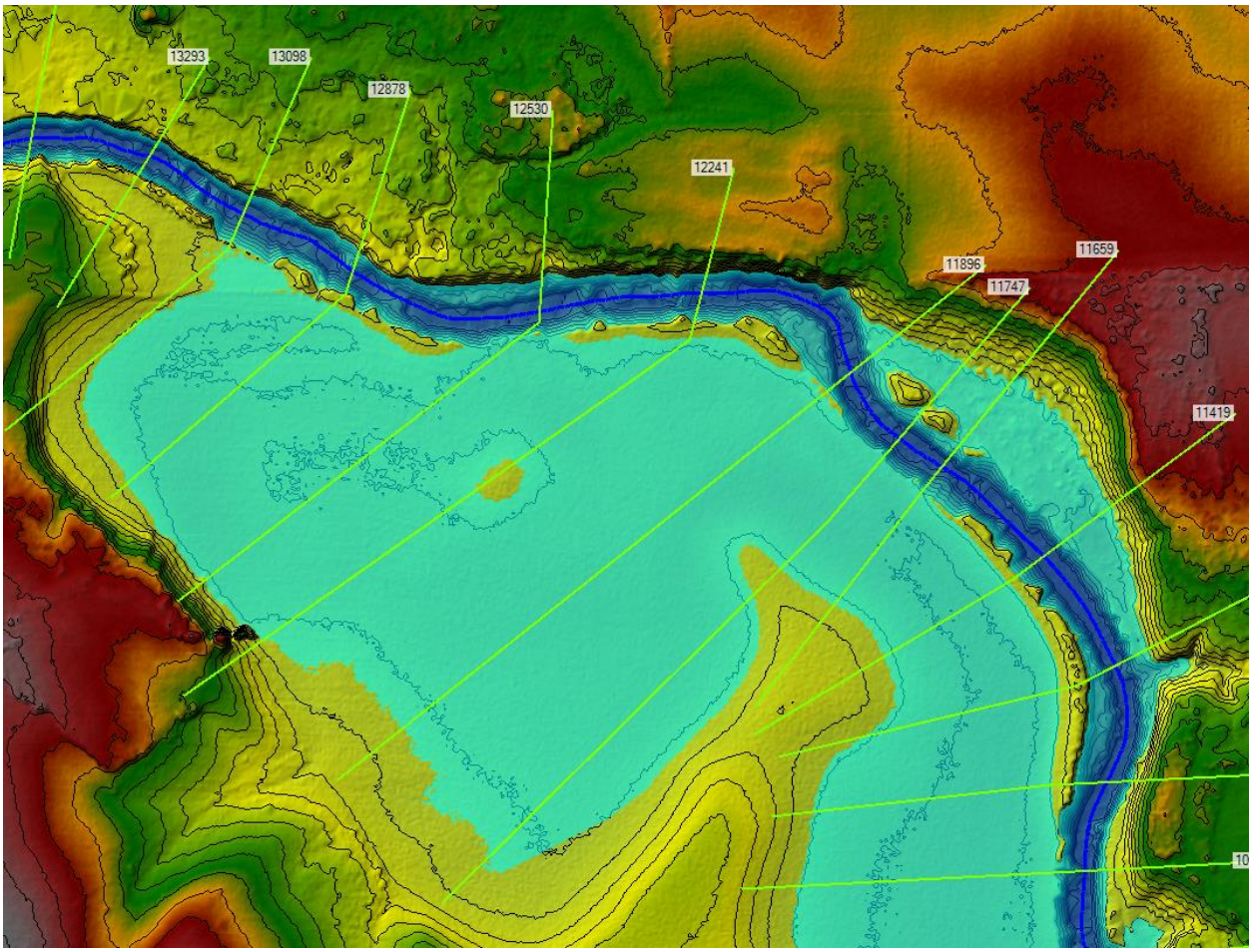
RAS Mapper Supplemental Reference Guide for LOMRs



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Objective: One Project with Duplicate Effective, Corrected Effective, Pre-Project and Post Condition HEC-RAS Plans

Your client needs a CLOMR to meet project financing requirements and she won't leave your waiting room until you get it for her. What do you do? Well, one thing you want to do is provide a coherent analysis with your CLOMR application that doesn't take us forever to figure out and get into a workable format that can eventually fit into the National Flood Hazard Layer. Aside from Endangered Species Act compliance, which we aren't talking about here, there is probably nothing you can do to speed the process more than achieving this objective. Speeding the process makes your client happy, which makes you happy and it makes us happy too. Here's the most basic starting point for coherent analysis. You should provide a single HEC-RAS project that contains a plan for each of the required model versions: Duplicate Effective; Corrected Effective and/or Pre-Project and Post-Project Condition. Each HEC-RAS plan should include all effective profiles.

Why all the versions? And who cares if I can duplicate a lost WSP-2 model? You care, because your client is still in your waiting room, waiting for her CLOMR. Here's why. Your ultimate objective is to design a problem free project. Problems cost time and money. We, Chris and I, are very good at finding problems. When it comes to LOMRs and CLOMRs problems can come from a lot of things that have nothing to do with your project. You want to avoid making those problems <u>your</u> problems. Understanding the required model versions help you do that.

For better or for worse, the effective study is what your project will be evaluated against. The Duplicate Effective model establishes a baseline of sorts. Sometimes you get lucky and you find a digital version of the Effective model that runs and produces the exact results reported in the FIS. The FEMA Engineering Library sent you the right model! The Duplicate Effective model can be created in either the original model platform or imported into a more recent version. A Duplicate Effective model developed in the original platform must match the effective model output or profile within 0.1 feet. A Duplicate Effective model developed in HEC-RAS when the Effective model was developed in HEC-2 must match within 0.5 feet.

The Corrected Effective model corrects any errors that occur in the Duplicate Effective model. Conversion to a current version of HEC-RAS may also be a part of the Corrected Effective model, if it wasn't done for the Duplicate Effective model. The Corrected Effective model may correct coefficients, add or move cross sections, adjust reach lengths and/or incorporate more topographic information than that used in the effective model. That topographic data and the Corrected Effective model must not reflect any manmade physical hydraulic changes since the date of the Effective Study. The updated topography should reflect the physical conditions of the area at the time of the effective modeling. Improved methods that weren't available at the time of the effective modeling however may be part of the Corrected Effective model. Under these conditions, however, there are no limits on profile changes resulting from valid engineering corrections.

Physical changes in the hydraulic condition of the stream may have occurred after the date of the Effective Study. Sometimes the changes are the result of natural changes, such as a channel "cut-off" at a bend. Sometimes these are the result of manmade changes that may result in a violation of the NFIP by the community. Not all man-made changes result in a violation, it depends on zone type, whether BFE increases are the result of a floodway encroachment, impact to buildings and other factors.

The Pre-Project condition model should reflect any modifications that have occurred within the floodplain or channel since the date of the effective models, including additional bridges and culverts. If no modification has occurred since the date of the Effective Study, then the Pre-Project model would be identical to the Corrected Effective model.

Ultimately your client wants their CLOMR. A CLOMR is FEMA's written opinion that a project may be constructed as designed without resulting in a violation of the NFIP for the community. It's not a permit. CLOMRs and LOMRs do reveal changes that have occurred that may be problematic. You don't want your client's project to be blamed for errors in the original analysis, or natural changes or even someone else's violation. The required model versions allow you to identify those other problems and make sure that they don't become your problems.

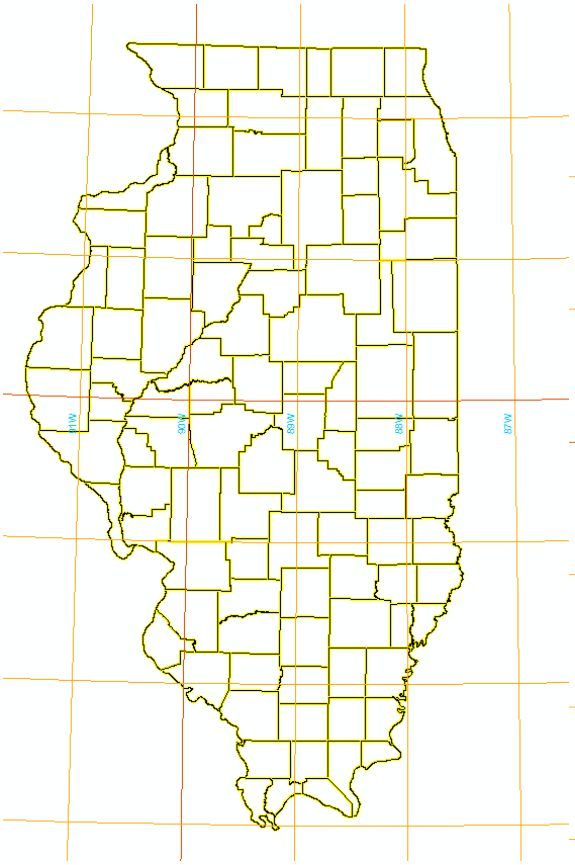
Duplicate Effective, Corrected Effective, Pre and Post Project Plans are the minimum Plans that you should include in your HEC-RAS Project. You may also need to include calibration plans, critical duration analysis plans, but please purge trial plans and previous model iterations. Please name HEC-RAS plan titles appropriately. Understanding and providing this analysis can shorten the process of getting a CLOMR or LOMR by months. We're happy, you are happy and your client is happy. That's the objective, now let's see how we can get there faster.

Spatial Projections

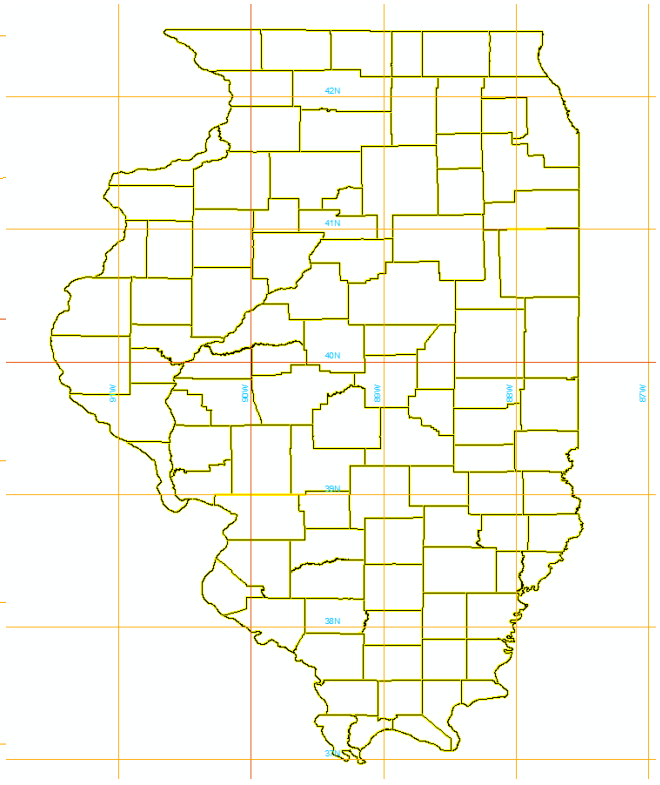
Mapping platforms such as GIS or RAS Mapper use coordinate systems to reference the location of geographic features. There are two primary types of coordinate systems; geographic coordinate systems and projected coordinate systems.

Geographic coordinate systems are spherical coordinate systems, latitude and longitude for example. Projected coordinate systems transform the earth's spherical surface into two-dimensional Cartesian coordinates.

The two images below show Illinois in two different coordinate systems. The image on the left shows Illinois in a projected coordination system, the image on the right shows Illinois in a geographic (spherical) coordinate system. Can you see the difference? Note how the latitude and longitude lines are straight, parallel and evenly spaced in the geographic coordinate system but have curvature in the projected coordinate system.



Illinois shown in projected coordinates



Illinois shown in geographic coordinates

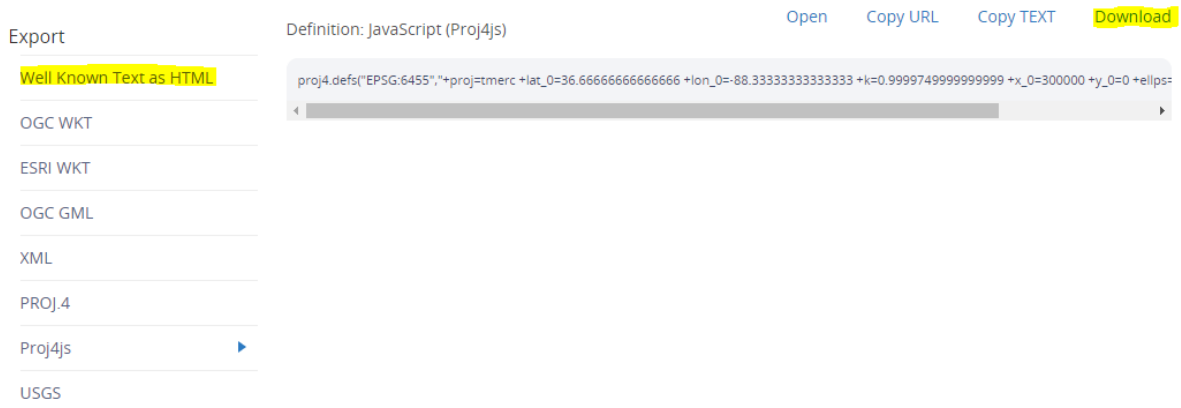
RAS Mapper uses projection coordinate systems rather than geographic coordinate systems. Projection coordinate systems can be saved or downloaded as .prj files which RAS Mapper accepts for spatial referencing. Projection files will contain information about the projection, like datum, projection method, spatial unit (which is important to ensure is in "U.S. Feet"), scale factors, etc.

In Illinois it is common to use the State Plane East and State Plane West projection coordinate systems. The image below shows which Illinois counties should use the East or West State Plane projection.

Here are links to download or save the two common Illinois State Plane projections:

State Plane East (2011): https://epsg.io/6455
State Plane West (2011): http://epsg.io/6457

You can download each projection as a .prj file by exporting the “Well Known Text as HTML”

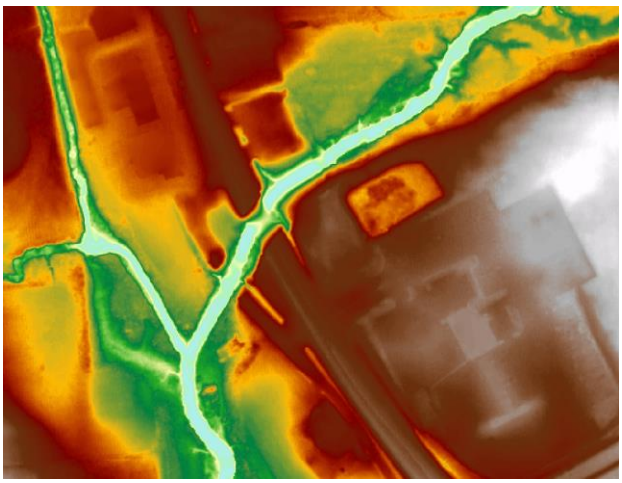


Terrain (LiDAR)

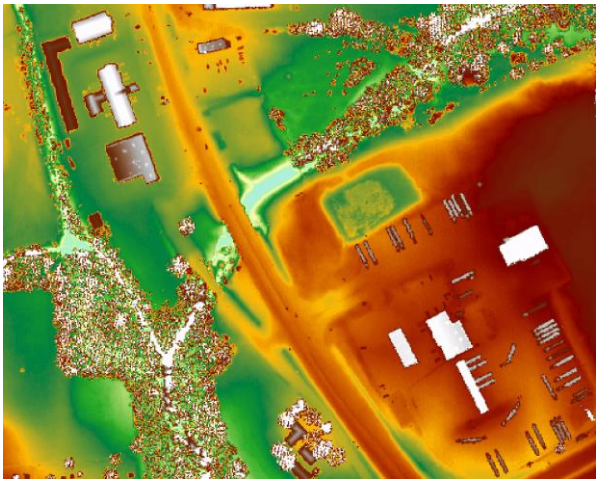
Illinois has acquired high resolution LiDAR data for every county in the state through the Illinois Height Modernization program at the Illinois State Geological Survey (ISGS). LiDAR stands for Light Detection and Ranging and is a remote sensing method to gather topography through aerial collection. Typically, LiDAR collection points are spaced about 1 meter apart.

The raw LiDAR collection points are classified as either bare earth, vegetation (trees), buildings, etc. The LiDAR data itself is not very useful for modeling or mapping purposes since it is simply a massive collection of point data. Derivative products are developed from the classified LiDAR point data. Digital Elevation Models (DEMs) are one of the most common derivative products from LiDAR data. DEMs are elevation raster images which can easily be used for modeling and mapping purposes. Most DEMs derived from LiDAR has a cell resolution of 3 to 5 feet. Each cell has a single elevation that was derived from the classified LiDAR point data.

There are several types of DEMs that display different classifications from the LiDAR points. Digital Terrain Models (DTMs) aim to model the bare earth terrain, therefore the DTM usually filters out buildings and high vegetation (trees) LiDAR points before creating the terrain model. Digital Surface Models (DSMs) usually do not filter out buildings or trees from the LiDAR points. The images below compare the DTM and the DSM for the same area. Which elevation model looks better for modeling floodplains?



Digital Terrain Model (DTM)

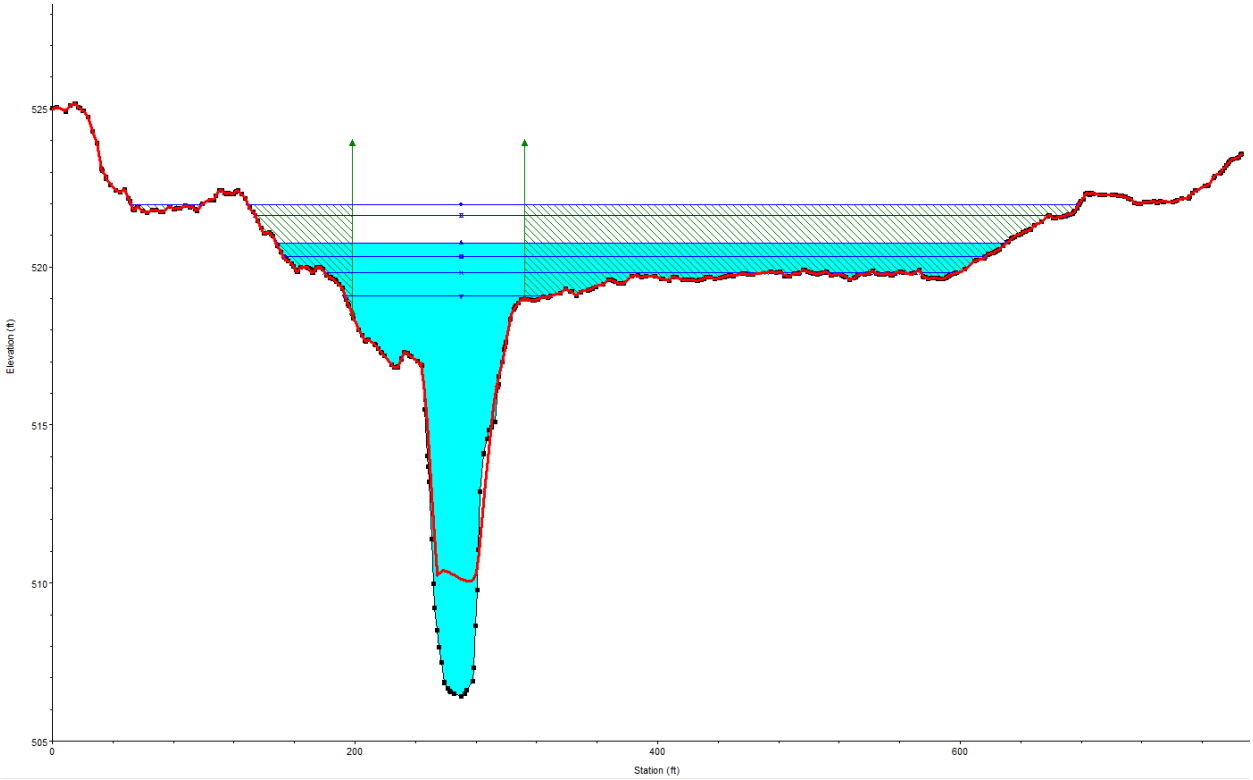


Digital Surface Model (DSM)

Notice that the DTM provides a level of hydro-correction to the terrain surface by showing rivers going through bridges compared to the DSM which shows the bridge deck elevations spanning rivers. This hydro-correction to DTMs generally occurs for larger streams and rivers, but is not applied all drainage crossing, especially at smaller scales.

One important note about LiDAR data and its derivative products is that they do not capture bathymetric data below water surfaces. So the elevations shown on lakes, ponds, and rivers is at best displaying the approximate water surface elevation at the time the LiDAR data was captured. So for most non-ephemeral streams you need to be aware that you the terrain dataset does not represent the full bathymetric channel. Channel surveys may be needed in many cases to accurate capture the full

channel geometry. The image below shows a comparison of a stream cross section obtained solely from a DTM (red line) and the cross section obtain obtained from channel survey supplemented with the DTM for overbank topography (black line).



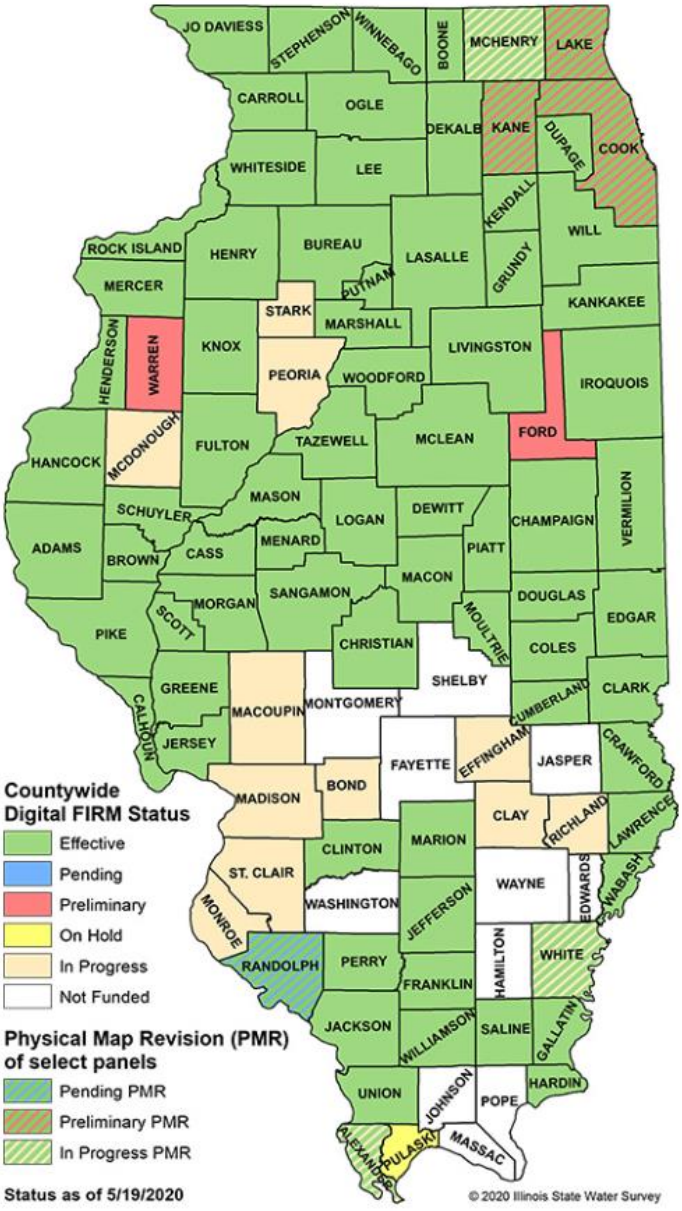
The best way to obtain LiDAR data and its derivative products in Illinois is from the ISGS Geospatial Data Clearinghouse:

https://clearinghouse.isgs.illinois.edu/data/elevation/illinois-height-modernization-ilhmp-lidar-data

You can download the derivative products (DTMs and DSMs) for entire counties. These large data set can range in size from about 5GB to nearly 100GB, so its usually a good idea to clip a portion of the data that you will need in either ArcGIS or the freeware QGIS to save file space.

National Flood Hazard Layer (Digital Floodplain Mapping Products)

The FEMA National Flood Hazard Layer (NFHL) houses the digital regulatory floodplain information. The NFHL contains spatially referenced stream water lines, cross sections, floodplain and floodway boundaries, and other data. These data are only available for counties that have been modernized from paper-based to digital floodplain maps. The image below shows the counties in Illinois that have been modernized and have digital floodplain mapping available through the NFHL.

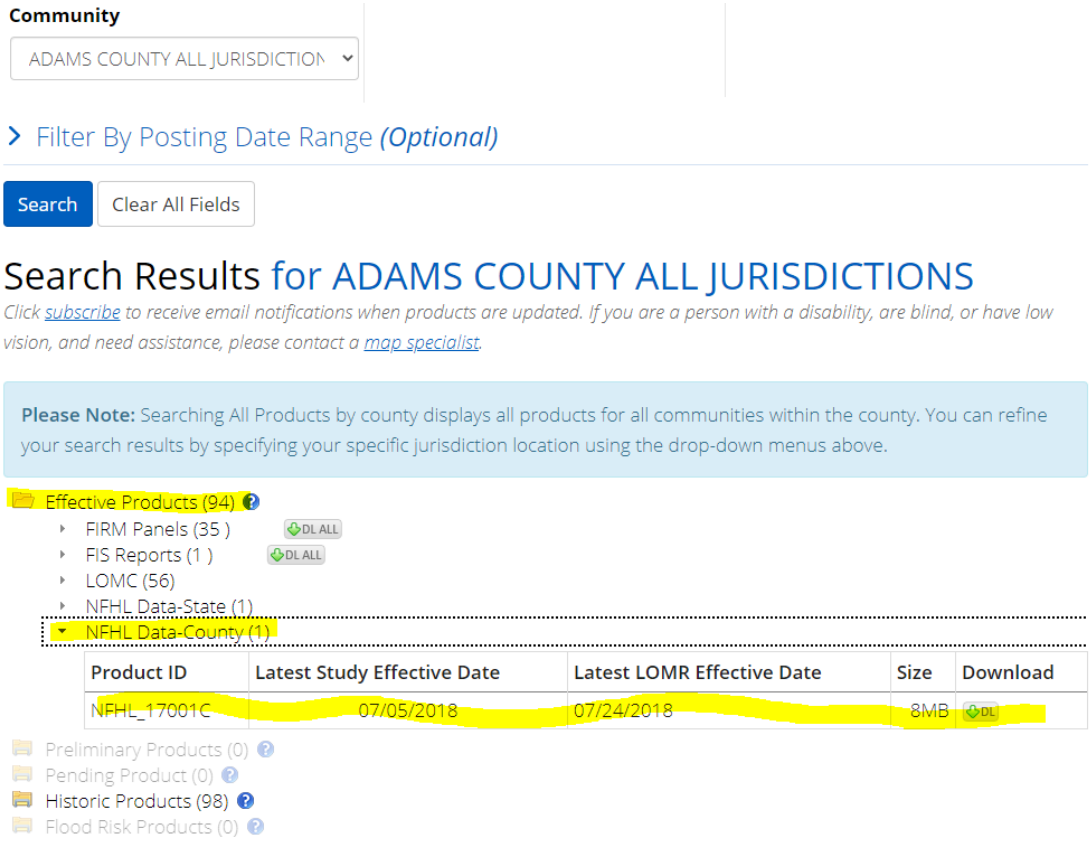


To obtain the digital flood hazard data for a modernized county you will need to visit the FEMA Map Service Center:

https://msc.fema.gov/portal/home

Once at the FEMA Map Service Center homepage, click “Search All Products”, the select your state, county, and community or all jurisdictions. Hit search.

You will see several folders, but the one to expand is the “Effective Products” folder. From there, expand the “NFHL Data-County” folder to see and download the NFHL data for the given county.



The data will download as a zipped folder and contains about a dozen shapefiles files which can be loaded into RAS mapper.

HEC-RAS Project, Plans and Profiles

When all the base data has been gathered, remember your objective. You want to provide a single HEC-RAS Project which will contain all the required Plans: Duplicate Effective (DE), Corrected Effective (CE), Pre-Project (Pre) and Post-Project (Post). Each Plan will contain all effective Profiles at a minimum. The typical detailed study includes the following Profiles: 1%, 1% Floodway, 0.2%, 2%, and 10% Annual Chance Events (100-Yr, FW, 500-Yr, 50-Yr, and 10-Yr Events). It’s important that the first Profile is the 1% and the second is the floodway, if you want the floodway to be based on the 1% profile. The order of the other profiles is not important. It is very important that the profile order is the same from plan to plan, at least when it comes to comparing plans to each other.