ATKINS

Member of the SNC-Lavalin Group

City Simulator:
State-of-the Art Modeling Tool

city simulator

AT A GLANCE

Communities can:

- Simulate growth from present day to mid-century while being hit with climate change-influenced disasters
- Obtain detailed information about their vulnerability
- Stress-test their plans for becoming resilient

City Simulator was recognized by the UK Environment Agency as a finalist in their **International Excellence Award** Competition for Atkins' application of the tool in prioritizing adaptation actions in the wake of Hurricane Matthew in 2017.

Atkins developed **City Simulator**, a state-of-the-art GIS-based resilience modeling tool that allows a community to move past traditional flood inundation as the measure of risk and introduces a host of new metrics that provide sharp focus on total risk.

By simulating present-day to mid-century transportation, economic, and land development activities integrated with climate change-influenced future flooding, City Simulator estimates the true impact a community will feel through metrics such as the number of commutes that will be disrupted and the dollar damage likely to be experienced from natural disasters.

Atkins uses City Simulator to first estimate vulnerability for communities in the study area. We then assess the value of taking action by adding scenarios that introduce mitigation and adaptation measures such as buy-out programs, elevating homes and roads, and adding green infrastructure. Ultimately, we leverage the results to provide a road map to address flood risk.

City Simulator has the following features:

- **Learn flood risks and vulnerabilities:** Using City Simulator, Atkins builds a digital twin of each community based on available climate projections and census, transportation, and flood model data. The digital twin includes each river, stream, building, road, bridge, and culvert in the community. Agent-based, the tool creates a population of avatars statistically similar to the actual community population and simulates them using these assets on a daily basis to understand in detail how events like floods impact the community.
  To estimate community vulnerability, Atkins will conduct a 2020-2050 "base run" scenario simulation. By definition, this scenario does not include any new mitigation or adaptation measures. A set of key metrics focused on the triple bottom line of economy, people, and ecosystems is selected to quantify how well the community performs in a climate change-influenced future and identify the community's vulnerabilities. Example metrics include productivity and dollars lost due to flooding, the number of commutes impacted, and the effect on natural assets like wetlands. These metrics are also assessed in alternative scenarios that introduce adaptation and mitigation measures, providing a clear-eyed method for assessing the value of taking action.
- **Leveraging existing models to forecast flood response:** To reduce model development time and maximize return on investment of past modeling efforts, City Simulator uses existing flood models, such as HEC-RAS models associated with FEMA flood studies, to create a flood-response curve for each asset (building, road) in the community. These curves, which estimate the depth of flooding in a building or overtopping on a road segment given a certain rain storm has occurred, allow for building-scale daily damage assessment over the

2020-2050 run. Atkins leverages both existing models, and the new models created, to build City Simulator models in parallel with the primary modeling tasks, giving an up-to-the-minute triple bottom line assessment throughout the project timeline.

- **Measure exposure to various types of flooding over time**: The objective of City Simulator is to forecast a community's performance as it evolves into the future. To meet this objective, the tool must simulate both how a community will grow as well as how threats such as storms and sea level will change in the future. The tool simulates growth of the community by projecting growth of the economy each year and then estimating how the growth will cascade into new commercial land development, jobs, population, and housing and infrastructure. The tool then simulates impactful events like floods using forecasts of future climate change-influenced rain and temperature. The simulation of disasters includes multiple flood types, including riverine flooding (HEC-RAS models), storm surge (FEMA FIS and NOAA SLOSH models), sunny-day (tidal) flooding, and pluvial (direct rain-based) flooding (Atkins TELEMAC models). Based on building or road segment's exposure to each type of flood, the tool will evaluate the flood impact from multiple sources and estimate the total impact for each asset.
- **Stress-test multiple flood mitigation strategies:** With the community's vulnerabilities identified, City Simulator allows users to test out different flood mitigation measures and create flood adaptation scenarios. Scenarios can include a mix of measures like economic development zones, green infrastructure, elevating homes, building seawalls, raising roads, and more. City Simulator compares multiple adaptation scenarios to the base run to determine which scenario will have the greatest potential to decrease flood risk. This analysis can inform decision makers and drive forward the planning process.
- **Arrive at a clear-eyed flood adaptation assessment:** After using City Simulator, a community receives a infographics-focused report with easily digestible conclusions about the costs and benefits of the scenarios that were tested. The report gives communities the information needed to create a flood adaptation plan with combinations of flood mitigation measures that will address its vulnerabilities to different types of flooding over time.

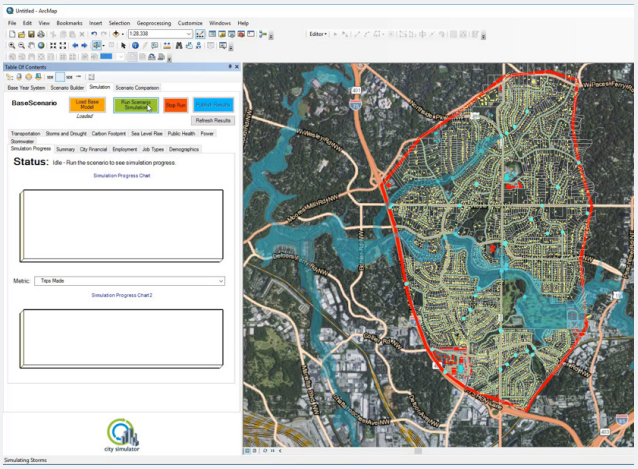
Due to its innovative way of integrating hard engineering modeling results into planning scale exercises, Atkins was invited by **Esri** to present City Simulator at the **2020 GeoDesign Summit**.

Case Study:
Boulder County Resilience Study

Atkin used City Simulator to incorporate blended fluvial and pluvial flood modeling, integrating recent HEC-RAS model results and 2-D pluvial modeling results into a single assessment of flood risk at each building in the county to develop their resiliency plan. The study showed that the highest resilience return on investment could be achieved by hardening and raising three key bridges; if all three were improved they would collectively cut flood-disrupted commutes by 39% between 2019 and 2050. Backed by this analysis, the county was successful in their application for FEMA funding for transportation system improvements.

Case Study:
Atlanta Regional Commission

Atkins is training the Atlanta Regional Commission staff to build models that simulate all their major transportation corridors from present day to mid-Century. The City Simulator models help pinpoint future hotspots and measure how adaptation actions will help to reduce future problems with disruption to city productivity.



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