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ZIP Codes are not Boundaries

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It is a common misconception that 5-digit US ZIP Codes are topographic boundaries that can somehow be accurately represented on a map. They are not. ZIP Codes are a trademark of the United States Postal Service (USPS), and they were created in the 60s (<https://www.serviceobjects.com/blog/why-smokey-the-bear-has-his-own-zip-code-and-you-dont-fun-facts-about-zip-codes/>) as a way to help improve mail delivery. So why can mapping services such as Google Maps display them as boundaries? In this blog post, we'll explain it all to you.

ZIP Codes, which stand for Zone Improvement Plan Codes, may sound like something that can be displayed on a map. After all, the Z in ZIP stands for "Zone," so it would naturally make sense to be able to display these Zones on a map, right? As it turns out, mapping systems like Google Maps are not actually showing you ZIP Code boundaries (because ZIPs are not boundaries), but are instead showing the boundaries of what is known as a ZIP Code Tabulation Area (ZCTA).

What is a ZCTA?

ZIP Code Tabulation Areas, more commonly known by their abbreviation ZCTA, are a trademark of the US Census Bureau and represent a general approximation of the area serviced by a USPS ZIP Code.¹ In the Census Bureau's own words, "We created the ZCTAs specifically to address the inadequacies of ZIP Codes for census data tabulation."⁵

When it comes to boundary information for legal, statistical, and administrative areas as well as geographic feature information the US Census Bureau is considered the nation's authoritative data provider.⁶ The ZCTA was first introduced in the 2000 census in an attempt to try and represent ZIP Codes as boundaries. They saw a need to group census data by ZIP code, but since a ZIP Code cannot be precisely defined by a boundary, they instead created the ZCTA.

How is a ZCTA created?

A simple explanation on how ZCTAs are created is that the US Census Bureau examines the addresses contained in a census block, which do have a boundary. The most frequently occurring ZIP Code within the census block will then be assigned as the census block's ZCTA. After all census blocks for an area are

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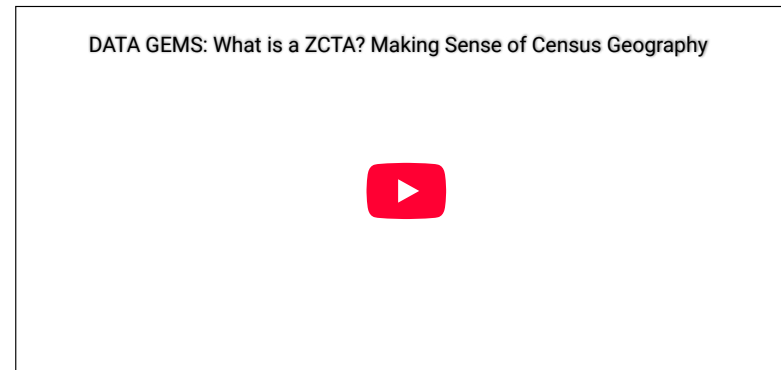
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assigned a ZCTA, they can then be aggregated with the resulting areas representing each ZCTA's boundary.¹ The whole process, of course, is much more involved and complicated than this. For more information about ZCTAs and how they are created, please visit the US Census Bureau's ZCTA page (<https://www.census.gov/programs-surveys/geography/guidance/geo-areas/zctas.html>).

For a simple visual explanation of how ZCTAs are created, check out this short two-minute video that the US Census Bureau released.

DATA GEMS: What is a ZCTA? Making Sense of Census Geography



The US Census Bureau also provides a ZCTA brochure (<https://www2.census.gov/geo/pdfs/education/brochures/ZCTAs.pdf>) that summarizes how ZCTAs are created.

Mapping ZIP Codes versus ZCTA

ZIP Codes are not a topographic feature, but a ZCTA is. ZIP Codes do not form a polygonal shape or contain an area, nor do they have a perimeter, but ZCTAs do. According to the U.S. Census Bureau, "USPS ZIP Codes identify the individual post office or metropolitan area delivery station associated with mailing addresses." Technically speaking, if you were to attempt to accurately map a ZIP code the best you could do is plot an individual point for the location of the post office or metro area delivery station that it is assigned to. That's it. A single point on a map to identify a post office or delivery station is all you would get.

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If you wanted to map the area that a post office services, then it would involve a process as detailed as what the US Census Bureau uses for creating a ZCTA. You would need to collect points for all of the addresses associated with a ZIP code, then you would need to pull boundary data for the buildings associated with those addresses and begin aggregating from there. However, in doing so you would run into issues with ZIPs that need to be handled, such as overlap and enclaves.

For example, some buildings may have more than one ZIP code associated with them. Some organizations that deal with large volumes of mail will have their own unique ZIP codes assigned to them. Some ZIP codes are assigned to just PO Boxes while others may be assigned to the military. Some ZIP codes are even mobile, as many ships in the US Navy have their own ZIP code (<http://www.uscs.org/wp-content/uploads/2011/05/ship-zip-codes.pdf>).

Realizing that not all ZIP codes can be accurately mapped was a big reason for why the US Census Bureau created the ZCTA in the first place. Not only that, but ZIP codes will often change: new ZIPs are created, old ZIPs are removed, or ZIPs will be reassigned and redistributed as locations and delivery needs change. The US Census Bureau does not frequently update ZCTA data, so far only releasing data for the 2000 and 2010 census (currently there are no 2020 ZCTA relationship files available from the US Census Bureau) as well as the American Community Surveys (ACS), whereas the USPS will make ZIP code changes on a monthly basis.

However, there are some vendors who will sell ZIP code boundary data and go thru the effort to try and describe ZIP code coverage as best as possible. While these data sets are often updated more frequently than the ZCTA data, they still can't keep up with the frequency of the USPS changes. These datasets are often purely geographic as well, and have nothing to do with census related statistical information.

The ZIP to ZCTA Relationship

There is no perfect one-to-one relationship between ZIP Codes and ZCTAs. As previously mentioned, there are more ZIPs than there are ZCTAs since not all ZIPs can be turned into a ZCTA, such as PO Box ZIPs as well as enclave ZIPs and ZCTAs in general being assigned the ZIP that makes up the majority of a census block.

Matching a ZIP Code to its corresponding ZCTA is an involved process commonly referred to as crosswalking, or ZIP Code to ZCTA Crosswalk. According to the Census Bureau, "In most instances the ZCTA code is the same as the ZIP Code for an area."¹ However, crosswalking from a ZIP to a ZCTA is necessary if you wish to accurately look up census information by USPS ZIP Code. Otherwise, you may find that your ZIP query yields no results due to no matching ZCTA being found, or you risk querying the wrong ZCTA if the ZIP code has changed and/or been reassigned.

Key Points

In summary, here are some key points to keep in mind when thinking about ZIP Codes and ZCTAs:

- ZIP Codes are not area features. They serve as identifiers of post offices and mailing stations for the purpose of delivering mail.
- ZIP Code Tabulation Area (ZCTA) codes were created by the US Census Bureau to represent the general area of USPS ZIP Codes.
- ZCTAs represent the most frequently appearing ZIP code for an area.
- There is no one-to-one relationship between ZIP Codes and ZCTA Codes.
- ZCTA codes only exist for populated areas included in the census data; therefore, there are no ZCTA codes for ZIP Codes that only represent PO Boxes or large volume mail organizations.
- A ZCTA code may be the same as a ZIP Code in some cases, but in other cases crosswalking the two may be necessary.
- USPS ZIP Codes are updated monthly.
- US Census ZCTA codes are updated decennially.
- Even though ZCTA codes are not ZIP codes and are not updated as frequently, they still serve as a popular and useful research and planning tool.



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