Hydrologic and Hydraulic Model Review

IAFSM
Illinois Association for
Floodplain and Stormwater Management

A Review and Assessment of Software for Illinois Practitioners

XPSWMM

Predominant H&H Software for Illinois Practitioners

1D/2D	Overland flow	Storm sewers	Multiple Hydrologic methods	Pond routing	Open channel

Perpetual License with Annual Support/Updates Subscription

Staff becomes aware of anticipated phase out of the XPSWMM software.

What are we going to do?

- Try many different replacements ➔ AutoDesk recommends Infoworks ICM

  $$ *expensive*

- Many consultants eventually need to utilize others' work ➔ Will we have to own and be competent in every software?

  inefficient

Formation of an Ad-Hoc Committee

Started calling peers

Gained concurrence that we should collaborate

Determined IAFSM was the right venue

Matt Moffitt, PE, CFM

IAFSM Hydrologic & Hydraulic Modeling Ad-Hoc Committee Chair

Associate Vice President – Water Resources at Baxter & Woodman, Inc.

- Leads the B&W Water Resources team in IL
- Coordinates B&W H&H modeling nationally

Hydrologic & Hydraulic Ad-Hoc Committee

Committee Chair	Matt Moffitt *Baxter & Woodman*	
Committee Members	Vincent Bergl *RJN*	Chris Gutkowski *Clark Dietz*
	Christopher Hanstad *Illinois State Water Survey*	Jennifer Kampa *2iM Group LLC*
	Derrick Martin *V3 Companies*	Marty Michalisko *Engineering Resource Associates*
	Darren Olson *Christopher B. Burke Engineering*	Tatiana Papakos *Michael Baker International*
	Henry Schmitz *CMT*	Ralph Stark *HR Green*
	Krashan Singhal *WSP*	Jeff Wickenkamp *Hey and Associates*

Disclaimer

The statements herein are the professional opinions of the members of the Hydrologic & Hydraulic Modeling Ad-Hoc Committee.

No one involved with the development of this assessment has any formal association with the software companies included in this review, other than they may have purchased a license and used the software before.

This publication presents the research and professional opinions of the authors and is not regulatory or a requirement for any practitioner. Each agency and/or practitioner will need to perform their own assessment.

History

1990s

- XP Solutions developed a customized version of SWMM that included an upgraded interface and customized features.

- Illinois water resources engineers found XPSWWM to be an affordable and effective tool that provided value through its enhanced

Although several other software developers have also prepared customized versions of SWMM, XPSWMM continues to be the only aftermarket SWMM-based program that is included in FEMA's list of numerical models meeting the minimum requirement of the National Flood Insurance Program.

History

2017

- Innovyze and XP Solutions merged. XP Solutions products, including XPSWMM, were presented under the Innovyze name.

- While this resulted in some changes to pricing and packages, in general, the operation and use of XPSWMM did not change

Innovyze®
AN AUTODESK. COMPANY

History

2021/2022

- In 2021, Autodesk acquired Innovyze. In 2022, Autodesk announced they would start phasing out the InfoCare support for the legacy Innovyze perpetually licensed products to Autodesk subscriptions and direct users to start migrating towards Audodesk InfoWorks ICM software.
- Subscription-based XPSWMM licenses will be discontinued within the next several years. Perpetual licenses (software or hardware based) will continue to function without support until they become corrupt.

Autodesk intends for InfoWorks ICM to become the future home of the XPSWMM modeling community.

While InfoWorks ICM is a powerful tool, it may not be a cost-effective option for all types of projects involving urban sewer and watershed modeling in Illinois.

Approach

In anticipation of XPSWMM being discontinued, the Ad-Hoc Committee assessed software options in order to provide guidance to IAFSM members.

- Researched previously developed studies of similar nature
- Researched available software options
- Developed a multi-tiered ranking process
- Scored the software that made it to the final review stage

Research

Two similar studies performed by a consultant for a specific entity:

- “Software Evaluation and Analysis for Stormwater Infrastructure Modeling” performed by Halff Associates on behalf of the City of Houston
- “Model Platform Selection” performed by Freese and Nichols for the City of Fayetteville, NC

Software Considered

- **InfoWorks ICM; Innovyze (Autodesk)**
- **EPA SWMM; US Environmental Protection Agency**
- **HEC-RAS; US Army Corps of Engineers**
- **HEC-HMS; US Army Corps of Engineers**
- **PCSWMM; CHI**
- **ICPR; Streamline Technologies**
- **Mike+; DHI Group**
- **TuFlow; BMT**
- **Flo-2D; Flo-2D Software**
- **PondPack; Bentley Systems**
- **StormCAD; Bentley Systems**
- **HydroCAD; HydroCAD Software Solutions**
- **InfoSWMM; Innovyze (Autodesk)**
- **SRH-2D; Aquaveo**
- **OpenFlows; Bentley Systems**
- **Autodesk SSA; Autodesk**

Initial Review

The **required** categories are those deemed necessary to perform basic modeling tasks common to most projects:

Unsteady Flow Regimes	Must be able to model hydrographs as opposed to a constant flow input
Open Channel 1D	Must be able to model 1D open channel flow (rivers, streams, etc.)
Storm Drains 1D	Must be able to model 1D closed conduit flow (pipe network)

The **preferred** categories are those that add value to model setup, visualization, and analysis but are not required to complete most projects:

Rain-on-Mesh	Allows rainfall data to be applied directly to a 2D surface rather than calculating hydrographs at discrete locations
2D	Able to integrate 1D pipe and/or channel flow with a 2D surface to show the interaction between surface flooding and sub-surface drainage systems
XPSWMM Conversion	Able to import an existing XPSWMM model
FEMA Approved	On FEMA's list of nationally and locally accepted hydraulic models that meet requirements for flood hazard mapping activities
Local Knowledge	Considers how well known the software is among modelers, clients, and government entities in Illinois.
No Cost	Free to use the software

Initial Review

	Infoworks ICM	PCSWMM	ICPR	Mike+	Bently Openflow	TUFlow	FLO-2D	EPA-SWMM
Unsteady Flow Regimes	x	x	x	x	x	x	x	x
Open Channel 1D	x	x	x	x	x	x	x	x
Storm Drains 1D	x	x	x	x	x	x	x	x
Rain-on-Mesh	x		x	x	x	x	x	
2D	x	x	x	x	x	x	x	
XPSWMM Conversion	x	x						x
FEMA Approved			x				x	x
Local Knowledge	x	x						
Free								x
	4	3	3	2	2	2	3	3

Detailed Review

The Committee performed a detailed review of the six software programs selected during the initial review. The software programs were scored (1-3) based on eleven categories including:

GIS Integration	Capability of the program to edit, import, and/or export GIS-based data files to use for data pre-processing, post-processing, and/or visualization.
XPSWMM Conversion	Capability of the program to read and/or import XPSWMM based files.
Cost	Fee or cost to use and run the program. Some of the programs evaluated are proprietary and have a license fee and a maintenance/technical support fee while some others are free.
2D Capability	Program's capability to simulate hydraulic parameters such as flow, water surface elevations, and velocities in a 2-dimensional domain (X, Y, and Z directions).
Local Knowledge	Programs that are either required by municipalities or agencies in Illinois and/or are commonly used by engineering practitioners in Illinois.
GUI	All programs evaluated have a Graphical User Interface (GUI); however, some are more user-friendly and allow the user to easily visualize results, navigate program functions, and set up model simulations.
SCS Hydrology	Capability of the program to simulate runoff using the Soil Conservation Service (SCS) Curve Number method.
Results Reporting	Capability of the program to automate the reporting of results with minor manual effort.
FEMA Approval	Some of the programs have been approved by FEMA for floodplain analysis.
Learning Curve/ Tech Support	Programs that require a higher learning curve and/or do not have technical support were given a lower score.
Rain-on-Mesh	Capability of the program to apply rainfall data directly to a 2D surface rather than calculating hydrographs at discrete locations.

Detailed Review

	Weight	Infoworks ICM	PCSWMM	ICPR	TUFlow	FLO-2D	EPA-SWMM
GIS Integration	15	3	3	3	3	2	1
XPSWMM Conversion	15	3	3	1	1	2	3
Cost	15	1	2	2	2	2	3
2D Capability	10	3	2	3	3	3	1
Local Knowledge	15	2	2	1	1	1	3
GUI	5	3	2	3	2	2	1.5
SCS Hydrology	5	3	3	3	1	1	3
Results Reporting	5	3	2	2	2	2	2
FEMA Approved	5	2	2	2	2	2	3
Learning Curve/Support	5	2	3	2	2	2	3
Rain-on-Mesh	5	3	1	3	3	3	1
	300	**245**	**235**	210	195	195	**227.5**

Summary

The three software programs that scored the highest in the detailed review are **EPA-SWMM, PCSWMM**, and **InfoWorks ICM**. Each model has different strengths and weaknesses, and thus different applications in hydrologic and hydraulic modeling.

EPA-SWMM	PCSWMM	InfoWorks ICM
• Lowest cost (free) • Fewest features	• Moderate price • Medium package of features • Uses EPA-SWMM as base engine	• Most expensive • Most features • Option to use EPA-SWMM as base engine

Each of the three modeling software programs is a strong and appropriate alternate to XPSWMM. All three models are compatible with internal model setup. In addition, InfoWorks ICM and PCSWMM can export and import EPA-SWMM files.

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