

Ok, I have USGS 3DEP lidar data... now what can I do with it?



Our hope through this article is to set realistic expectations for creating contours from lidar data. In almost every scenario, companies like Atlantic can make data look more like traditional photogrammetric contours by making manual corrections, but it will be timely and costly. Furthermore, it will be no more accurate; just “prettier”. In an effort to keep costs down particularly in large areas like municipalities and counties, we have developed an algorithmic function to reduce the costs and provide you contour derivatives with little investment.

A contour line is generated by connecting points on the land surface that have the same elevation, making contours a visual representation of elevation. Not all contour datasets are created in the same manner. For lidar-derived contour modeling, we recommend using a subset of the Class 2 (bare earth) points in the lidar LAS files. That subset is known as contour key points. This is an algorithmic determination of which points are necessary for identifying breaks in the terrain surface without using all Class 2 points, which would result in a very jagged and difficult to read set of contours.

After the contour key points are identified, we develop a smoothed bare earth DEM from the contour key points. The smoothed surface helps both identify natural breaks for the contours, but it also creates a product that can be easily interpreted by the human eye, which is the general purpose of contours.

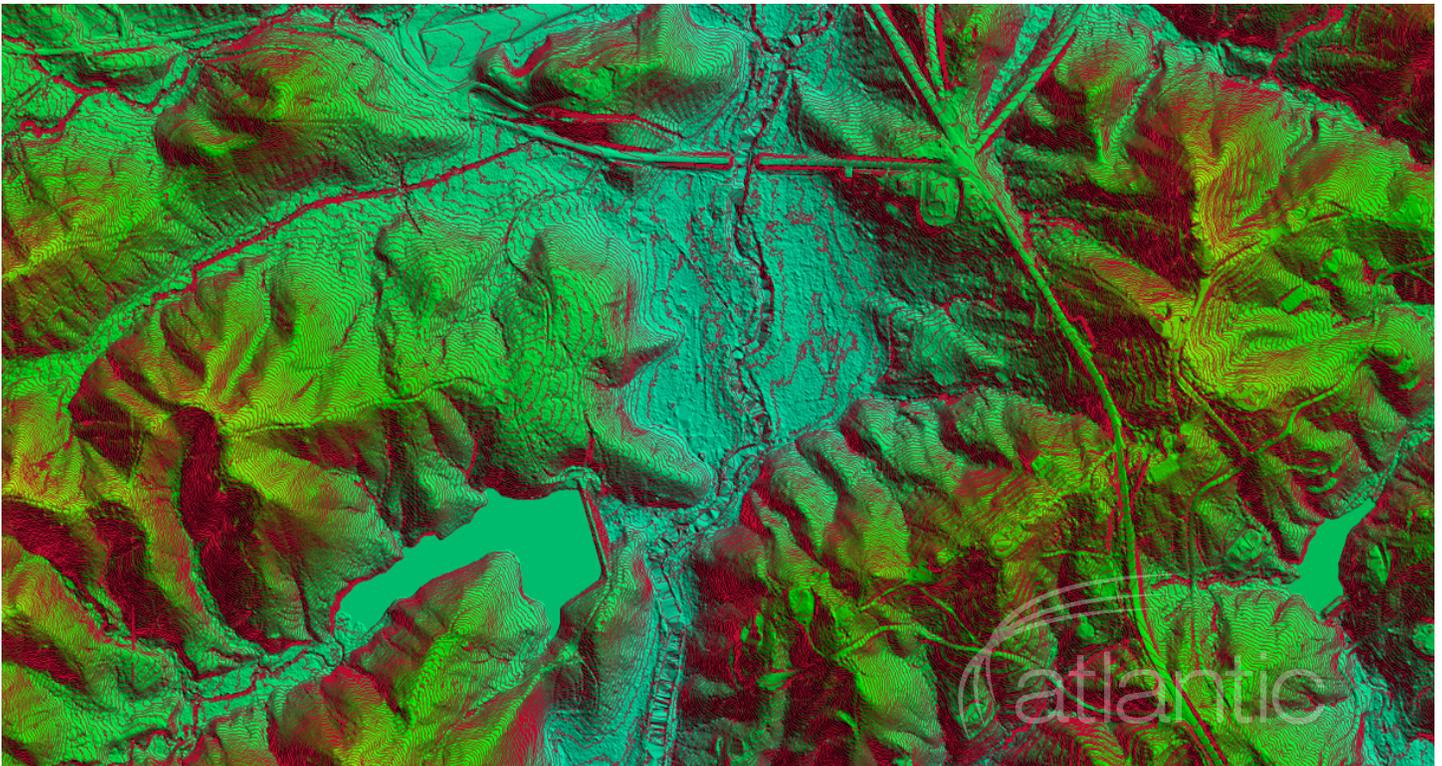
When we are developing 2' contour models, a focal statistic will be calculated using a 3 by 3 rectangular neighborhood using the mean value to smooth the surface to produce cartographic contours. The contours will be generated as polylines at 2-foot intervals with an index contour at every 10-foot interval. As this is an automation, topology is not validated but topology errors will be minimum. Small isolated contours with a perimeter less than 50 ft. in length are deleted for better readability and data size. Simplify polyline will be used to remove any unneeded vertex to reduce file size while maintaining its correct position.

Many parts of the United States are receiving new lidar data for the first time through the USGS 3DEP (3D Elevation Program). For many end users in the GIS community, their excitement shifts quickly from excitement to contemplation. Understanding the benefits and limitations of lidar is essential to getting the most value from the information. At Atlantic, we have developed several algorithmic approaches to efficiently create additional data products from new lidar at a very reasonable cost. This blog entry will cover our approach to creating building rooflines from lidar data.

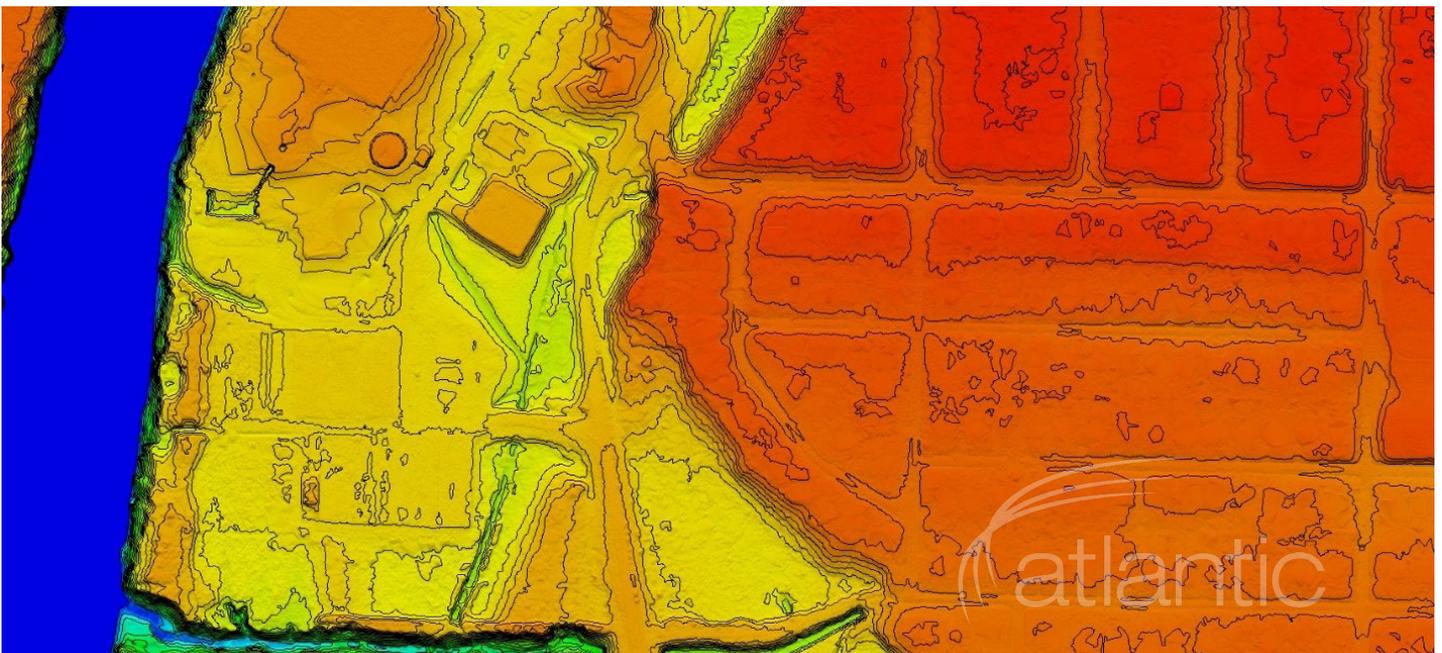


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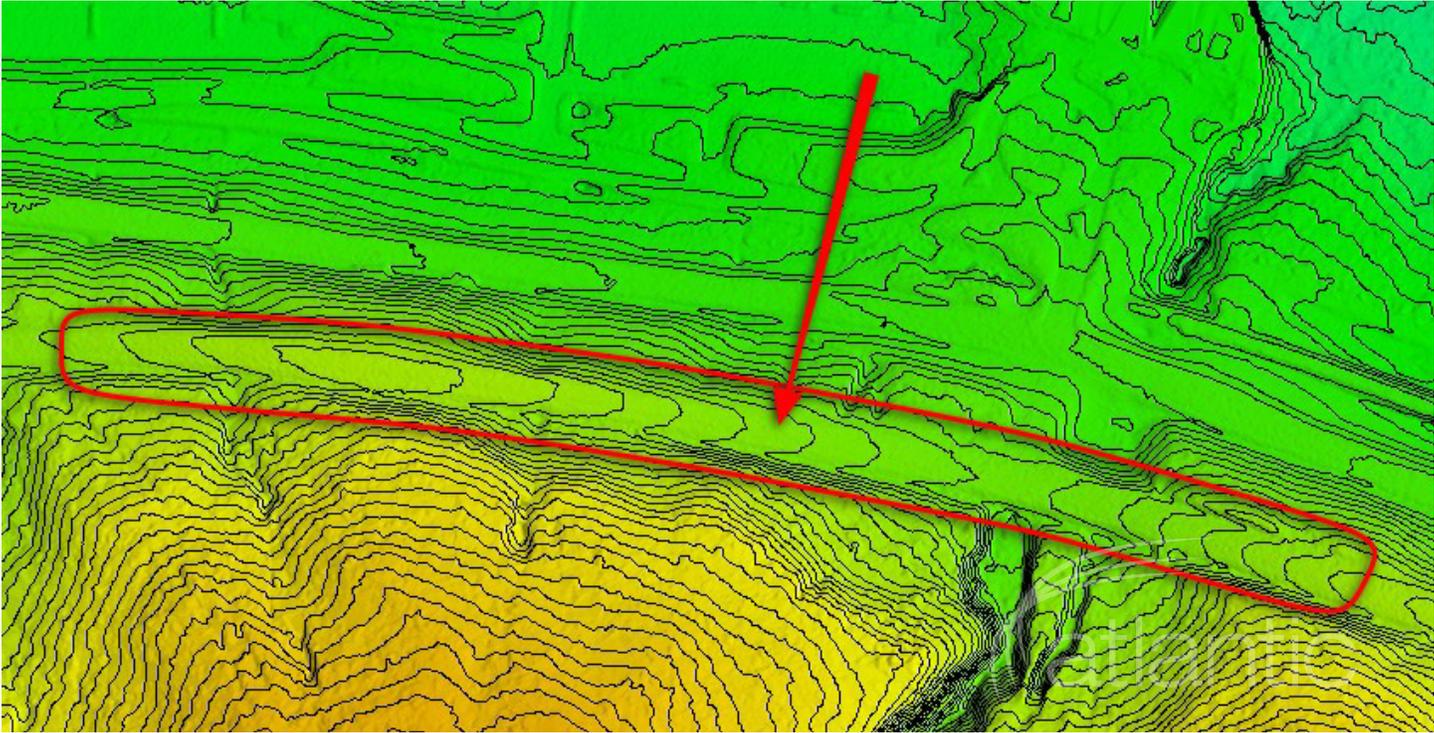
The example below illustrates automated contours of an area that includes hydrography (both flattened and un-flattened), transportation and a residential neighborhood.



The next example offers a larger scale view of a similar scene. There are many things the user will notice about this dataset when compared to a traditional contour product. First, depressed contours will not be distinguished but will be shown as a contour in the dataset. The algorithm chosen simply assigns an elevation value and does not consider the relative elevation to the surrounding surface; therefore, it will not be properly labeled. Spot elevations, such as tops, saddles, depressions or highest, lowest, turn back contours will not be added in the final product of a typical lidar-derived contour data set. All of those features can be added, but it requires more manual data collection of features, which will increase the cost to produce the dataset.

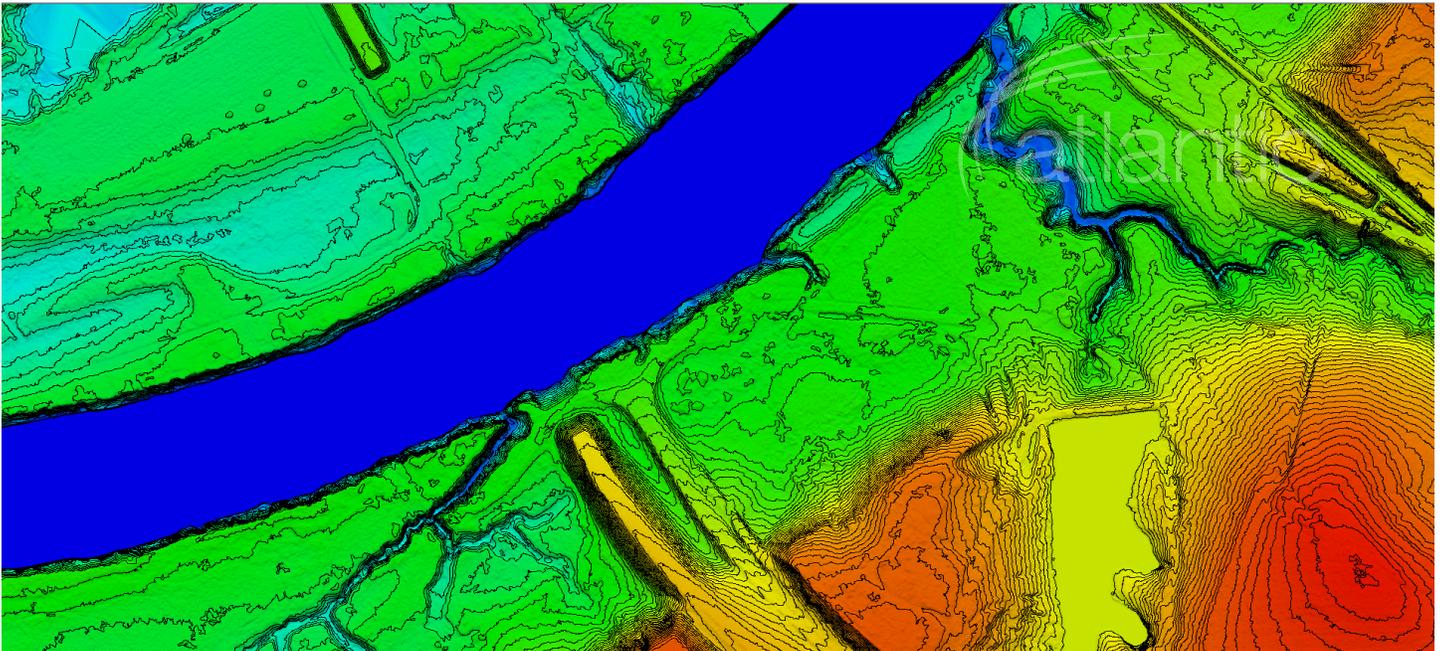


The following two examples illustrate how the automated contours fit road surfaces. The algorithm does a pretty good job of identifying and crossing roads, but it is not perfect. Again, additional breaklines of the roads would improve the interaction of the contour with the road surface but that would come with potentially significant additional costs.

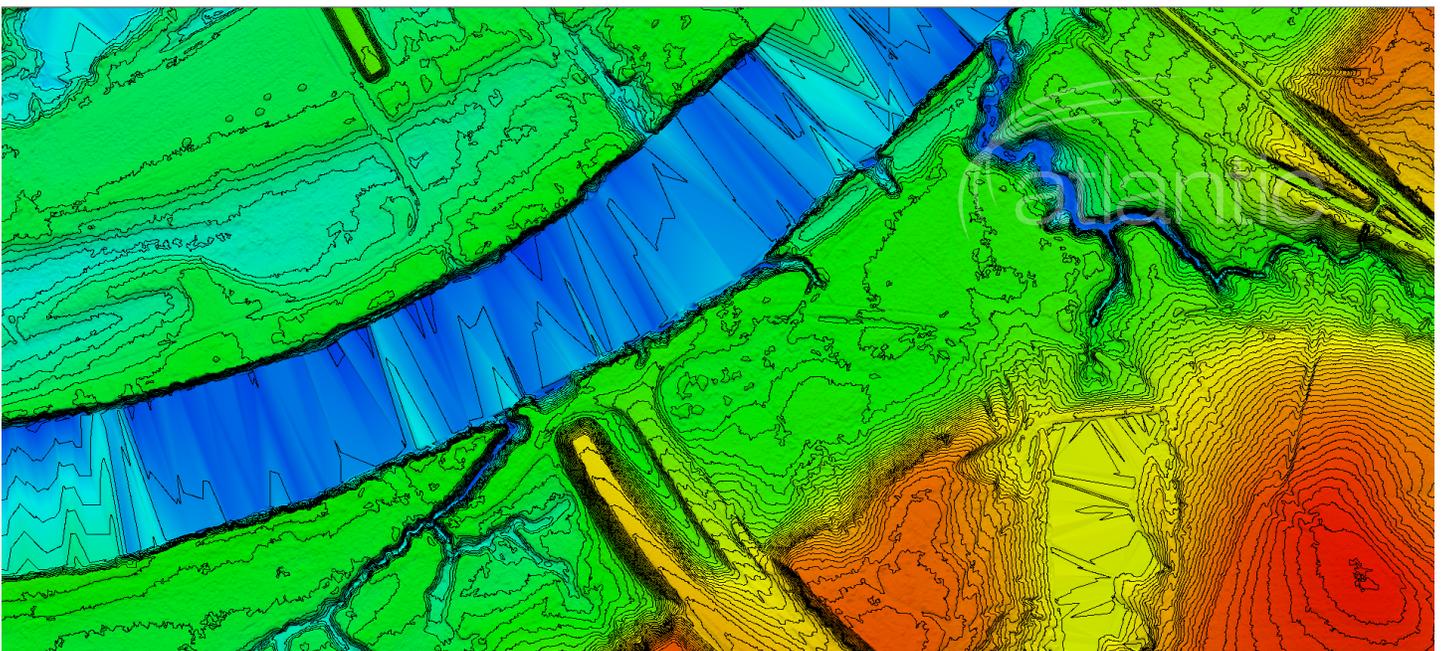


The samples below are essentially auto-generated from lidar data using these methods, along with the hydro breaklines that are part of the 3DEP deliverables. Hydro lines will be present for streams and rivers that are larger than 100' in nominal width. Hydro lines will also be present for lakes and ponds that are larger than 2 acres. Contours will correctly behave over these water features, if used properly. However, these largely automated lidar derived contours will cross hydro features that are too small to meet the collection specifications for contours.

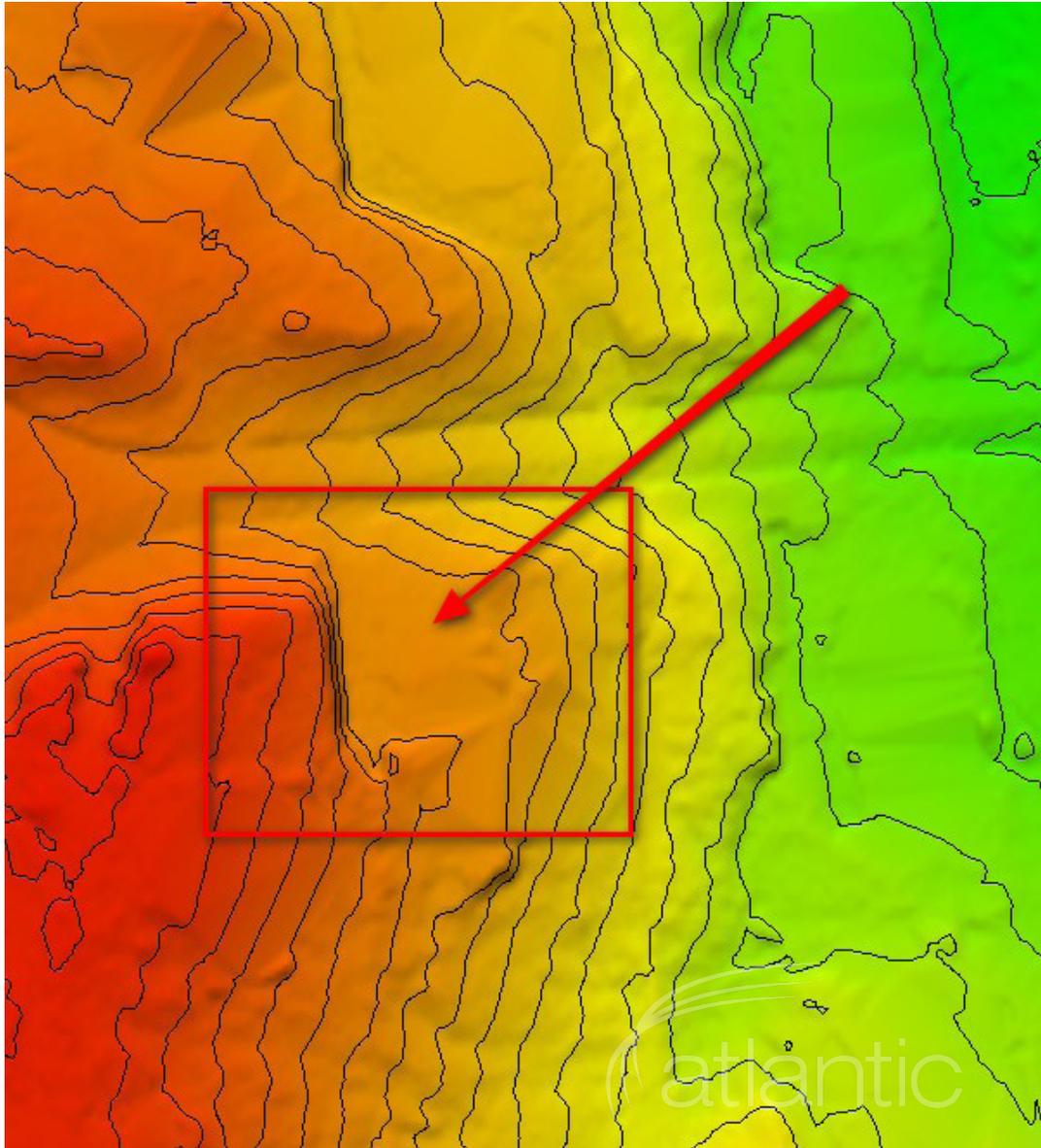
The first example illustrates how the contours lines behave with the presence of hydro breaklines that were delivered as part of this 3DEP lidar dataset.



The next example (same area) illustrates how the contours lines behave without hydro breaklines. Features that do not meet the specifications for data collection, will present more like this example than the one shown above.



Here is a great example of a problematic area for the data set. (see the pic of the house with retaining wall.) This is a retaining wall that is modeled from the lidar only without a breakline. The feature models pretty well but does not meet traditional engineering or photogrammetric standards for how the contours should behave at the wall. While we could collect additional breaklines or input other data sets and perfect the contour lines for retaining walls, roads, or other features that may be problematic in the data set, this process will cost three times what it will be to simply accept the data as accurate and understand the limitations.



Not all contours are equal so understanding your needs will help us understand how to produce contours that will offer the best solution. Every client has different needs. An engineer, planner and a GIS professional will have very different functions for contour lines. Knowing how the data will be used helps us design a project to create the best end dataset to meet those needs. We hope you better understand the algorithmic options and limitations so you can best select an approach that is most valuable to you and your organization. As always, please reach out to us if you have questions or are ready to discuss a custom solution that works best for you.