Acknowledgements:

• Flood Control District of Maricopa County
  - Tom Loomis, PE
  - Pedro Melo-Rodriguez, EIT
  - Valerie Swick, CFM
  - Gabriela Bota

• FLO-2D Software/Riata Engineering
  - Jim O’Brien, PE
  - Alejandro Riano
1-D Model Results

- Cross-sections (hopefully georeferenced)
- Tables
2-D Model Results

- Tables (lots of them)
- Spatial Data (a lot of it)

What do you do with it?
How do you share it with others?
You can put it in a map!

- Display model input and output data in a web map
- Allow users to interrogate/view results interactively
- We called it the “Web Access Tool” (WAT)
What is the Web Access Tool?

Shared to: Communities, Public, Agencies, Consultants
What is the Web Access Tool?
Grid-Level Detail

Initial Abstraction (in): 0.3
Impervious (%): 0

Hydraulics:
- Grid #: 613608
- Ground Elevation (ft): 1912.43
- Manning’s n: 0.04
- Maximum Depth (ft): 0.61
- Maximum Resolved Discharge (cfs): 47.31
- Maximum Velocity (ft/s): 3.33
- Final Depth (ft): 0.04
- Maximum WSEL (ft): 1913.04

Rain:
- Depth Area Reduction Factor(%): 0.921
- Total Rain (inches): 4.517
- Rainfall (inches): 4.159
Model-Level Detail

- Input Variables
- Output Variables
- Features
  - Culverts
  - Storm Drain Inlets, Outfalls & Conduits
  - Inflow Nodes
  - Outflow Nodes
  - Wall/Levees
  - 1D Channel
  - Width Reduction Factors
  - Multiple Channels
Additional Tools

- On-the-fly hydrograph generation
- Water surface elevation profiling
- Data request processing
On-the-fly Hydrograph Generation

Hydrographs for All

Discharge: 7,922 cfs @ Time: 15.3 hrs for Cell 599092

These hydrographs represent the maximum discharge magnitude for the indicated grid(s) at each reporting time interval. It does not
These profiles represent the ground elevation and maximum water surface elevation along the profiled line, independent of time. The maximums are not necessarily concurrent and should not be assumed as such.
Data Request Processing

Submit a Data Request for the Area of Interest

Please Note: Your area of interest polygon must completely enclose the features you wish to request; if it does not, please click the "Cancel" button and redraw.

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* Denotes a required field.

After clicking "Submit", you will be sent an e-mail with a request ID number and instructions for downloading the data.

[Submit] [Cancel]
How do the tools work?

The Water Surface Elevation Profile tool and Hydrograph-By-Line tool use a similar ray-tracing algorithm.
Ray Tracing

A quick idea of the concept:
WSEL Results

Cells 0, 1, 4, 5, 6, 9, 10
Hydrograph-By-Line Results

Cells 0, 1, 3, 4, 5, 6, 8, 9, 10 (depending on direction of line, 3 and 8 might be replaced by 2 and 7)
FPXSEC vs Hydrograph-by-Line

Why they aren’t the same:
How Does it Work?

Hardware/Software Required:
- ArcGIS Desktop
- ArcGIS Server (software, but a computer is necessary too)
- Web Server (to host the page, computer could be same as above)
- For large models, extra hard disk space
Process Required Modifications to FLO2D Model

- New Output File (TIMDEP_NC4.OUT)
- New Output Variables
  - Flow Accumulation (time varying)
  - Discharge Magnitude (time varying)
  - Peak Discharge Direction (time varying)
  - Surface Flow Exchange (time varying)
- SWMM Modifications
  - SWMM node names
What is a NetCDF File?

• Typical file extension is .nc
• It’s a Binary file format very popular with atmospheric scientists (NOAA, for instance)
• NetCDF and HDF5 files are really the same format – just like a .CSV file is really a text file (SMS, TUFlow and HEC-RAS 5.0/2D use HDF5 files extensively)
• HDFView is a free viewer for NetCDF/HDF5 files.
A Look Inside
TIMDEP_NC4.NC
A Look Inside

**TI MDEP_NC4.NC...**

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**Max_WSEL (2801, 8)**

32-bit floating-point, 1692 x 1108

Number of attributes = 9

DIMENSION_LIST = 1214,789
Other NetCDF Perks

• **Compression**
  - A 20 GB text file can be quickly stored as a 5 GB NetCDF file.

• **Storing Additional Data**
  - For two of the web viewer tools, we are able to eliminate the need for more expensive ArcGIS extensions by storing data in the NetCDF file.
  - Searching non-time varying, spatial data such as water surface elevation and cell id is very efficient.

• **ArcGIS Desktop** can read the data directly and produce animations based off of it.
System Process Diagram

- **Script-Create Tabular Geodatabase Data**
- **Script-Create CSV Files (Various)**
- **Script-Create NetCDF File**
- **Spatial Data**
- **FLO-2D Data Geodatabase**
- **FLO-2D Input/Output Files**
- **TIMDEP_NC4.NC**
- **Web Viewer**

Diagram shows the processes involved in creating and managing data for FLO-2D, including the creation of tabular data, CSV files, NetCDF files, and spatial data, which are then used for viewing with a Web Viewer.