Cooling Tower Identification Guide

Supplement

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PURPOSE

This document is a supplement to CDPH's *Cooling Tower Identification 101: How to Use Satellite Imagery to Identify Cooling Towers* document, which includes more details on processes useful to scanning satellite imagery for cooling towers (CTs). This document can also be used standalone as a reference when trying to distinguish CTs from non-CTs on satellite/aerial imagery.

Note: Images included in this document are for example only, intended to familiarize users with the variety of structures that may be found while conducting searches for CTs using satellite imagery.

CT ID GUIDE

The following selection criteria, adapted from the U.S. Centers for Disease Control and Prevention (CDC) Geospatial Research Analysis, and Services Program and the Philadelphia Department of Public Health, can be used as a general guide for determining if a building structure has a CT. The list is meant to be used as an additional check as users start to find CTs and are determining if it fits within the CT definition.

DISTINGUISHING COOLING TOWERS ON SATELLITE/AERIAL IMAGERY

CTs can be difficult to distinguish on satellite/aerial imagery, but tend to follow certain patterns. The CDC has published Procedures for Identifying Cooling Towers as a guide that helps to outline a systematic strategy for finding CTs, including a detailed section to help differentiate CTs from similar appearing devices (https://www.cdc.gov/legionella/health-depts/environmental-inv-resources/id-cooling-towers.html).

One of the most difficult processes in finding CTs is distinguishing CTs from air conditioning (A/C) units or other devices with fans. Some characteristics that may help:

- CT fans are large

- In a 2019 collaborating between CDPH and Orange County Health Care Agency to map all CTs in Orange County, we identified over 1000 CT fans; all were over 0.75 meters, the average diameter was 2.3 meters, and some were as large as 8 meters in diameter (Figure 1).
- Non-CT fans tend to be less than 0.6 meters in diameter. Note that Google Earth includes a handy measurement tool that can be used to measure fan diameters (Figure 2).

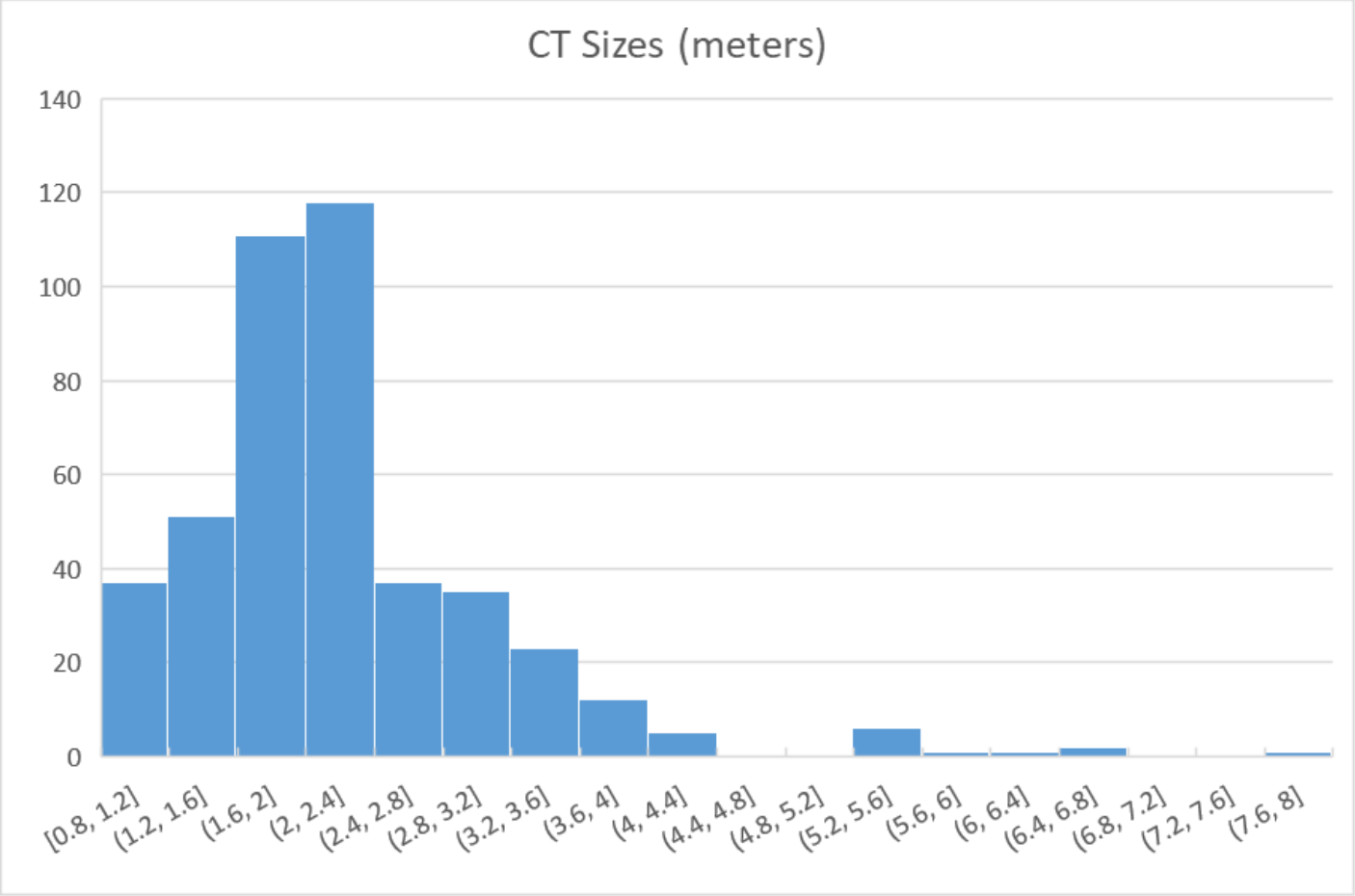

Figure 1: Histogram of CT fan diameters (meters) in OC (2019).

Figure 2: Measuring CT fan diameter using Google Earth ruler.

- Each individual CT structure tends to have fewer fans compared to other cooling units. For instance, most CTs have 1-2 large fans each, whereas other cooling units can have 8-12 smaller fans on a similarly-sized structure. This observation is a comment only on the characteristic of individual CT units; a building could have multiple CT units (with 1-2 fans each, for instance) or multiple alternate cooling units on it (for example, with 8-12 fans on each; Figure 3).

Figure 3: Two non-cooling towers with 10 fans per unit, and four CTs with one fan each (note the green water pipes serving the CTs).

- CTs with a fan on top tend to have that fan symmetrically or only somewhat asymmetrically placed, so that it can pull air evenly across the fill. For non-CT units, the fans may be cooling a motor or other unit, and thus most of the unit is actually not made up of the fan, resulting in a unit that appears widely

asymmetric or where the fan only takes up a small portion of the whole unit (Figure 4).

Figure 4: A common, somewhat asymmetric CT design with proportionally large fans (Top: CTs with a slightly smaller average fan size of about 1.2m; Bottom: widely asymmetric non-CTs with small fans.

- Building type is helpful. Certain types of buildings are more likely to employ a CT (think about whether a building would pay to build a CT, i.e., if they have large cooling needs for storage of produce or goods, industrial processes, or large numbers of people). A large building is much more likely to need a CT than a small (i.e., residential) building; in OC, no single-family homes were found to have a CT.
    - In OC, the most common buildings/areas to have CTs included:
        - Offices
        - Industrial buildings
        - Warehouses
        - Parking lots (hidden in/around parking lots but serving other buildings)

- Hospitals
- Malls
- Hotels
- Universities and /schools
- Supermarkets
- Parks and recreation centers
- Municipal buildings (e.g., convention centers, police departments, libraries)

- Of note, building types likely to have a CT may vary widely in different regions depending on cost of water/electricity and weather conditions.
- As a rule of thumb, if a building has many small A/C units relative to its size, it is less likely to also need a CT. Conversely, a large building with no A/C units is suspicious for having a CT (often hidden; Figure 5).

Figure 5: A lack of A/C for warehouse area buildings is suspicious (exceptions of course depending on what is being stored there). On closer inspection, the CT is found (Top, red circle) with zoom of area (bottom).

Additional examples with tips are described over the next several pages (Figure 6 - Figure 17).

Figure 6: Two CTs (labeled 73) with multiple water white water pipes versus four non-CTs with large air ducts (CTs circulate water to and from the building, not air; top image). Two CTs (top of picture) with multiple small pipes and non-CT with small fans and a large air duct running to it (bottom image).

Figure 7: Large buildings with multiple small cooling units and less likely to have a CT.

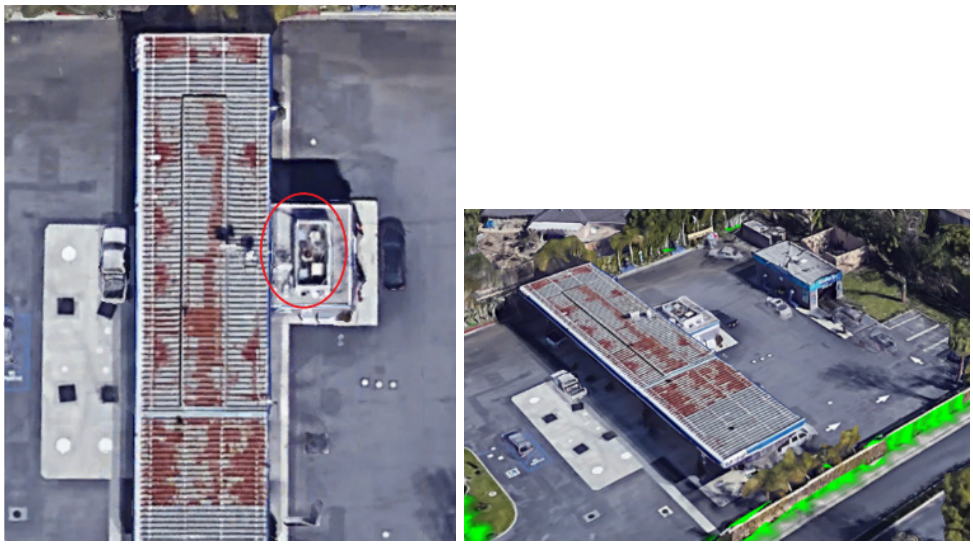

Figure 8: Could there be a CT in this side structure (red circle)? Oblique views show us this is a carwash and thus nothing to cool (no need for a CT).

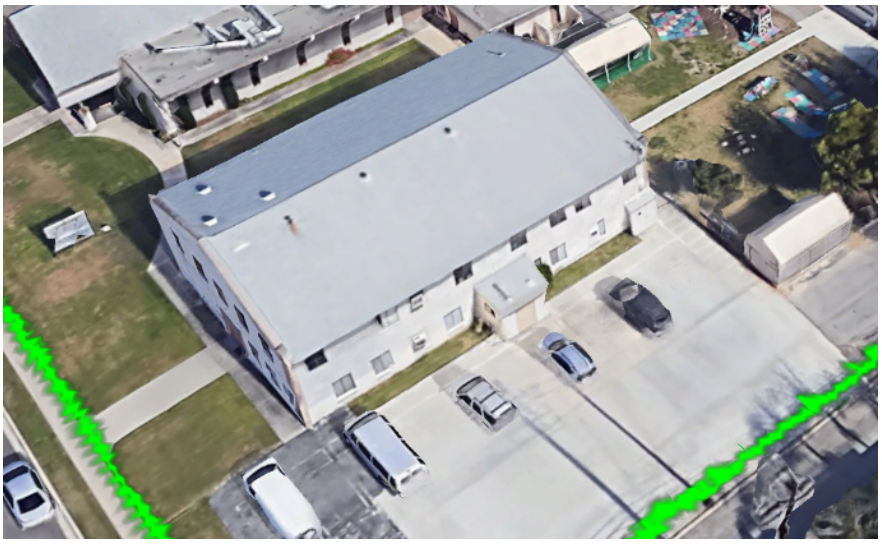

Figure 9: Window A/C units suggest this building does not need a CT.

Figure 10: Large building with no cooling units? Suspicious and warrants closer inspection (right image reveals a CT).

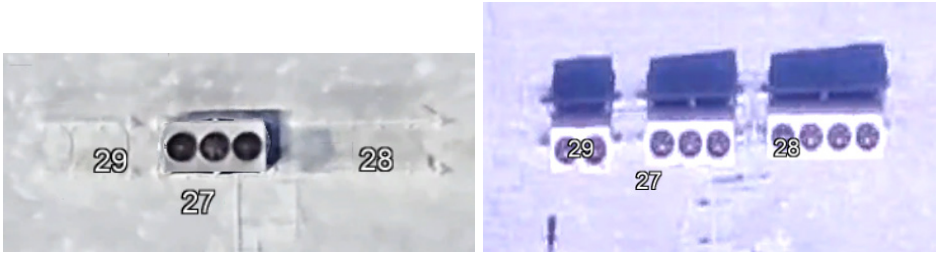

Figure 11: Use all tools available to investigate suspicious areas, including time series satellite imagery. Left image shows current 2019 satellite image showing

only one block of CT fans, but hints of old CTs. Review of 2017 images demonstrate old CTs that have since been removed (right image).

Figure 12: Google Earth Streetview can also be helpful, when available. Top images show unclear, round barrel-shaped object suspicious for CT. Bottom image shows Google Earth's Streetview of the same area, revealing a common, small, cylindrical CT with assorted small water pipes.

Figure 13: Oblique images reveal side fans. CTs with side fans are easy to miss but generally have characteristic dark grated tops and otherwise retain the same characteristics as other CTs (building types, pipes, logos), though fan diameters tend to be smaller than other CTs (less than 2m). High index of suspicion is needed to identify these.

Figure 14: Use non-3D view in Google Earth if 3D renderings are unclear. Google Earth's default 3D view can help provide seamless oblique views, but can also obscure details. Left image shows a hospital with CTs that are easily missed because the fans are blurred. Right image shows the view of same area after switching off 3D view, revealing clearly that these are three CTs with distinctive fans.

Figure 15: CTs are often branded with the company logo, which can be helpful for identification. Two distinctive, popular brands are BAC (top) and evapco (bottom).

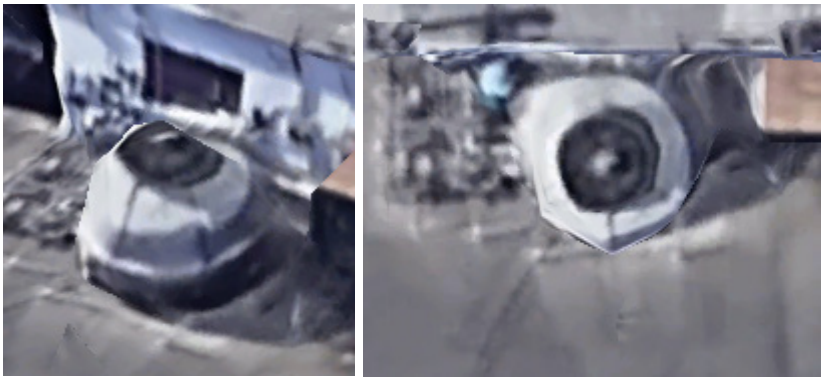

Figure 16: Small, cylindrical ground unit CT. These tend to have a single fan that is smaller (i.e., less than 2m).

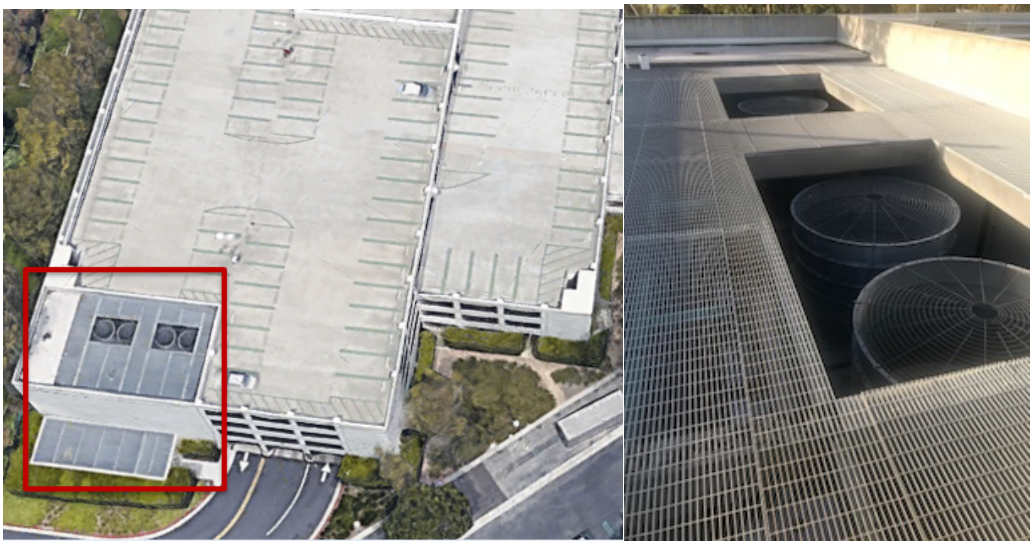

Figure 17: CTs hidden below a grate inside a parking garage (left) with photo of the actual, three-story tall CTs taken from parking garage roof (right).