COMPANY
Lockwood, Andrews, and Newman Inc. (LAN)

LOCATION
Houston, Texas, USA

SOFTWARE
InfoWorks ICM

Mapping ‘Flash Flood Alley’

LAN built a digital twin hydraulic model for the city of San Marcos

Headquartered in Houston, with 11 Texas offices and 5 more out of state, Lockwood, Andrews, and Newman Inc. (LAN) is a full-service consulting firm offering planning, engineering, and program management services. They leveraged the power of InfoWorks ICM to model and protect San Marcos for years to come.

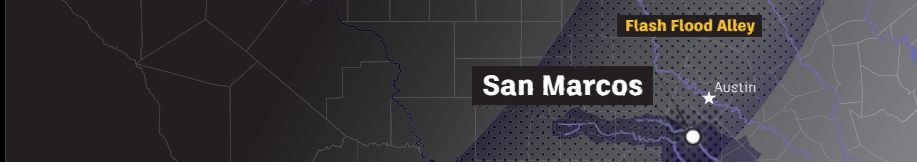
San Marcos Faces Flood Challenges

Along the busy highway corridor between the ever-expanding exurbs of Austin and San Antonio lies the City of San Marcos, Texas – or as locals like to call it, San Marvelous. This municipality is growing, too, at an even faster rate than its larger neighbors. In fact, a full decade ago San Marcos was on the list of fastest growing cities in the US. Since then, it has struggled to keep up with development.

Purgatory Creek natural area has steep terrain, shallow soil, and high rainfall rates.

What makes developing extra difficult in this area isn’t just keeping up with the extraordinary demand; it’s that this place is located smack dab in the middle of Flash Flood Alley, a legendary area along the Balcones Escarpment that is one of the most flood-prone regions on the continent. Situated by the San Marcos River, the Blanco River, and Purgatory Creek, this area has been flooding for as long as people have been living here, which has been estimated to be around 10,000 years. With this growing population, consulting firm LAN was brought in to evaluate the current stormwater network and determine its flood resiliency.

The City of San Marcos initially identified the need to address existing flooding issues within their main watershed, known as the Purgatory Creek Watershed, which covers the city center. A particularly notable flooding event occurred in April of 2017, causing structures to be submerged in up to two feet of water. These persistent flooding issues lead the city to question the exact cause and wonder what improvements to their existing system they could make.



Historic photos of San Marcos during and after April 11, 2017 flooding event. Courtesy of LAN.

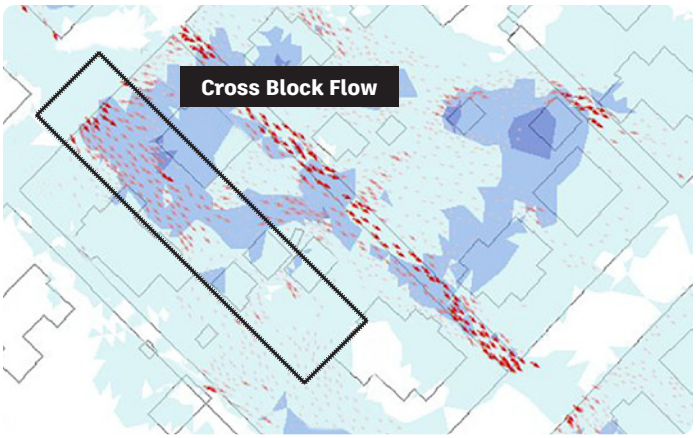
Going big on hydraulic modeling

Having already completed many flood mitigation and floodplain mapping projects in the surrounding region, including flood mitigation and storm drain improvement projects for the City of Austin and City of San Antonio, LAN brought the perfect mix of industry expertise to this project. They also embrace the latest technologies, in this case InfoWorks ICM for modeling.

To begin the evaluation of the watershed, LAN created a 1D and 2D InfoWorks ICM model of the two-square-mile watershed. Doing so allowed them to assess the existing flooding conditions in the area and calibrate the model appropriately to past flooding events. As part of the project, the city specified a 25-year design storm criteria.

In the not-too-distant past, the creation of a highly accurate catchment model for an entire city was often only undertaken by some of the largest metropolitan areas in the world – but not by smaller cities. However, as the barriers to technology have been removed, industry experts like LAN are more and more willing to leverage powerful tools regardless of the size of the model, giving cities like San Marcos, with a population just shy of 70,000, the ability to understand their storm drain networks like never before. By creating a digital twin of their catchment, the city can make smarter, more informed flood risk reduction planning and engineering decisions than other similarly sized municipalities.

LAN leveraged the rain-on-mesh method in InfoWorks ICM to simulate the runoff and conveyance characteristics based on a 25-year storm event for the given catchment. Working from an input hydrograph, they also simulated the inflow from an upstream dam into Purgatory Creek, the main waterway in the catchment. Utilizing the data the city had from the April 2017 storm event, LAN was able to calibrate the InfoWorks ICM model to accurately match the reality of the entire network.



Building an extensive model with GIS

As part of the project, LAN evaluated every single storm drainpipe in the entire catchment. This is a significant amount of data to integrate and calibrate, but it was made easier by InfoWorks ICM's integration with GIS, allowing them to import the storm drain sizing characteristics and flowlines into InfoWorks ICM via the city's GIS database.

The model wasn't only calibrated and built leveraging numerical data. LAN also leveraged photos from the April 2017 flooding event and the graphical outputs from the InfoWorks ICM model to validate that the model was delivering true-to-reality results for the watershed.

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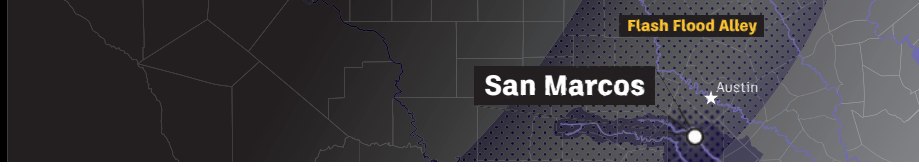
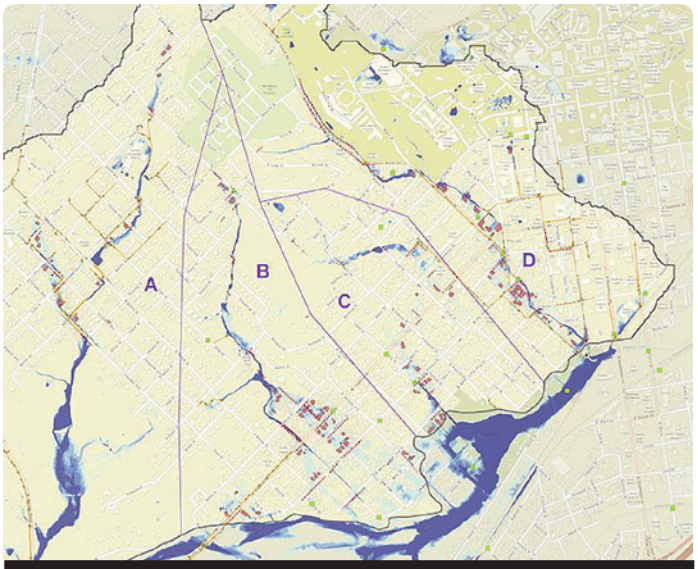


After LAN calibrated the model, they developed an inundation map for the city. By setting a minimum display depth of 0.5 feet in the InfoWorks ICM model and exporting the map, they were able to visually display for their client exactly where there were areas of concern with varying flood depths.



Inundation map for the Purgatory Creek watershed. Courtesy of LAN.

Not only was LAN able to leverage InfoWorks ICM to determine the cause of the flooding events, they were able to map out exactly where the problems areas are. For the city, this meant that as they undertook the next phase of the project – implementing improvements and making planning decisions – they had a trustworthy source of information mapping out and justifying exactly the location and significance of the investments they needed to make.

LAN was able to determine that the existing infrastructure supporting the stormwater network in the Purgatory Creek watershed was undersized to meet the city's desired 25-year storm model. As a result, flood risk was pinpointed to roughly 100 homes across the watershed that were at the highest risk of flooding during a 25-year storm. Additionally, LAN was able to identify over 40 locations where the existing stormwater controls were insufficient for handling the designed event. On the plus side, significant portions of the network performed adequately, with over 12,000 linear feet of storm sewers in the watershed being able to handle the 25-year storm event based on the InfoWorks ICM model.

An evergreen resource for San Marcos

As a result of this project, the city can now accurately understand how to allocate resources and keep its residents safe from wet weather events. Additionally, the model LAN created during this project isn't just useful for a given point in time; it's a digital resource that LAN and San Marcos can leverage to inform development and make further upgrades as the city continues to expand – which it most certainly will.

As technology continues to advance, the benefits of digital twin hydraulic models compounds, creating benefit after benefit that help water professionals manage their water infrastructure. LAN's model is now an evergreen digital twin of San Marcos' storm drain network, helping them rise above the floodwater that's increasingly putting communities around the world at risk.

Go deeper into the story

- Read Purgatory Creek: Finding Flood Mitigation Solutions for San Marcos, Texas, written by LAN and the City of San Marcos.
- Read the LAN report: City of San Marcos Purgatory Creek Watershed Phase I Drainage Study.
- The San Antonio River Authority has an excellent Web viewer, which allows everyday citizens to explore regional watersheds. View the San Marcos watershed.

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