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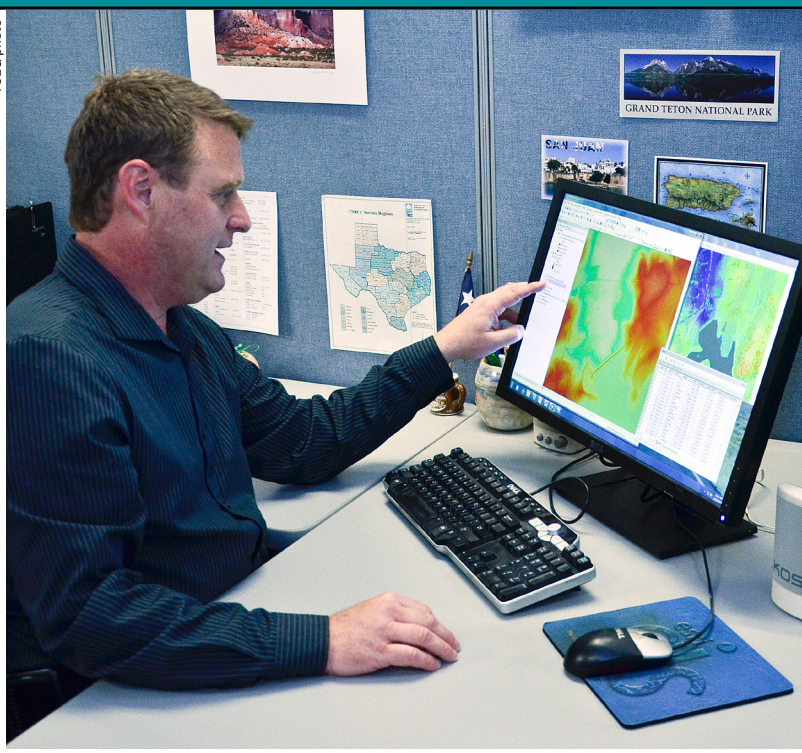
TCEQ PLOTS A COURSE WITH ENVIRONMENTAL MAPPING

Greg Smithhart admits that he could stare at a map for hours. "There is a certain beauty in the creation of a good map. A good cartographer can pack a great deal of information into a single space through the use of symbols, color, labeling, and captions." But the GIS work leader of the Texas Commission on Environmental Quality's Application Development and Support Team is quick to add that there's more to his appreciation than an admiration for cartography. "Here at the TCEQ, the use of maps or geographic information systems gives our agency an important spatial tool to help protect human health and the environment."

A geographic information system, or GIS, documents the geospatial environment on a two-dimensional canvas (either printed or electronic), providing useful information via a map interface. The agency employs this method as a means of documenting everything from the state's air-monitoring sites to wastewater outfalls.

TCEQ photo



Greg Smithhart, TCEQ GIS work leader, explaining LiDar technology.

Charting with Advanced Technology

As in the days of Abraham Ortelius, the creator of the first modern atlas, cartography remains today both an art and a science. Whether it's for the analysis of potential sources of pollution to water sources, air-dispersion modeling, the mapping of damage for emergency response, or the mapping of superfund sites, a majority of TCEQ programs use increasingly detailed GIS technology.

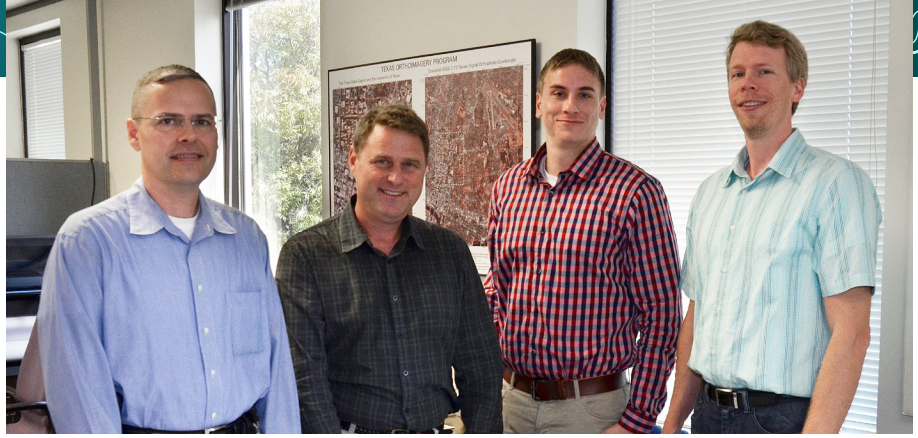
At the TCEQ, measuring distance by analyzing reflected light from a laser, or what's commonly referred to as LiDar (a mash-up of "light" and "radar"), is being used by the agency's Dam Safety Section to map the topography of a ground surface at high resolution. "This resource provides invaluable visual and geospatial analysis capabilities that have drastically improved the quality and accuracy of dam safety assessments," says Warren Samuelson, the manager of the Dam Safety Section. LiDar technology allows the agency to view downstream hazard assessments as well as dam and impoundment sizing, downstream inundation, and breaches. "GIS has also significantly enhanced the efficiency of responses to inquiries and information requests," he added.

Mapping is a valuable tool in the agency's Air Quality Division, where GIS is used to chart the expansion of oil and gas operations in the state. "The agency's mapping experts have continuously been a source of information and technical expertise," says Raj B. Nadkarni, a planner with the TCEQ's Air Modeling and Data Analysis Section. GIS is used to program and update the TCEQ's online Barnett Shale map viewer, which provides both agency staff and the public with

information on air quality sampling in the Barnett Shale. "The [digital] viewer is a great example. The GIS Team created a viewer where data from multiple teams—including toxicology, our regional offices, monitoring, and air quality—is brought together to assist and better inform the citizens of Texas."

The Water Quality Division is using the technology to map Surface Water Quality Monitoring (SWQM) stations. The Surface Water Quality Viewer tracks the water quality along selected rivers, lakes, and estuaries around the state, and includes other features upstream that could possibly contribute to elevated pollutants in the water.

GIS also continues to play an important role related to the drought. "When priority calls are made, staff must respond quickly and accurately to determine which water rights are in the priority-call area," says L'Oreal Stepney, head of the TCEQ's Office of Water. "Staff also use GIS to map public water systems that have restrictions due to drought and possibly locate alternative sources of water." The agency's Water Well Report Viewer allows the public to locate more than 800,000 water wells drilled in the state.



TCEQ photos

The TCEQ GIS team. From left to right: Paul Buschow, Greg Smithhart, Matthew Gray, and Conrad Schaefer. (not pictured: Tom Nuernberger)

"GIS provides TCEQ staff with various critical tools for the analysis of permit applications for routine discharges—which includes accurately identifying dischargers' locations and related water bodies, measuring parameters for hydraulic modeling, estimating reservoir depths, determining the location and extent of regulatory mixing zones, and locating SWQM and flow gaging stations. These tools serve to reduce permit review times and increase the accuracy of permit reviews," she added.

> ***"The GIS Team created a [digital] viewer where data from multiple teams—including toxicology, our regional offices, monitoring, and air quality—is brought together to assist and better inform the citizens of Texas."***

GIS technology assists source water assessment staffers, who use the data—including information related to elevation, hydrology, geology, potential sources of pollution, and the locations of public water wells and intakes—to assess the vulnerability of the state's public water supply sources. The model then analyzes the proximity of these potential sources of pollution to the water sources, factoring in how long the pollutant moves through soil, to produce a vulnerability assessment for each well and intake.

Maps are further used to locate point- and nonpoint-source pollution (such as, wastewater outfalls) to analyze their spatial relationships to rivers and lakes. Along with water sampling, these tools arm agency personnel with the information they need to issue and maintain permits along the state's waterways. "GIS locational data is used to help monitor the water supply, making it possible for TCEQ staffers to quickly locate permits that are

GIS developer Tom Nuernberger looks over stormwater program maps made by the agency.

on a lake or river that is low," says the GIS team's Greg Smithhart. "It is possible to then analyze the geographic relationship between water diversion points, water bodies, and river basins."

"GIS is also a very effective tool for the Remediation Division, as it allows us to quickly assess the environmental conditions in and around the locations of sites that may pose a risk to the public and environment," says Beth Seaton, director of the TCEQ's Remediation Division.

Watch a 3D landfill animation at youtube.com/user/TCEQNews

This 3D animation displays the topographic and geologic information of an authorized landfill. Monitoring wells are shown in the subsurface, as is the surface of the upper-most aquifer (in blue).

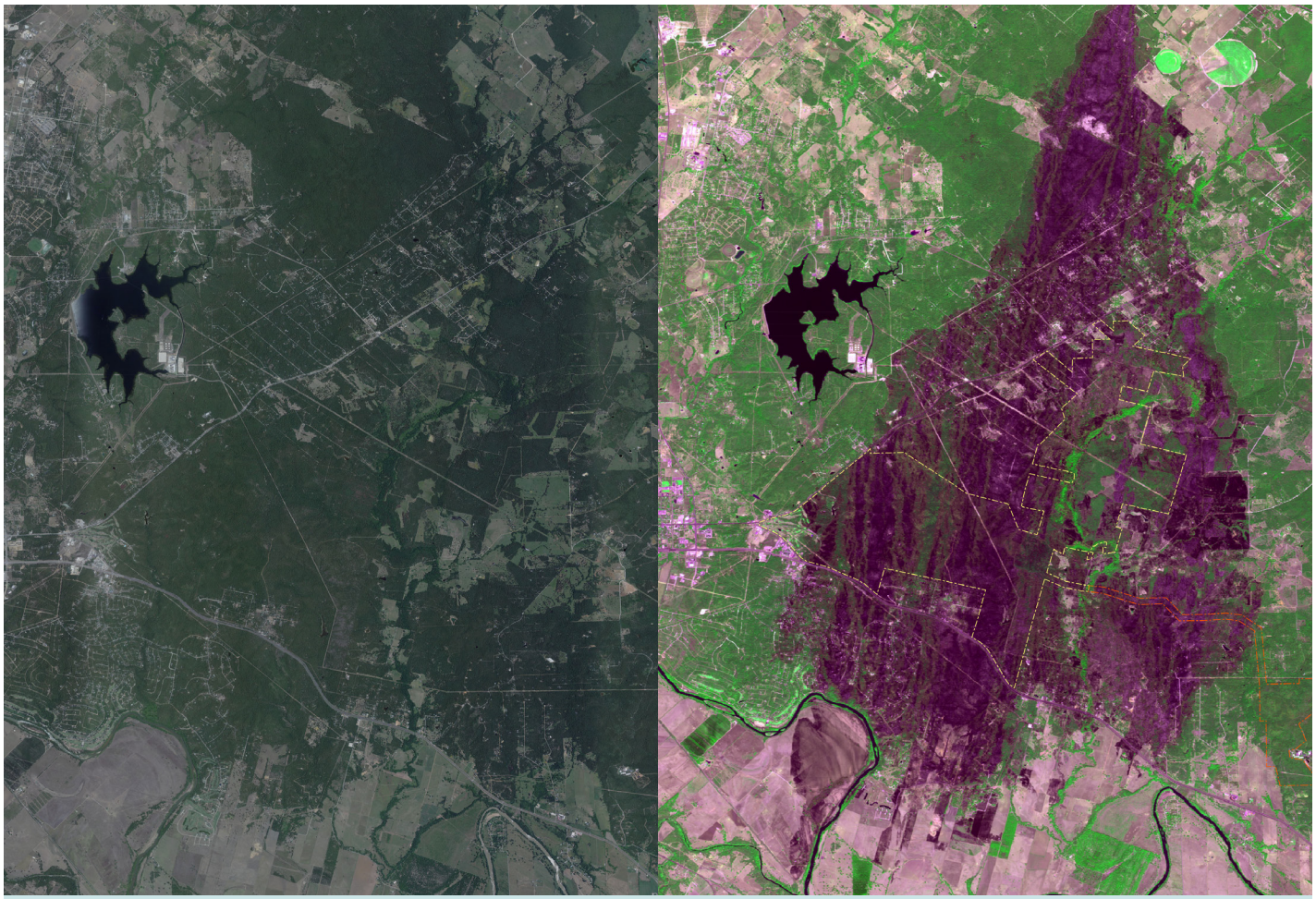
Emergency Response

On Sept. 4, 2011, sparks from a damaged electric power line ignited dry grass in Bastrop County, resulting in the most destructive wildfire in the state's history. Over the course of five weeks, some 34,356 acres were left scarred, and 1,673 homes were destroyed.

After the fires had been extinguished, TCEQ GIS staffers used SPOT 5 multispectral imagery to analyze the distribution of the burn scar **(see maps below)**. "There was concern that heavy rains could wash ash and other pollutants exposed by the fire into the rivers, causing fish kills," said Kelly Cook, director of the TCEQ's Critical Infrastructure Division. "Knowledge of this relationship assisted ground crews in determining the best location for the placement of retention structures and felled trees."

This wasn't the first time that TCEQ mapping specialists were called on to help deal with a disaster. During Hurricanes Rita, in 2005, and Hurricane Ike, in 2008, the GIS team was tasked with preparing large quantities of paper maps, and deployed to the scene for their expertise. "The maps were designed to represent potential sources of contaminants for both emergency response personnel and sediment sampling teams," Smithhart said. "Because paper maps are fixed in terms of scale and the information they can represent, it was necessary to print a large number of maps representing different areas within the hurricane impact zones."

GIS crews continued to be called on to map areas affected by floods,



TCEQ photos

2008 **2011**

SPOT 5 multispectral imagery of before and after the Bastrop fires of 2011. Note the burn scar on the right.

hurricanes, fires, the shuttle Columbia recovery, and other natural or human-caused disasters—but, thanks to technology, the printing of large maps is becoming obsolete. "Today, emergency response teams can display the same information using mobile devices. Furthermore, they can literally create their own maps, display a particular geographic area of interest, and display only the features they want," says Smithhart. "In other words, a single iPad can replace an entire three-ring binder filled with 8½ x 11 inch paper maps," says Mike Meed, a special-projects coordinator with the TCEQ's Business Automation Section.

Mapping the Future

Over the past few years, the TCEQ has been moving away from paper maps, and creating online map viewers. "One of the primary reasons for this is that data is changing on a daily basis," said Smithhart. "As soon as you have printed your large, poster-sized map for your wall, the data on the map will have become outdated. Additionally, with paper maps, you cannot zoom in to see more detail in a particular area of interest. With paper maps, you can only show as much data as can legibly be illustrated on a map of a particular scale, and, in the case of larger maps, they aren't very mobile."

By distributing the data through digital map viewers, inspectors and other field personnel can easily pull up the necessary data on laptops, tablets, or even cell phones. In addition to viewing GIS data, they can also collect information using built-in GPS technology.

"In the future, paper maps will probably be a rare sight," he added. "As the accuracy of GPS on mobile phones continues to improve, more data will be gathered by the public, a practice known as crowdsourcing. We are seeing examples of this now, with apps that allow anyone to report traffic accidents, and give the user the ability to digitize or add new roads."

Information Online

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Barnett Shale viewer
www.tceq.texas.gov/airquality/barnettshale/bshale-maps

Surface Water Quality Monitoring stations
www.tceq.texas.gov/gis/segments-viewer

Water Well Report Viewer
www.tceq.texas.gov/gis/waterwellview.html

Source Water Assessment Viewer
www.tceq.texas.gov/gis/swaview

TCEQ Geographic Data Viewers
www.tceq.texas.gov/gis/tceq-geographic-data-viewers

The TCEQ provides the public with a spatial portal allowing anyone to find data within the agency's regulatory authority. Users can find data by an address search or by zooming in on their area of interest using base map information from the cloud or on the TCEQ's Enterprise Geodatabase.

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