

## **Hazard Identification and Modeling Software Assessment**

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### *White Paper: City of Taylor, Michigan*

This white paper builds upon a prior jurisdictional profile of the City of Taylor, Michigan, a home-rule municipality of approximately 63,000 residents situated in Wayne County within the southeastern "Downriver" region of the state. As established in that earlier report, Taylor presents a uniquely complex risk environment shaped by aging infrastructure, high-volume transit corridors, a history of significant flood events, and its proximity to one of the nation's busiest aviation hubs. The purpose of this white paper is to formally identify the hazards that Taylor faces, contextualize their relative severity, and evaluate two hazard modeling software programs that could support the city's emergency planning and preparedness efforts.

It is worth stating clearly what hazard modeling software is and why it matters. Hazard Modeling is the process of using data and computational tools to simulate the potential consequences of a disaster before it happens. Rather than waiting for a flood, a chemical spill, or a severe storm to reveal the city's vulnerabilities, these programs allow emergency managers to run "what if" scenarios, estimate damage and casualties, and identify which neighborhoods or critical facilities would bear the greatest impact. Think of it as a fire drill.. but powered by data and geography! When used effectively, these tools allow communities like Taylor to plan smarter, allocate resources more efficiently, and ultimately protect more lives.

### **Hazards Facing the City**

Based on the Michigan State Police Emergency Management and Homeland Security Division's Michigan Hazard Analysis, FEMA's National Risk Index, and the physical and demographic characteristics of the community... the following hazards represent Taylor's primary risk profile: the most persistent and well-documented threat facing Taylor is urban and riverine flooding. The Ecorse Creek, which functions as the city's primary drainage artery, is notoriously prone to overflow during periods of heavy rainfall or rapid snowmelt. The city's terrain (predominantly flat with clay-heavy soils characteristic of the Great Lakes basin) dramatically limits natural water absorption. This combination of factors produced two major flood events, in

2014 and 2021, that rendered critical road networks impassable and caused widespread property damage across residential and commercial areas. According to FEMA's National Risk Index, Wayne County ranks among Michigan's highest-risk counties for inland flooding. For a city that sits along I-94 and I-75 and depends on those corridors for commerce and emergency access, flooding is not merely a property issue, it is a public safety issue of the first order.

A second major risk category is hazardous materials transportation incidents. Taylor is bisected by two of Michigan's most heavily traveled interstates (I-94 and I-75) and is further crossed by active rail lines. These corridors carry a constant volume of commercial freight, including regulated hazardous materials shipments. Whether the incident is a tanker truck rollover on I-94 or a rail car derailment near a residential neighborhood, a hazmat release in Taylor could rapidly expose thousands of residents to toxic chemicals. This risk is compounded by the city's significant "daytime population" surge driven by the Eureka Road shopping center, which can bring thousands of non-residents into the city on any given afternoon. These visitors are unfamiliar with local evacuation routes, increasing the complexity of any emergency response.

A third hazard, one deeply embedded in Taylor's institutional identity, is the risk of aviation-related mass casualty incidents. The crash of Northwest Airlines Flight 255 on August 16, 1987 (which killed 154 people and left the wreckage on Middlebelt Road near the I-94 interchange) demonstrated that Taylor's positioning next to Detroit Metropolitan Airport places it in a permanent high-consequence zone for aviation emergencies. While not a daily operational concern, the statistical reality is that an airport handling millions of passengers per year produces a non-trivial probability of catastrophic events during departure and approach phases, both of which occur directly over or adjacent to Taylor's boundaries.

Rounding out the profile are the hazards of severe weather events (including ice storms, high winds, and significant winter weather) which the Michigan Hazard Analysis identifies as among the state's most frequent and costly natural disasters. These events strain the city's aging utility infrastructure, create dangerous road conditions on its major transit corridors, and increase the vulnerability of elderly and medically dependent residents. While individually less dramatic than a plane crash or major flood, severe weather is Taylor's most frequently recurring operational challenge.

## **Two Hazard Modeling Tools**

HAZUS-MH is a free software program developed and maintained by the Federal Emergency Management Agency. It is, in many respects, the gold standard of publicly available hazard modeling in the United States. The program uses Geographic Information System (GIS) technology to estimate potential physical damage, economic losses, displaced households, debris generation, and casualties resulting from a natural hazard event. It is built on Esri's ArcGIS Pro platform, which means its outputs are professional-grade spatial maps that can be directly incorporated into emergency operations plans, grant applications, and mitigation plans.

The program can model four hazard types: flooding (both riverine and coastal), hurricanes, earthquakes, and tsunamis. For Taylor, the flood modeling capability is the most immediately relevant. A user can input local topographic and hydrologic data, define a flood scenario by depth and extent, and HAZUS-MH will produce detailed estimates of which structures are damaged, how many residents are displaced, and what economic losses are likely to be (all visualized on a map of the jurisdiction.). The strength of HAZUS-MH lies in its depth and credibility. Because it is federally developed and maintained, its output is accepted by FEMA for use in official hazard mitigation plans and grant applications. The primary limitations of HAZUS-MH are practical rather than methodological. The software requires ArcGIS Pro, which carries a licensing cost for the underlying platform. Additionally, the most powerful analyses require a significant investment in data preparation and GIS expertise. A municipality relying solely on default data may produce results that are directionally accurate but lack the granularity needed for specific infrastructure decisions.

## **Computer-Aided Management / Arreal Locations**

CAMEO is a free software suite developed jointly by the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA), designed specifically to support chemical emergency planning and response. The suite is comprised of several integrated tools, the most relevant of which for hazard modeling purposes is ALOHA (the Areal Locations of Hazardous Atmospheres module).

ALOHA is an atmospheric dispersion model. In other terms, this means a user can input details about a chemical release (what substance was released, how much, under what weather

conditions, and from what type of source) and ALOHA will calculate and map the threat zone: the geographic area where the hazard (whether from toxicity, flammability, heat, or explosion) exceeds a defined level of concern. The output is a visual threat zone map that can be overlaid on a street-level map of the community using the companion application MARPLOT, and can also be exported to Google Earth or ArcGIS. The strength of the CAMEO/ALOHA system lies in its speed, accessibility, and operational specificity. It was designed with first responders in mind and can produce a threat zone estimate within minutes, fast enough to be operationally useful during an active incident, not just in pre-event planning. The software runs on standard Windows or Mac systems without requiring a specialized GIS platform, making it far more accessible to small or under-resourced municipal emergency management offices like Taylor.

The limitations of ALOHA are worth noting. The tool is specifically optimized for short-range, short-duration chemical accident scenarios and begins to lose reliability under certain atmospheric conditions, such as very low wind speeds or complex terrain effects. It does not account for terrain features, wind shifts, or chemical mixtures, which can limit its precision in real-world incidents. Most importantly, ALOHA is a narrowly focused tool: it does not model the full range of natural hazards (flood, wind, earthquake) the way HAZUS-MH does.

## **Recommendations**

In my assessment, HAZUS-MH is the more appropriate primary hazard modeling platform for the City of Taylor, and the reasoning is rooted in the nature of the city's dominant risk. Taylor's most persistent, costly, and operationally disruptive hazard is flooding. The 2014 and 2021 flood events did not simply damage property (they severed the road networks that emergency vehicles, supply trucks, and evacuees depend upon). For a city bisected by two major interstates and home to a large commercial hub, a flood model that can tell an emergency manager exactly which streets will be impassable, how many residents in which census tracts will be displaced, and what the total economic impact on the local commercial sector will look like is enormously valuable. HAZUS-MH delivers all of that and does so within a framework that is already accepted by FEMA for official hazard mitigation planning purposes.

This last point deserves emphasis. Taylor participates in the Downriver Mutual Aid system and relies heavily on state and federal partnerships for large-scale disaster response. HAZUS-MH outputs are the currency of that intergovernmental conversation. When Taylor seeks FEMA mitigation funding (such as through the Building Resilient Infrastructure and Communities program recently reopened for applications by the Michigan State Police Emergency Management division) a HAZUS-based risk assessment strengthens that application in ways that no other tool can match. The software speaks the language of federal emergency management, and that has tangible resource implications for a city of Taylor's size.

A final note on implementation: HAZUS-MH's value scales directly with the quality of local data that is fed into it. Taylor's emergency management office should prioritize building or acquiring a current building inventory, updated utility infrastructure data, and refined Ecorse Creek hydrology information to move from a Level 1 to a Level 2 analysis. The baseline analysis is a starting point, not the end! A community that invests in quality local data inputs will get exponentially more actionable intelligence from the platform (and that investment directly serves the city's broader obligation to its 63,000 residents).

## **Conclusion**

The City of Taylor faces a genuinely complex hazard environment: chronic flooding risk amplified by aging infrastructure and impermeable soils, a constant hazardous materials exposure from two major interstate corridors and active rail lines, a statistically non-trivial aviation risk generated by its position adjacent to a major international airport, and the recurring operational burden of Michigan's severe winter weather. This is not a jurisdiction where emergency management is theoretical... these hazards have materialized before, and they will materialize again.

HAZUS-MH, used with locally refined data inputs, provides the most robust and institutionally credible platform for long-range planning across Taylor's risk landscape. Its flood modeling capabilities directly address the city's most frequently recurring and economically damaging hazard. Its multi-hazard architecture supports a comprehensive all-hazards planning approach. And its alignment with FEMA's mitigation planning and grant frameworks positions

Taylor to compete effectively for the federal resources that will ultimately be essential to reducing the city's vulnerability over time. The recommendation is clear: HAZUS-MH should form the analytical foundation of Taylor's hazard modeling infrastructure.

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