the WNv Surveillance Applications to assist in the collection of data, tracking, analyzing, and mapping this virulent disease.

Geomatics creates maps that anticipate and respond to the needs of the region, its partners, clients, and residents.

Moving Forward

Data collection for the 2003 WNv season is coming to an end. Analysis of trends, mapping findings, and the development of the 2004 action plan will take place in the winter months. Enhancements to the Database Management System, Field Data Collection System, and GPS will be made to accommodate the growing needs of Health Services Departments and any new developments as the disease progresses. The WNv is an unpredictable disease that is spreading rapidly and indiscriminately. It knows no political boundaries, which highlights the need for partnerships in the sharing of resources and data to combat WNv.

Regional Municipality of York – www.region.york.on.ca

City of Ottawa's West Nile Virus Action Plan

Ottawa is a large city with both rural and urban environments covering 2,778 square kilometres, with 775,000 people and over 310,000 dwellings. The population density ranges from as low as 10 persons per square kilometre in the greenbelt area to as high as 7,000 persons per square kilometre in some urban neighbourhoods. The task of safeguarding and protecting such a diverse population from various health related threats is a huge undertaking. The City of Ottawa is striving to ensure that one such threat, West Nile virus (WNv), is efficiently tracked and monitored in order to protect the citizens of Ottawa.

The City of Ottawa's People Services department has a large Public Health and Long Term Care Branch responsible for tracking and monitoring WNv in the city. In May 2003, the People Services department launched a WNv tracking project using ArcView® and Tracking Analyst. The West Nile virus is hosted in birds and can spread to humans by mosquitoes. Because crows are highly susceptible to the disease, they are good indicators of the presence of the virus in an area. Once the virus is present, the risk that mosquitoes can then transmit the virus is increased. As a result the city monitors the locations of dead crows and when a significant cluster appears, extra efforts are undertaken to control the mosquitoes.

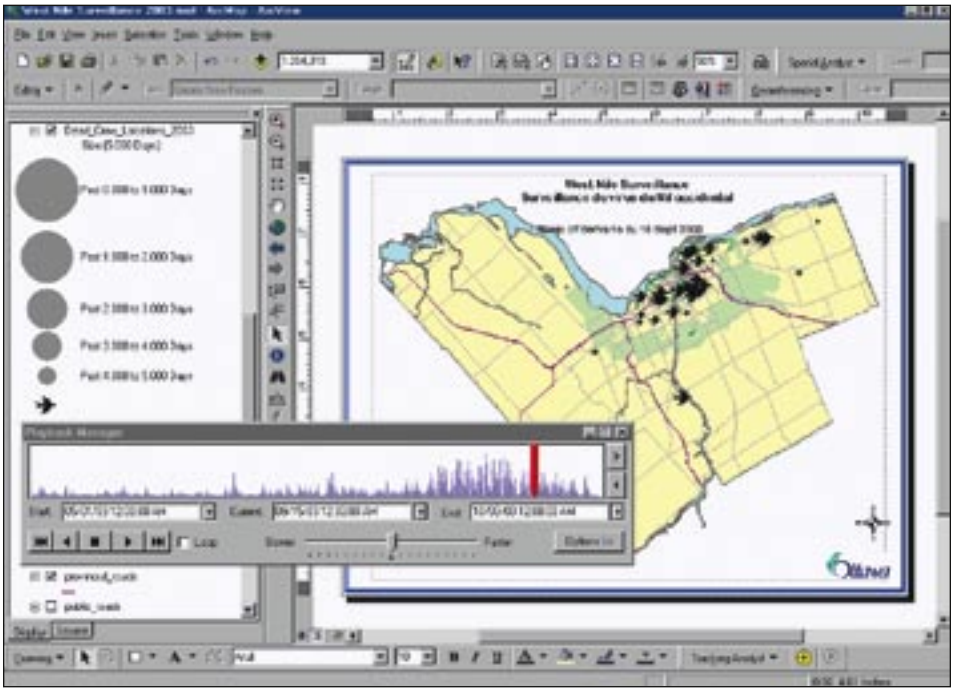
"Tracking Analyst makes it possible to explore, visualize, and analyze WNv data relative to time," said Laura Cole, Senior Planner (GIS Business Development), People Services of the City of Ottawa. "We can reveal time-related trends, allowing us to see where and when dead crows were found, monitor the spread of the virus, and take appropriate action based on our observations. We can replay history and observe how any time period is associated with the occurrence or location of various events."

The project was developed to address the need to see and monitor the locations of dead crows and mosquitoes on a map in order to determine significant clusters throughout the summer. Both ArcView and Tracking Analyst have become an integral part of the daily data entry process. Dead bird location information is entered in an Access database, the data is geocoded in ArcView, Tracking Analyst processes the data, and a map/report is developed for the Project Manager detailing areas of concern. An AVI file is created and distributed to the Project Manager and Associate Medical Officer of Health for their review and action if necessary.

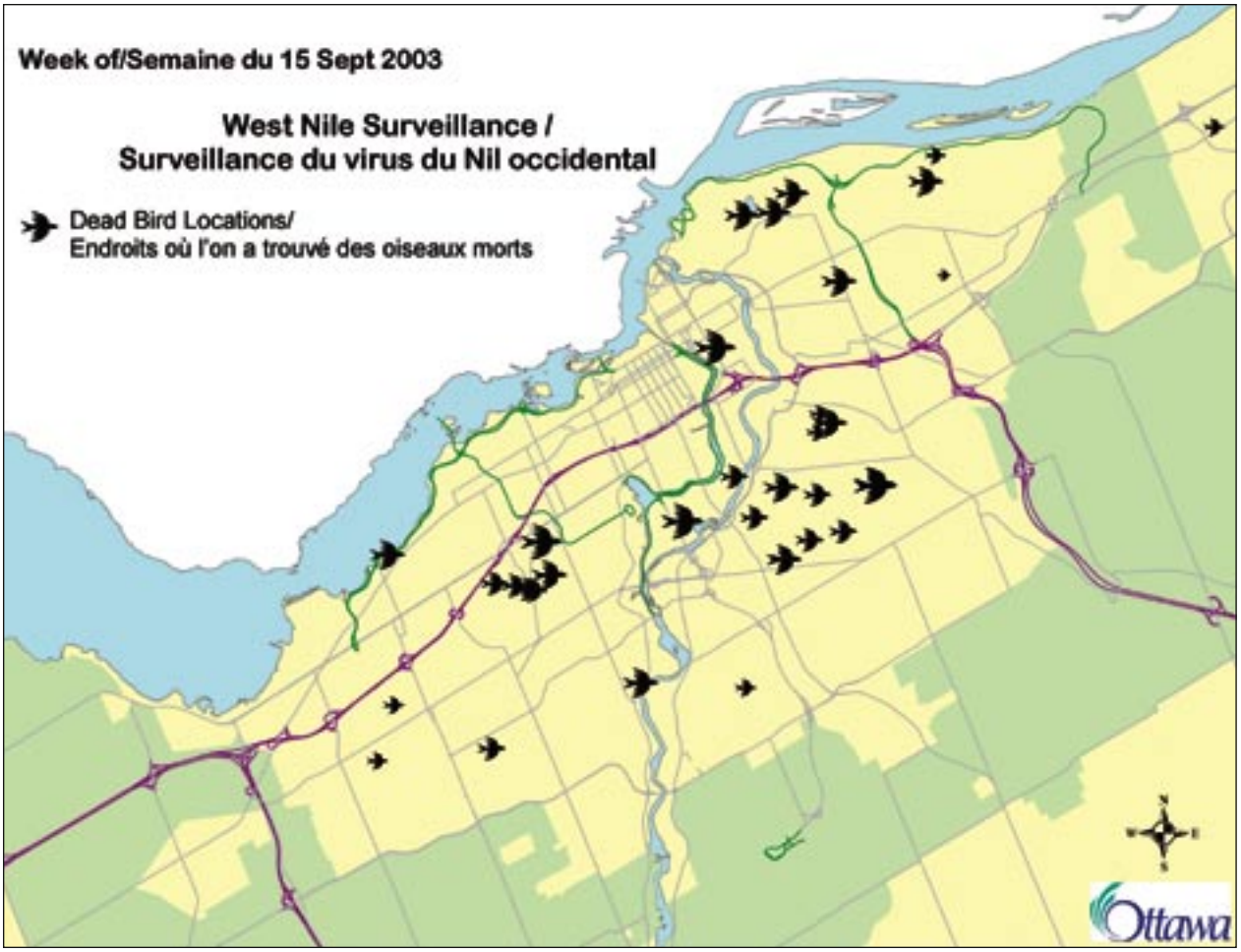
"A major benefit of the ArcView and Tracking Analyst project has been in time savings from last year's manual process," added Ms. Cole. "Last year, the People Services department manually created a map for each week and "flipped" through them as needed. This new system has significantly improved our ability to analyze the data based on the time series and the tracking playback manager. This year health experts can sit with the GIS person and view the data and ask questions, and they can also view AVI files at all times and from any location. The most important benefit is the improved ability of Health experts to manage the control of the virus and thus protect our citizens' health."

Early in May of 2003, the first infected crow was found in Ottawa, indicating that WNv was present. The city quickly launched a project to control mosquito populations. GDG Environment Consultants were hired to perform a larvicide treatment project as well as monitor mosquito populations in the city. To assist with this project, staff provided data from the city's GIS databases so that GDG could plan and then implement the larvicide program. The program involved placing larvicide in every storm water sewer twice during the summer. Staff created maps using ArcView to be displayed on the city's Internet site which advised the community when a larvicide treatment would be done in each ward throughout the city. GDG also made extensive use of the city's GIS database and aerial photography to review detailed areas where additional larvicide treatments should be placed and to find large areas of standing water, major ditches, etc.

Even though the city was actively completing the larvicide program, it was necessary to continue to track the dead crows throughout the summer to monitor the spread



The Tracking Analyst extension was used to analyze all the temporal data and create daily AVI files for review by the Health Experts.



Once an area of concern was identified, maps and AVI files were created for specific locations and specific time periods.

(increasing and/or decreasing) of the virus. Once a grouping or significant pattern of dead crows is determined, the city monitors the area closely using mosquito traps. If any of the traps are found to contain infected mosquitoes, the WNv Project Manager and the Associate Medical Officer of Health determine the appropriate action to be taken. Mr. Jamieson McLaughlin, WNv Project Manager, commented that "being able to see clustering in real time against a real background provides an excellent means of visualizing what is going on in different areas of the city. It really does let us react in real time."

Although adulticide spraying has not been needed in Ottawa, as a precautionary measure, the city has established an Environmental Sensitivity Registry. It maintains information of the whereabouts of people who may be sensitive to adulticide spraying and who would need to be notified if spraying is undertaken. ArcView and the city's address geocoding services were used to convert the Access database for the registry into maps. If needed, this data can be overlaid on a proposed spraying area map, and based on the results notifications can be produced or calls can be made.

"Overall, Tracking Analyst has been very useful in determining the scope of an area that must be monitored," concluded Ms. Cole. "The spatial tools in ArcView were used extensively as both crows and mosquitoes have a location and an area of influence (approximately 500 metres). Since WNv has several incubation/time periods which are of concern such as average 5 day infection periods for mosquitoes or crows, temporal analysis (track the position of objects through time) from Tracking Analyst was a logical tool to add to ArcView. Temporal GIS is a great tool for tracking and determining patterns."

Moving Forward

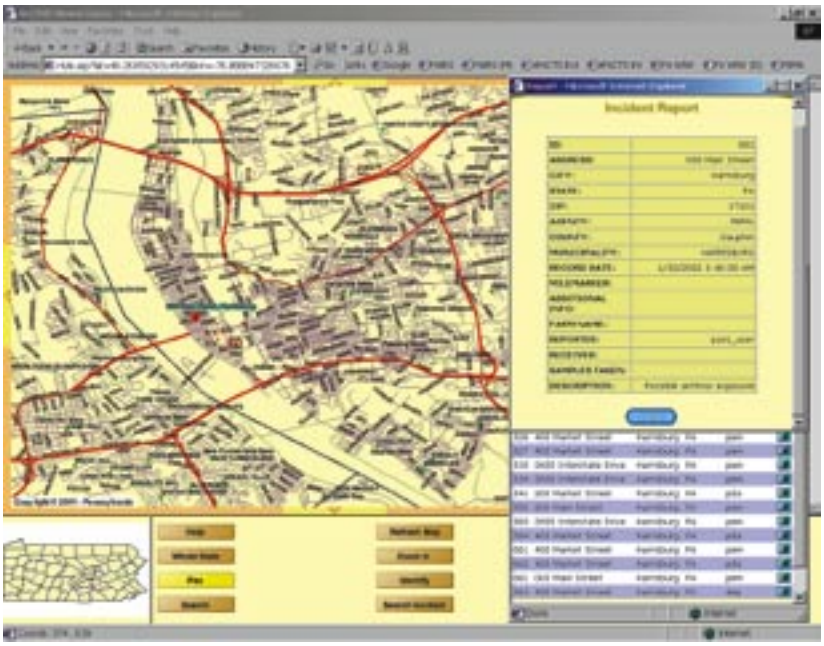
Given the success of the 2003 WNv project using GIS technology, it is anticipated that the project will be repeated next year if WNv resurfaces in the spring. As well, ArcView and Tracking Analyst have now opened the door for many other possible temporal based projects within the City of Ottawa's People Services department, particularly in the Health Branch.

City of Ottawa – www.ottawa.ca
West Nile virus – www.ottawa.ca/city_services/yourhealth/environmental/westnile_en.shtml

Using GIS to Track Terrorism

The Commonwealth of Pennsylvania's Incident Response System Grows Out of Virus Surveillance System

The Winter 2000–2001 issue of *ArcNews*™ presented an article that showed how the Commonwealth of Pennsylvania was developing and implementing a system designed to combat the spread of West Nile virus. The surveillance system was designed to permit the storage and collection of the various field and lab data and make the data immediately available to commonwealth staff, key decision makers, and the public so the spread of the virus could be tracked and appropriate decisions made. Three commonwealth departments collaborated with each other and the ESRI Professional Services Division to build the system with ArcPad and ArcIMS. This article explains how the system has evolved due to new concerns born of recent events.



Incident data can be viewed or queried in a number of ways with the PAIRS map viewer. This ArcIMS viewer is launched from the main menu or from any agency reports.

Many state and local agencies across the country lack strategies for responding to terrorism, or their activities are generally not well integrated with those of other state agencies responsible for responding to emergencies. The Commonwealth of Pennsylvania has found a solution to this problem. Over the last two years, the Pennsylvania Departments of Environmental Protection (DEP), Health (DOH), and Agriculture (PDA) have implemented the geographic information system (GIS)-based Pennsylvania West Nile Virus (WNV) Surveillance System. Given the success of this system in combating the spread of the West Nile virus in the commonwealth and the events of September 11, 2001, the WNV system model has been modified by the commonwealth for the development of the Pennsylvania Incident Response System, better known as PAIRS.

PAIRS is a data system that provides a secure Internet-based application for reporting and tracking potential terrorism events associated with anthrax exposure, smallpox, nuclear incidents, chemical attacks, foot-and-mouth disease, or contamination of water treatment systems. In addition, the system supports routine emergency events such as hazardous materials on highways, atmospheric release of toxic chemicals, toxic spills, or natural disasters. This is the first system that incorporates both health and environmental data in everyday decision making, and it is the first of many health and environment related projects on which the commonwealth is working.

Background

At the highest level, PAIRS is intended to fill a unique position within participating agencies by providing timely, spatially defined information through data acquisition (surveillance), laboratory analysis, decision making and response, and communications. It is intended to be an integral part of any overall system that the commonwealth has developed for incident response with access to the system and data being provided to any commonwealth system or agency that requires health, agricultural, and environmental data during an incident using preestablished protocols. PAIRS is the best GIS-based solution to provide a system

for terrorism actions response because it builds on the existing experience, infrastructure, and database that was successfully developed to respond to the West Nile virus by DEP, DOH, and PDA.

In PAIRS, users can facilitate password protected Internet-based data entry, issue immediate alerts to agencies involved in an emergency event, and generate maps and reports that immediately document the location and nature of the event. "If multiple agencies are involved in the response, we will be able to quickly alert other agencies or states," says Conrad, DEP's deputy secretary for field operations and Pennsylvania's PAIRS and WNV system creator. "For example, in the case of the use of weapons of mass destruction, the Pennsylvania Emergency Management Agency (PEMA) could immediately notify the Health Department, which in turn can alert hospitals of the need to treat patients due to exposure to weapons of mass destruction and simultaneously notify other response agencies as well."

The PAIRS system allows decision makers to communicate effectively with the large numbers of people responding to the same incident. In any emergency event, time is of the essence, and this system meets the commonwealth's needs by providing decision makers with tools to view and analyze data from various sources. Eventually these sources will include 9-1-1 and hospital admissions data along with environmental and veterinary data.

PAIRS Development

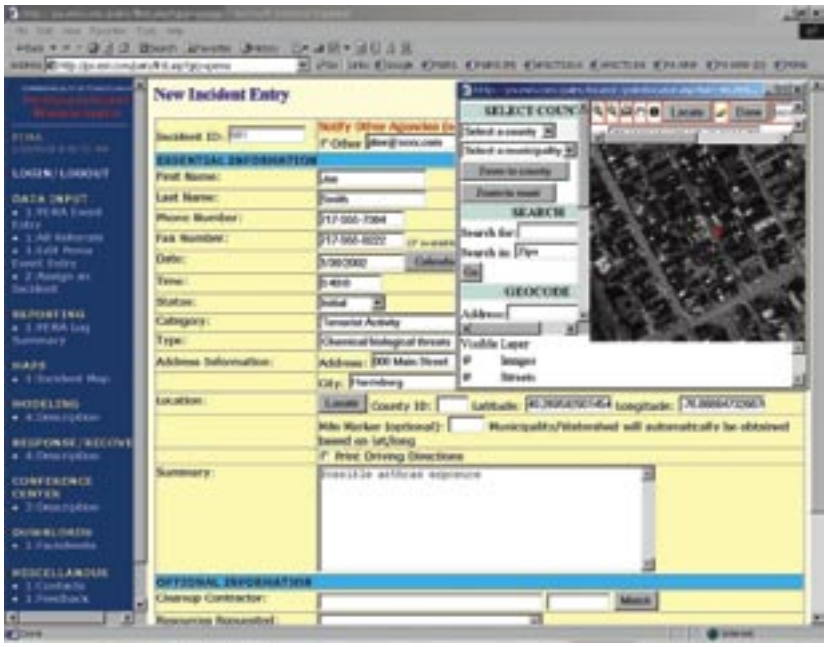
Initial development of PAIRS included the same agencies that were involved with the West Nile virus system—DEP, DOH, and PDA—but also includes PEMA. Since each agency has its own business process for tracking and responding to incidents, ESRI Professional Services initially met with the agencies with the objective of eliciting their specific requirements for the system. ESRI then developed mock-ups of Web forms representing the fields of data that each agency would require in order to capture the same information that in most cases was being captured manually on paper. Upon completion of the database design, the system was developed using an application service provider and an Oracle® database with ArcIMS to provide the mapping functionality of the system.

Current Status and Future Plans

Pennsylvania is using a phased approach in the development of PAIRS. To date, a basic PAIRS system has been built and deployed that links PEMA, PDA, DOH, and DEP to emergency response outfits. Many other state and federal agencies will be added over time. Subsequent phases will enable linking to data systems in other agencies including laboratories and existing databases, modeling with real-time data, and eventually the ability to share summary data with the public.

For more information

Please contact Craig Devine, ESRI project manager
(e-mail: cdevine@esri.com; tel.: 909-793-2853, ext. 1-2117).



PAIRS users initially enter incident and location data into a Web form and click the locate button to launch the point locator that geocodes the incident and stores its location in ArcSDE.

For more than 30 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS technology in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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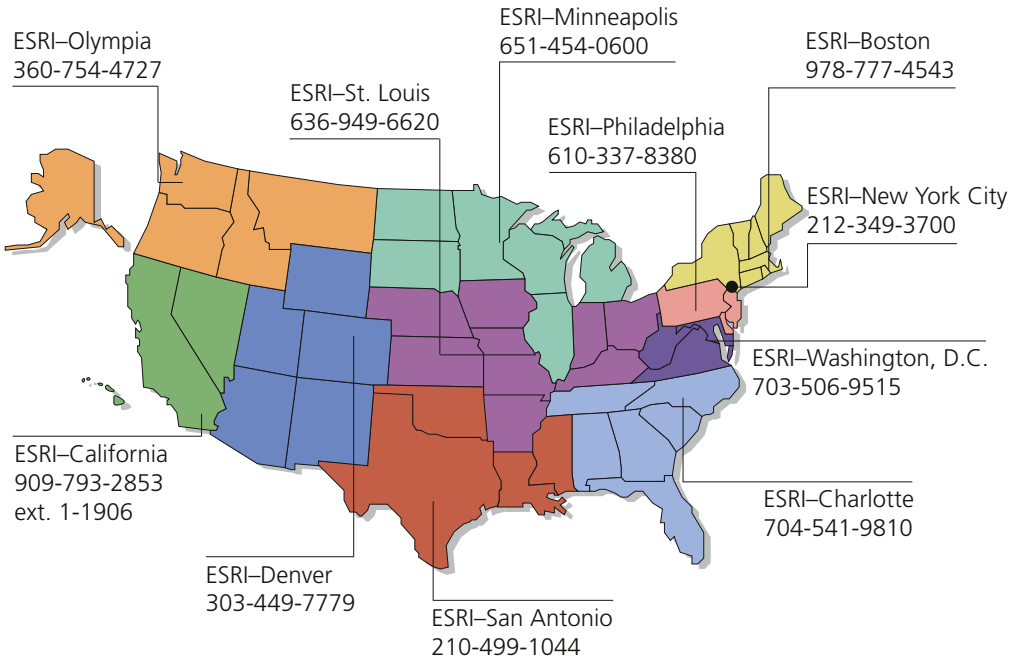

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