

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

# Overview of Elevation Data in HEC-RAS 1D Models Lauren Grimley

lauren.grimlely@unc.edu June 16, 2025

**Earth, Marine and Environmental Sciences** 

#### **HECRAS** models repositories

- Base Level Engineering HECRAS models are available for FEMA region 6 and 9 (Texas, Louisiana, Oklahoma, Arkansas, New Mexico, California, Nevada, Arizona) <u>https://webapps.usgs.gov/infrm/estBFE/</u>
- Harris County, Houston, TX <u>https://www.hcfcd.org/Resources/Interactive-Mapping-Tools/Model-and-Map-Management-M3-System</u>
- North Carolina HECRAS models <u>https://fris.nc.gov/map</u>
- As part of the Louisiana Watershed Initiative, they plan to have a model repository. It is unclear if this has been implemented (<u>https://watershed.la.gov/modeling-program</u>)
- Iowa try (<u>https://www.mvr.usace.army.mil/Missions/Flood-Risk-Management/Silver-Jackets/Iowa-Flood-Risk-Model-Inventory/</u>) or the Iowa Flood Center (<u>https://iowafloodcenter.uiowa.edu/people/directors</u>)



The model elevation is based off a DEM that includes channel information extracted from 1D HEC-RAS models used for floodplain mapping.

Grimley, L., A. Sebastian (2025). Topobathymetric Digital Elevation Models (DEM) for Flood Modeling in the Carolinas. DesignSafe-CI.

https://doi.org/10.17603/ds2-mzc8-s589

I will upload these river rasters to DesignSafe





#### **Presentation Outline**

- Overview of HEC-RAS geometry file (\*.g01)
- Data in cross-section and centerline shapefiles
- Recommendations



There are over 39,000 mapped streams in NC each with a separate HEC-RAS model (archived by the state) amounting to hundreds of thousands of river cross-sections.

Built on a tributary-bytributary basis using surveyed cross-sections





## HEC-RAS Geometry File (\*.g01)

- Text file that stores all the model geometry information (reach, cross-section, structures)
- A model can have more than one geometry file (e.g., before/after levee, bridge design scenarios, etc.)
- Engineering and floodplain mapping RAS models are built using the state plane projection (feet) NAVD88
- Top of geometry file
  - HEC-RAS model version
  - If viewing rectangle values are between 0 and 1, it is not georeferenced.

<pre>1 Geom.Title=Geom.01.by.CodeH2.for.Windows 2 Program.Version=4.10 3 Viewing.Rectangle=.2329334.62.,.2359830.71.,.335613.17.,.301930.15. 4 5 River.Reach=NortheastCapeFea,Reach1</pre>	📄 Nort	heast Cape Fear River_US_(adj).g01 🔗 🔀			
<pre>2 Program.Version=4.10 3 Viewing.Rectangle=.2329334.62.,.2359830.71.,.335613.17.,.301930.15. 4 5 River.Reach=NortheastCapeFea,Reach1</pre>	1	Geom.Title=Geom.01.by.CodeH2.for.Windows			
<pre>3 Viewing.Rectangle=.2329334.62.,.2359830.71.,.335613.17.,.301930.15. 4 5 River.Reach=NortheastCapeFea,Reach1</pre>	2	Program.Version=4.10			
4 5 River.Reach=NortheastCapeFea,Reach1	3	Viewing Rectangle= 2329334.62 2359830.71 335613.17 301930.15			
5 River.Reach=NortheastCapeFea,Reach1	4				
	5	River.Reach=NortheastCapeFea,Reach1			





### HEC-RAS 1D Models

- There are conventions and common practices used by model builders that are not intuitive to figure out for new users... to list a few...
  - Cross-sections are drawn left to right facing downstream
  - Cross-section numbers get smaller as they go downstream and the difference is the distance along the stream centerline.
  - Some XS are surveyed points while some are interpolated using the model builder, check description otherwise \* in the station name
  - Bank stations are assigned at the discretion of the engineer so "definition" can vary



#### **River reach data**

- River reach name and # (there can be more than one in a • model)
- # Reach XY points listed below

Geom.Title=Geom.Ol.by.CodeH2.for.Windows

Viewing Rectangle= 0., 1., 1., 0.

neast Cape Fear River\_US\_(adj).g01

Program.Version=3.10

Points are listed afterwards, I need to double check but I • think you can parse this assuming a certain number of characters, but I am not sure if this changes with different model versions

🔚 NORTHEAST CAPE FEAR RIVER.g01 🔗 🗵

Not georeferenced

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#### Cross-section (XS) Geometry Viewer/Editor in RAS

Cross Section Data - Geom 01 by CodeH2 for Windows

Exit Edit Options Plot Help



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#### XS data in the geometry file – georeferenced



#### XS data in the geometry file – not georeferenced



Can use the HYDRAID of the non georeferenced model to match the data in the geometry file to the georeferenced data in the state shapefiles

For example, HEC-RAS model folder is called "371070201203261337\_CF033Northeast Cape Fear River". We find a match for this RAS model in the stream centerline shapefile and can use it to assign the reach XY.

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Northeast Cape Northeast Cape

XS in shapefile is not associated with the HYDRAID we expected. It does intersect with it though.

Not all the data in the shapefiles is useful... these tiny rivers do not have a corresponding RAS model. Could be created by the state for forecasting system and/or oddity when exporting the RAS data?

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	37100968	1500	Northeast CapeFear Ri	1010	-9999	1	37	191	
	37100968	1500	Northeast Cape Fear R	1010	-9999	1	37	061	
	37100968	1500	Northeast Cape Fear R	1010	-9999	1	37	061	
	37100968	1500	Northeast Cape Fear R	1010	-9999	1	37	061	

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💮 Selected Features: 8 🛛 🔀 🖉 🖬

### Recommendations for extracting the HEC-RAS data

- Start with getting the elevation data from the geometry files from georeferenced models
  - Issues when reading georeferenced geometry files
    - Changes in model version might modify the format of the geometry file
    - Dealing with bridges or structures
    - Bank stations can be wrong/wonky sometimes if issue importing
  - <u>https://github.com/mikebannis/parserasgeo</u> (last updated 6 years ago)
- Then move on to non-georeferenced models
  - Must match information in geometry file to the shapefile to get the reach XY and XS GIS cutline but this requires some matching/sorting
  - <u>https://github.com/lgrimley/hecras\_geometry</u> (last updated 3 years ago)

#### \*\*\*RAS stream centerlines do not align with the NHD centerlines





#### Example of bridge/culvert/weir XS

#### T Bridge Culvert Data - Geom 01 by CodeH2 for Windows



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#### Example of bridge/culvert/weir XS

Should be able to identify these in the geometry file (XS Type) to treat differently when processing

- 555 Type RM Length L Ch R = 3, 302893.0,,,
- 556 BEGIN · DESCRIPTION:
- 557 CROOMS · BRIDGE · RD
- 558 Structure ID: NECF\_100
- 559 END · DESCRIPTION:
- 560 Node Last Edited Time=Dec/10/2004 10:39:30
- 561 Bridge · Culvert--1, 0, -1, -1, 0 •
- 562 Deck.Dist.Width.WeirC.Skew.NumUp.NumDn.MinLoCord.MaxHiCord.MaxSubmerge.Is\_Oge
- 563 10,32,2.6,0,.370,.370,.,.,0.95,.0,.1,1,,

564 ·-1773.9·-1772.7·-949.3·-944.1·-865.3·-862.2·-722.8·-703.2·-693.6·-59 ··-596.9··-595.5··-564.8··-557.1··-509.1··-506.1··-491.9··-475.8··-308.1· 565 566 --297.1 -- 292.7 -- 284.6 -- 106.7 -- 104.7 -- 93.8 -- 100.7 -- 104.4 ···104.7 567 240 241.8 343.4 387.6 389.2 409.8 434.2 438.3 ...441.5 . . 443 568 460.6 464.8 467.2 470.8 482.6 745.7 754.9 762.5 781.3 · · 80 569 ·1131.4 · 1136.3 · 1294.7 · 1480.6 · 1576.2 · 1582.1 · 2174.9 · 2176.2 · 2184.6 218 570 2192.6 2199.4 2202.5 204.5 2227.5 2227.7 2246.3 2252.5 · · · 2433 2728.1....2846...2853.9...2860.5...2863.4...2887.9...2890.9...2893.3...2893.4...29 571



