



Case Study: Interactive 3D Flood Simulation of the City of Redlands, CA . USA

FORUM8 Partner, Michael Baker International were commissioned to produce a flood simulation and risk map of the City of Redlands in California



The City of Redlands, located in San Bernardino County, California, has been plagued by flooding in their historic downtown area for over 125 years. Four major watersheds and undersized aging infrastructure contribute to flood depths of over 1 to 1.75 meters through the downtown area. Several studies have been completed over the last few decades to identify flood

hazards and potential solutions, with varying results. As part of their new Master Plan of Drainage, the City requested a comprehensive study to identify potential improvements and their potential impacts to the existing floodplain. The results of this evaluation are being used to establish flood risk maps in addition to establishing a basis for future Drainage Impact Fees.

The Project

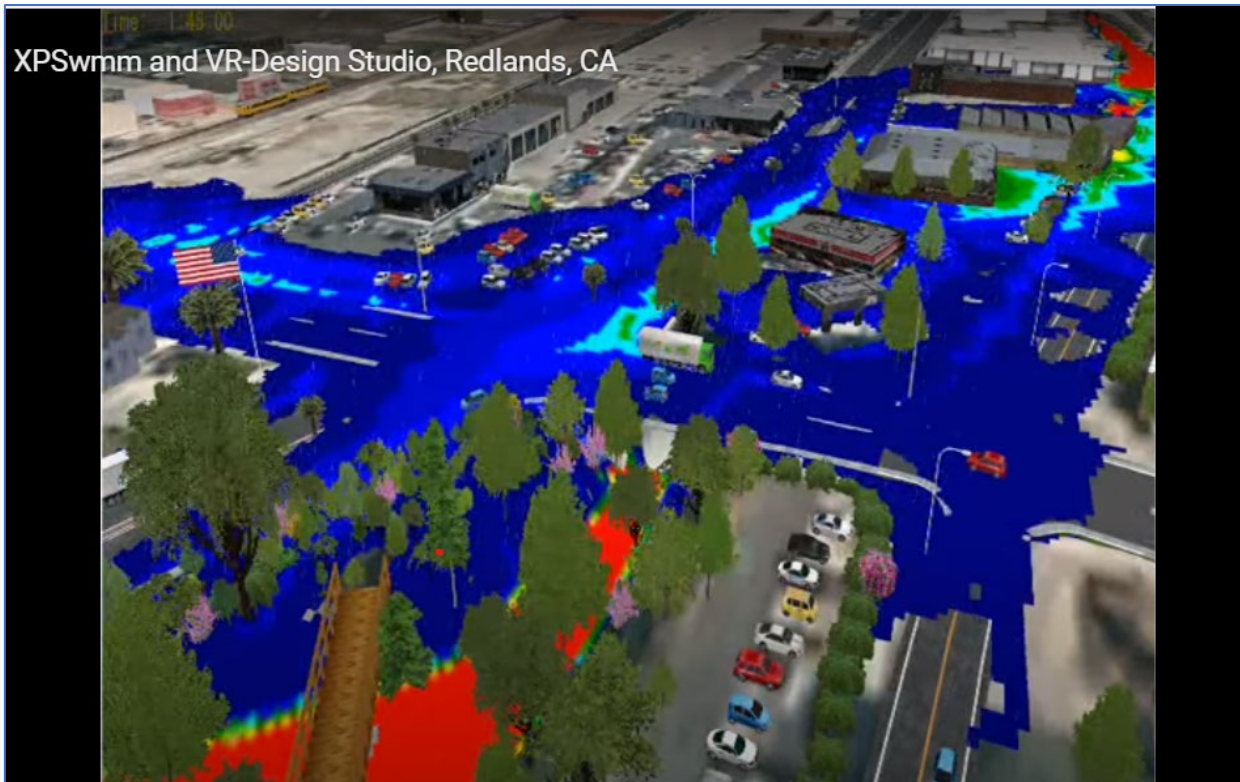
To pay for the required drainage improvements, the City determined that they would have to increase their Drainage Impact Fees. To obtain this the City needed the approval of both the City Council and the general public. The project involved modeling an area of about 800 x 6000 ft of the downtown streets of the City of Redlands which were prone to flooding due to an under-capacity channel.

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Tom Ryan of Michael Baker International commented. *“As with many non-professionals the stakeholders of the City of Redlands would not necessarily have appreciated the technical flood modeling data expressed in 2D format, whereas we were confident that if we could display the data more realistically, their appreciation of the flood hazards would improve enormously. This is why I approached FORUM8 regarding the potential to use their interactive 3D simulation software (VR-Design Studio).”*

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[View City of Redlands CA, Flood Simulation/Animation](#)

To support the consensus building through the public outreach and Council approval, VR-Design Studio was used to create a 3D-hybrid animation to graphically show the flood hazards of a 100-year storm event, and the risks associated with not improving the existing storm drain infrastructure. The video animation was based on the results of a complex coupled 1-Dimensional / 2-Dimensional (1D/2D) XPSWMM hydraulic model.

Technical Description:

A 3D animation of the calculated 2D results for such a large, urbanized area had not previously been prepared in the U.S. Michael Baker International teamed with Forum8 and XP Software to produce a first draft animation.

Model Calculations: A linked XPSWMM 1-dimensional/2-dimensional model was prepared for an urbanized area larger than 2 square kilometres. The large DTM surface was linked to the City's existing subsurface storm drain system. Building footprints, provided by ESRI, were placed on the surface and overlaid with a detailed aerial photograph. Calculations were performed for several large storm events, up to the 100-year design storm. The model was validated using historical flood photos at several locations.

Animation: The results of the XPSWMM analysis was sent to FORUM8, who provided a preliminary animation. Michael Baker International prepared subsequent animations for the project client to communicate to the general public and City Council the need for improving their storm drain systems. Several alternatives were calculated to show the most feasible solutions to eliminate flooding hazards.

Software Tools: To complete the project the Michael Baker team used a range of class-leading software tools including.

- **VR-Design Studio** – Interactive 3D Virtual Reality Simulation and modelling
- **XPSWMM** - dynamic modelling of stormwater, river systems, floodplains and foul water.
- **Civil3D** - civil infrastructure design and documentation software.
- **AutoCAD** - CAD software used by architects, engineers and construction professionals.
- **ArcScene** - a 3D visualization application for viewing GIS data in three dimensions.
- **ArcGIS** - mapping and spatial analytics software
- **SketchUp** - 3D-modeling program
- Hydrology Software, internal programs to convert data.

Project Success

Communicating technical calculations to non-technical audiences has been an issue engineers continually face. When the audience consists of stakeholders or decision makers, the issue of communication becomes much more important. What we have learned from this process, based on several projects, is the more realistic the calculated results appear, the more the audience understands what the engineer is communicating. Assuming the calculations are performed correctly, this process produces trust in the engineer's work.

In the United States, there has been a recent campaign from the State and Federal agencies to communicate to the public the existing flood hazards and the need for major flood prevention (storm and Sea Level Rise). Based on the responses we've had in presenting VR-Design Studio animations at recent conferences, this software could be a valuable asset in this process.

Partnership



Michael Baker International began in 1944 in Southern California, since then the company has grown to a full service consulting firm with project experience in 13 countries, 27 states and over 700 local agencies. over 100 offices and over 3,200 employees serving local, national and international markets.

The company prides itself as being the leading global natural and built asset design and consultancy firm, working in partnership with its clients to deliver exceptional and sustainable outcomes. They state that this objective is achieved through the application of the very best design, consultancy, engineering, project and management services.

<https://www.mbakerial.com/>

Contact: Tom Ryan tomryan@mbakerial.com



FORUM8 is the leading Japanese producer of state-of-the-art 3D Engineering software. It's premier product in the west, VR-Design Studio (aka UC-win/Road), is at the forefront of Real-time Interactive 3D VR Simulation & Modeling technology. Established in 1987, this award-winning company has offices and partners on every continent and is a member of the ITE and an associate of the TRB visualization group.

VR-Design Studio is the ideal solution for urban and transport planning and design projects, either on its own or adding value to 3rd party 3D design or 2D micro-simulation software and other data sources such as point-clouds and photo-logs. It is also used extensively for the interactive visualisation of rail, road and pedestrian-based situations and environments, as well as flood modelling, emergency and security planning / training scenarios.

Due to the high visual quality of the software and its high level of interactivity, VR-Design Studio powers many different Rail, Road & Marine Drive Simulators in use throughout the world, from desk top units to multi-million dollar hexapod systems.

www.forum8.com

Contact: Dr. Brendan Hafferty brendan@forum8.com

FORUM8 Western Regional Offices – London & Dublin – W: www.forum8.com – E: office@forum8.com

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