MEMORANDUM

Tetra Tech, Inc.
10306 Eaton Place, Suite 340
Fairfax, VA 22030
phone 703-385-6000
fax 703-385-6007

TO: Paul Shriner, EPA
FROM: Kelly Meadows and Christine Wong
DATE: July 30, 2010

SUBJECT: Estimating the number of potential facilities with increased costs due to noise or plume abatement and space constraints

EPA requested that Tetra Tech develop an analysis to estimate the universe of facilities that may need to be considered for increased costs of compliance with the 316(b) existing facility rule due to noise or plume abatement requirements, as well as space constraints, for installing cooling towers as a compliance response. This memo documents the analysis and rationale for the estimated universe of affected facilities. Tetra Tech has concluded that about one in four (25 percent) of the overall universe of facilities addressed by the proposed 316(b) existing facility rule may be affected by one or more of these technical factors; EPA has increased its estimate of compliance costs accordingly to account for additional technologies or other mitigation activities at these facilities.[1]

Approach

To comply with a potential requirement for flow reduction, some facilities are likely to choose to install cooling towers to comply with this requirement.[2] Under certain conditions or at certain locations, the installation of cooling towers can lead to non-aquatic impacts such as plumes or noise. Facilities located in densely populated areas or on small sites may also have difficulty identifying sufficient space to construct the towers. In the majority of cases, these technical issues do not ultimately affect the feasibility of constructing the cooling tower, but they do affect the cost. The analysis below reflects EPA's assumptions in estimating the number of facilities that may

[1] See chapter 8 of the Technical Development Document. Instead of estimating which model facilities would require increased costs, EPA applied a cost increase to all exiting facilities.
[2] In fact, EPA's costs reflect the assumption that all facilities subject to the flow reduction requirements will install cooling towers.

encounter these difficulties and establishes an approach for increasing the cost estimates accordingly.

Natural draft or mechanical draft cooling towers can produce a plume. Plumes (comprised largely of water vapor) can create problems with fogging and icing, which have been recorded to create dangerous conditions for local roads and for air and water navigation, as well as cause aesthetic impacts. To estimate the number of facilities that would likely be subject to plume abatement requirements, Tetra Tech used two indicators as a proxy for potential impacts: proximity to airports and proximity to major roads. Tetra Tech selected a 2-mile radius from airports and a 0.5-mile radius from major roads as the distance thresholds for facilities likely to require plume abatement. EPA had previously mapped the prevalence of cooling towers and their proximity to highways, navigable rivers and lakes, and railways, and defined those facilities that were within several hundred meters from those types of areas as being in "close proximity."[3] Tetra Tech selected a 2-mile radius from airports as a proximity threshold to include this earlier definition of "close proximity," plus a generous safety margin for aviation safety. Tetra Tech selected the 0.5-mile radius from major roads as a proximity threshold to account for the distance required to disperse fog or ice-forming plumes, plus a generous safety margin.[4]

Noise from mechanical draft cooling towers is generated by falling water inside the towers, plus fan or motor noise. Noise from power plant sites generally do not result in off-site levels more than 10 decibels (dB) above background levels.[5] Facilities that make use of cooling towers, however, might expect the typical noise level to be approximately 70 dB within 50 feet of the tower.[6] Because sound levels diminish approximately 5 dB per doubling of distance, and 55 dB falls between the sound level of rainfall and normal conversation[7] (and therefore would not be considered noise pollution), a buffer of 400 feet would suffice for noise abatement at most sites.[8] In addition, EPA's "Protective Noise Levels" guidance found that ambient noise levels of 55 dB was sufficient to protect public health and welfare and, in most cases, did not create an annoyance.[9] As for noise pollution at the site itself, the New York State Department of Environmental

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[3] Technical Development Document for the Proposed Section 316(b) Phase II Existing Facilities Rule, Chapter 6, Non-Water Quality Impacts, p. 6-7.

[4] The documentation from the NPDES permit renewal for Brayton Point was also considered (see http://www.epa.gov/ne/braytonpoint/index.html). In this case, the facility cited a proximity to highways and bridges as potential challenges to retrofitting to closed-cycle cooling. Using online aerial photos, the distance to the nearest major road is approximately 0.5 mile and the bridge is approximately 1.0 mile away. Dominion Energy ultimately concluded that a natural draft cooling tower was the best choice for its closed-cycle cooling system; while Dominion has not publicly stated its rationale, it can be assumed that abatement of the cooling tower plume was at least one factor.

[5] US EPA. 2002. Technical Development Document for the Proposed Section 316(b) Phase II Existing Facilities Rule, Chapter 6, Non-Water Quality Impacts, p. 6-9.

[6] SPX. 2009. Cooling Tower Fundamentals, p 75.

[7] American Speech-Language-Hearing Association. Noise and Hearing Loss. Accessed at http://www.asha.org/public/hearing/disorders/noise.htm on August 1, 2010.

[8] Noise levels would be as follows: 70 dB at 50 feet, 65 dB at 100 feet, 60 dB at 200 feet, and 55 dB at 400 feet.

[9] EPA 550/9-79-100, November 1978.

Conservation's "Assessing and Mitigating Noise Impacts" policy states that 60-70 dB is the beginning of the threshold for annoyance in non-industrial sites and that noise can exceed 65 dB (and up to 79 dB) in commercial or industrial sites. A common goal is to keep new noise sources from increasing the overall noise levels by 5-10 dB. Given that noise is measured on a logarithmic scale, adding a cooling tower that operates with a sound level of approximately 70 dB will be unlikely to add a significant level of noise to an already noisy industrial site.[10] Given that noise appears to dissipate relatively quickly (and the fact that many industrial sites are large and a 400 foot buffer would not be a significant limitation), effects from noise are not expected to be significant at most sites. There will certainly be some sites that require noise mitigation, but the number of sites is likely to already be represented by the analyses for plume and population density.

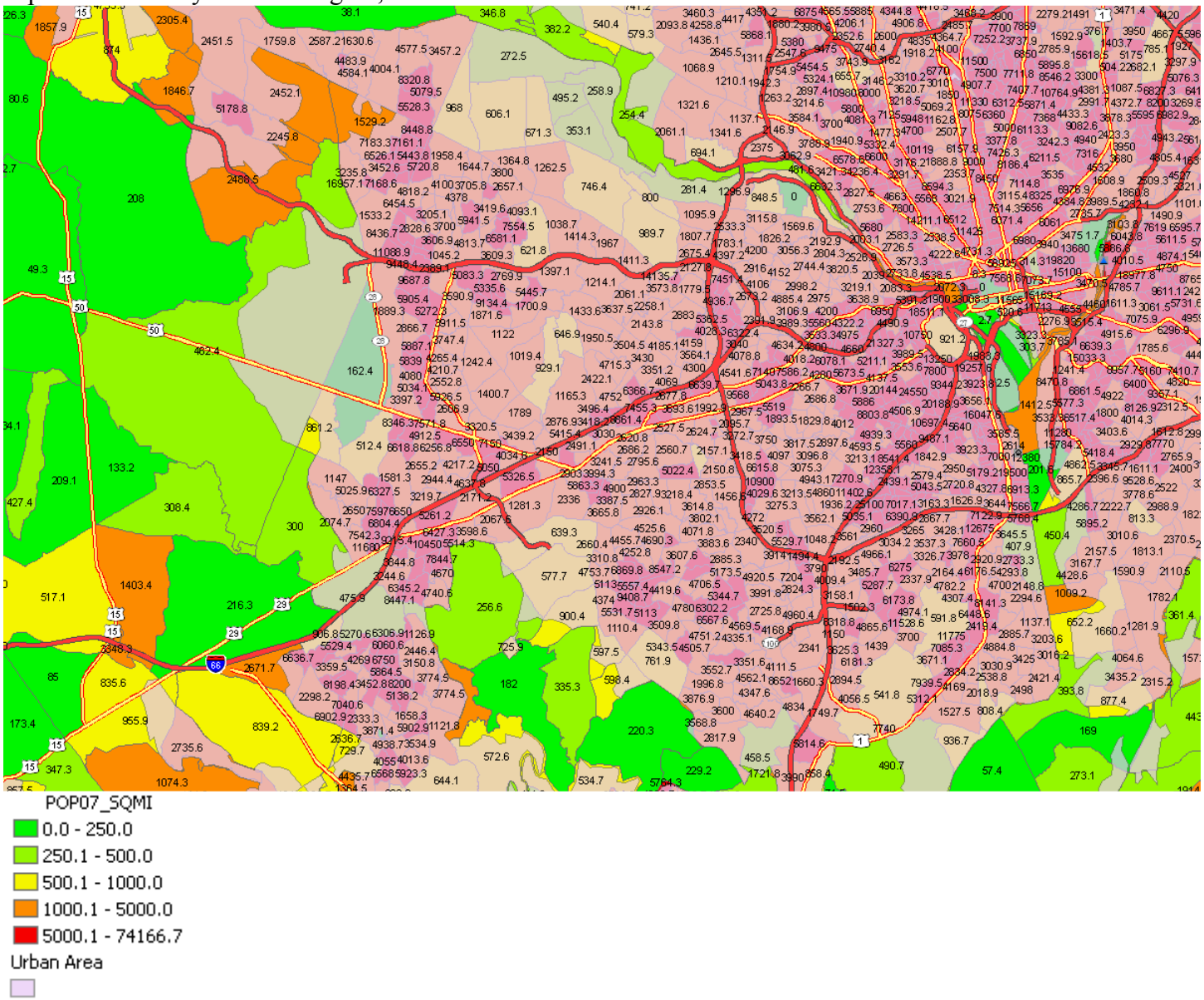
Tetra Tech decided to use population density as a proxy indicator of facilities that might be subject to land or space constraints for installing cooling towers. Tetra Tech conducted a geographic information systems (GIS) analysis of various U.S. Census (2007 figures) data to determine the point at which population blocks (blockgroups) indicate the transition from more densely developed urbanized areas to areas with ample space for development.[11] After comparing several urban areas as examples, a threshold of 1000 persons per square mile was selected as the approximate transition point. The figures below show areas color-coded and labeled according to Census population density (2007 figures). For this analysis, a facility was considered to be development restricted if the facility was located within a blockgroup where population density was greater than or equal to 1000 persons per square mile.

Washington DC and Buffalo, New York were examined to estimate the selected threshold and the graphics are presented below. Topeka, Kansas and Salinas, California were also examined but are not presented below.

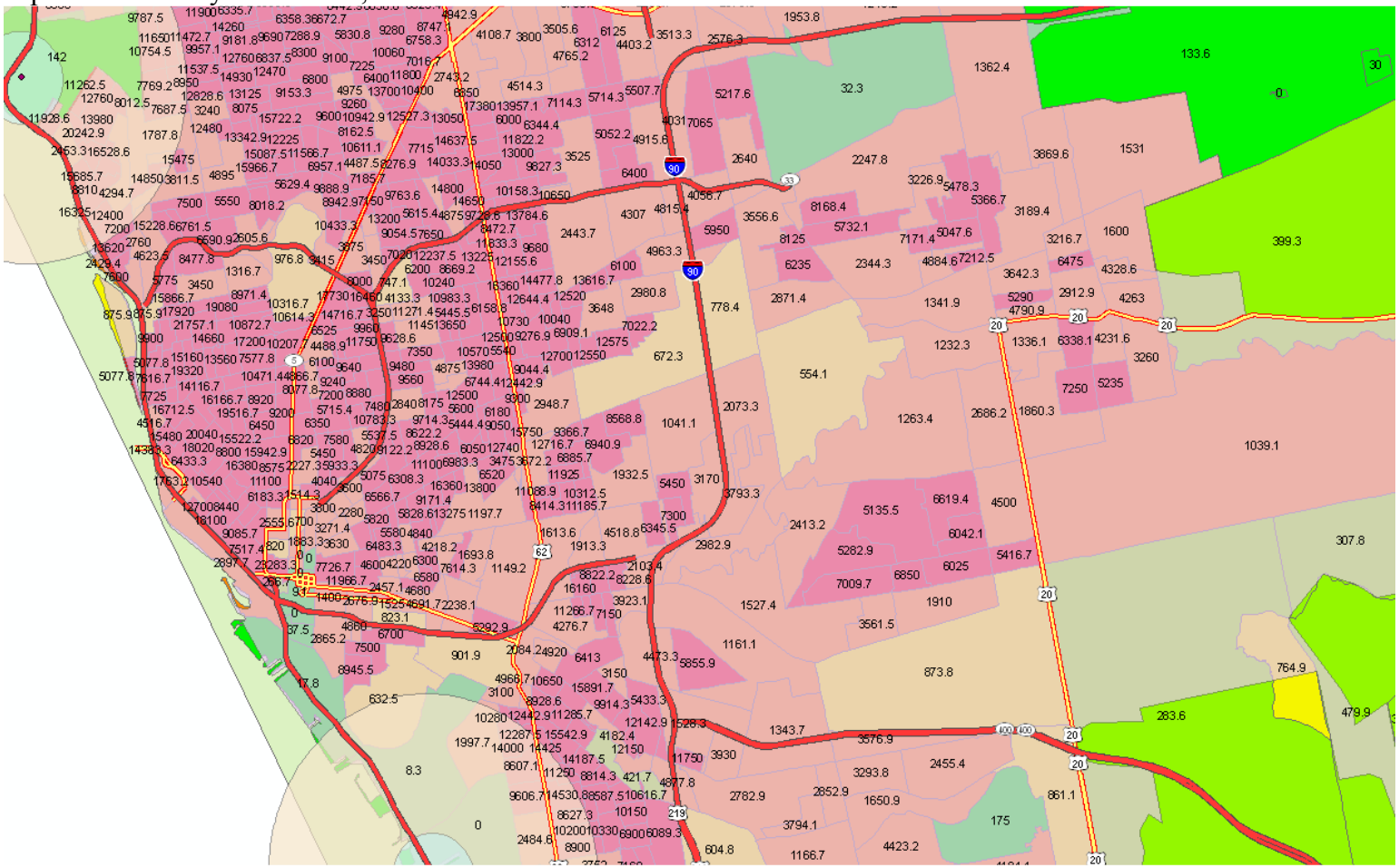
[10] NYDEC. 2000. Assessing and Mitigating Noise Impacts, p. 14.

[11] Tetra Tech also considered an analysis using the Census Urban Areas layer, but chose to use blockgroups instead because they allowed for the identification of low-density blockgroups within the urban area boundary.

Population Density for Washington, DC



Population Density for Buffalo, NY

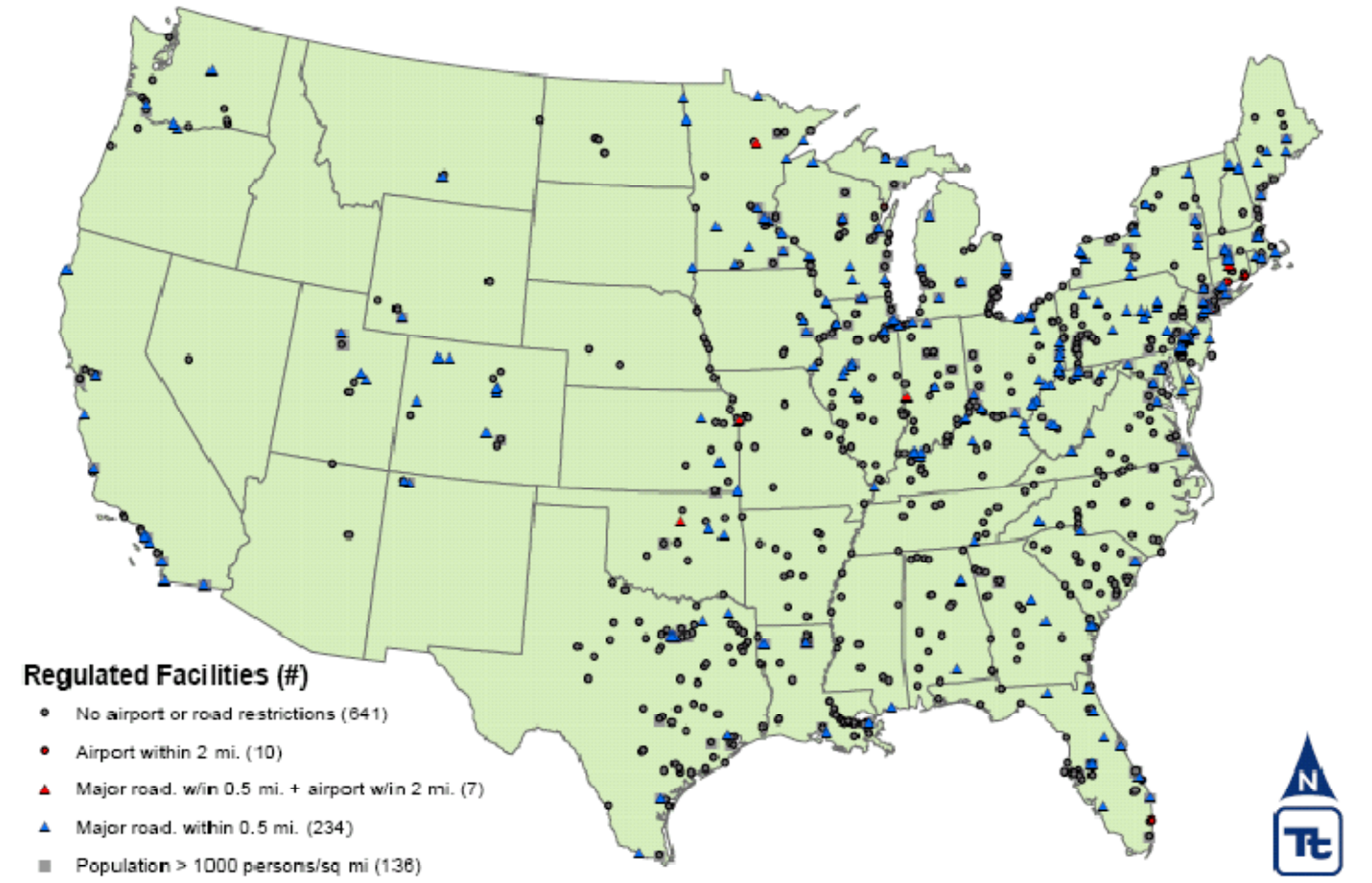


For the purpose of this analysis, facilities located within a blockgroup with a density greater than 1000 persons per square mile are considered to be potentially subject to space constraints for installing cooling towers.

Because proximity to airports, major roads, and densely populated areas may be correlated with the need for facilities to install technologies to mitigate those effects, the proximity analyses for all these of these factors are expected to complement one another. In other words, each of these technical challenges relate to a proximity to other uses of surrounding areas (e.g., roads, residential, etc.); as a result, it is reasonable to expect that separate analyses for each challenge would identify some of the same facilities.

Analysis

Tetra Tech plotted the longitudinal and latitudinal coordinate locations of the model power plant facilities used to develop compliance costs. Tetra Tech then plotted GIS layers to determine if facilities 1) fall within a 2-mile radius from all airports; 2) intersect the 0.5-mile radius from all major roadways (defined as a limited access road or highway); and 3) are located within a blockgroup with 2007 population density per sq mile ≥1,000 (FacilPopDens1000). The results are shown in the map below.



316b Facilities with Development Restrictions

North_America_Albers_Equal_Area_Conic
Map produced 07-27-2010

0 195 390 780 Kilometers

0 150 300 600 Miles

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Results

Tetra Tech further refined the analysis with four additional steps. First, the universe (initially comprised of 891 facilities, including all power plants and manufacturers that completed a technical questionnaire) was limited to facilities with a design intake flow (DIF) of greater than 125 million gallons per day (MGD).[12] Second, facilities that did not complete a detailed questionnaire were removed, as costs for these facilities will not be developed in the proposed rule.[13] Third, manufacturers were removed from the analysis, as these sites are already assigned "difficult" level costs in the EPRI cost methodology. Fourth, statistical survey weights were added to properly adjust the representativeness of each facility.

Out of the 224 detailed questionnaire facilities (250 weighted) with a DIF greater than 125 MGD, the analyses showed that:

1) 50 (56 weighted) of these 224 are within 0.5 miles of a major road.
    - 1 of these was within 2 miles of airports.
    - 12 of these are in high population density areas as defined by FacilPopDens1000.
        - Of these 12, none are within 2 miles of airports.
2) 4 (4 weighted) of these 224 are within 2 miles of an airport.
    - 1 of these was within 0.5 miles of a major road.
    - None of these are within high population density areas.
3) 25 (28 weighted) of these 224 are within a high population density area.
    - None of these are within 2 miles of an airport.
    - 12 of these are within 0.5 miles of a major road.

As such, a total of 66 (29.4%) facilities (74 weighted or 29.6%) of the universe of facilities with a DIF >125 MGD facilities are subject to at least one constraint. Given the conservative nature of this analysis,[14] rounding the percentage of facilities that may require additional costs for abatement technologies or face challenges due to space constraints to 25% was deemed appropriate.

By comparison, Electric Power Research Institute (EPRI) conducted a survey of its members and found that approximately 23 percent of respondents answered that they

[12] Lower flow facilities will require smaller cooling towers and be less likely to encounter issues with noise, plume, or space. Additionally, many low DIF facilities already employ closed-cycle cooling

[13] In other words, only model facilities for which costs are generated for the proposed rule were included.

[14] For example, the analysis did not account for prevailing wind direction, which may eliminate some facilities from the likely area of effect. In another example, noise abatement costs are relatively low; assigning a "difficult" level cost to a facility that is only required to mitigate noise impacts would likely be an overestimate of the compliance costs.

would be concerned space constraints, should they be required to retrofit with cooling towers.[15,16] While this seems to be consistent with Tetra Tech's analyses, over half of the facilities surveyed by EPRI had not yet studied the impacts of installing closed-cycled recirculating systems. In addition, EPA personnel have observed, during the course of site visits, situations in which space constrained facilities were able to creatively resolve technical issues.[17] Additionally, based on EPA personnel best professional judgment, many facilities are conservative when estimating their required responses to potential regulations regarding cooling water intake structures. Furthermore, facilities that have not yet studied their site-specific impacts from installing closed-cycle cooling may not take into account the innovative or creative solutions that can be developed, even for space-constrained areas. As a result, the assumptions underlying EPA's analysis are likely to be conservative and may overstate compliance costs.

Given the results of the GIS analyses and the best professional judgment of EPA personnel, as well as the safety margins incorporated in the GIS analyses, Tetra Tech's analysis supports a threshold of 25 percent of facilities that may be constrained by cooling tower plume, noise, or space restrictions and should therefore be assigned an increased compliance cost.

[15] *Net Environmental and Social Effects of Retrofitting Power Plants with Once-Through Cooling to Closed-Cycle Cooling.* EPRI, Palo Alto, CA: 2008. p4-59.
[16] Forty six percent responded that there were local noise ordinances; there was no indication of whether these ordinances would be restrictive to installing cooling towers. There were no questions regarding impacts due to a cooling tower plume.
[17] See, for example, the site visit report for McDonough Station.