Cost-to-Revenue Impacts of Proposed Effluent Limitation Guidelines for the Construction and Development Industry
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Introduction

E.H. Pechan and Associates, Inc. (Pechan) performed a bottom-up analysis of the cost-to-revenue impact of Option 2 of the proposed effluent limitation guidelines (ELGs) for the construction and development (C&D) industry. Due to data constraints, Pechan focused the analysis on the new single-family residential construction sector of the C&D industry. The results of this analysis show that Option 2 will result in several thousands of single-family residential construction establishments with costs exceeding 1% of revenue, including nearly two thousand with costs exceeding 3% of revenue. It is unknown if a similar or higher or lower percentage of firms in other industry sectors (new multi-family residential, transportation, and non-residential) will also incur these impacts. However, it is expected that many more establishments beyond those identified in this analysis will incur impacts above the 1 and 3 percent cost-to-revenue thresholds considered significant by EPA.

In the following documentation, Pechan details the methods used to develop the cost-to-revenue estimates, and describes the results of the analysis, including a discussion of analytical assumptions/limitations.

Cost-to-Revenue Methodology

It is preferred that cost-to-revenue analyses be performed using firm-level data (in part because SBA defines small entities based on firm-level statistics such as employment and revenue).[1] However, necessary firm-level data are often unavailable. Instead of attempting to estimate the necessary data, Pechan performed this analysis using establishment data. Based on data reported in EPA's Economic Analysis for the proposed ELG, 99.5 percent of firms in the residential construction sector are comprised of a single establishment (EPA, 2008).[2] Therefore, a firm-level analysis would not significantly change the results estimated herein. As described more fully below, Pechan utilized data from the U.S. Census Bureau to estimate the revenue generated by establishments constructing new single-family housing units, and developed compliance costs associated with the number of these units based on cost inputs prepared by URS Corporation (URS, 2009).

Pechan utilized 2002 housing starts and sales data from the U.S. Census Bureau's Survey of Construction (Census, 2009a, 2009b, 2009c) as the starting point for estimating revenues accruing to residential construction firms. Year 2002 data were used because this is the last year in which Census reported data characterizing the distribution of single-family housing starts by

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[1] The Small Business Administration defines a firm as "the aggregation of all establishments owned by a parent company (within a geographic location and/or industry) that have some annual payroll."

[2] For the C&D industry as a whole, EPA estimates that 98.9% of firms are comprised of a single establishment.

establishment size. These are key data used in estimating the distribution of both revenues received, and compliance costs incurred, by single-family residential construction establishments. To place costs and revenues on the same basis, year 2002 revenues were adjusted to reflect 2008 housing prices. For reasons described later, the analysis focused on detached and attached single-family housing units (multi-family single-family units were excluded). The analysis involved first developing cost-to-revenue estimates by housing sales price and lot size category, and estimating the number of establishments building homes in each sales price/lot size category. The following describes each step in the analysis.

Step 1: Compile the number of single family homes sold in 2002 by price and lot size category. The U.S. Census Bureau's *Characteristics of New Housing* provides the number of housing units (excluding condominiums) sold in 2002, sorted by lot size and sales price (Census, 2009a, 2009b). The following are the categories used by the Census Bureau to report the number of attached and detached single-family houses sold in 2002:

Lot size in (1,000 square feet): under 7; 7 to 8.999; 9 to 10.999; 11 to 21.999; and 22 and over;

Sales price (in $000s): under 125; 125 to 149.999; 150 to 199.999; 200 to 249.999; 250 to 299.999; 300 to 399.999; 400 to 499.999; 500 to 749.999; and 750 and over.

For example, of the 261,000 detached single-family houses with lot sizes under 7,000 square feet that sold in 2002, Census reports that 53,000 sold at a price under $125,000. Pechan obtained year 2002 microdata from the Census' Survey of Construction (SOC) to fill-in values withheld in *Characteristics of New Housing* (Census, 2009c).

Step 2: Identify average sales price for homes sold in each price range. Using the SOC microdata, Pechan calculated the average sales price of detached and attached housing units for each sales price category. These values are displayed in Table 1.

Table 1. Average Year 2002 Sales Price for Detached and Attached Units by Price Range

Sales Price Category	Average Sales Price (Detached)	Average Sales Price (Attached)
Under $125,000	$101,500	$104,400
$125,000 to $149,000	$136,900	$137,500
$150,000 to $200,000	$172,300	$171,900
$200,000 to $250,000	$223,400	$220,000
$250,000 to $300,000	$272,400	$270,300
$300,000 to $400,000	$343,000	$340,000
$400,000 to $500,000	$440,000	$437,900
$500,000 to $750,000	$590,300	$565,200
$750,000 and Over	$888,000	$760,000

Step 3: Compile number of establishments and housing starts by housing starts size category. The 2002 *Economic Census* reports both the number of establishments and the number of housing starts by each of six housing start size categories (Census, 2006). These data are provided for New Single-Family Housing Construction (except operative builders) (NAICS code 236115), New Multifamily Housing Construction (except operative builders) (NAICS code 236116), New Housing Operative Builders (NAICS code 236117), and Residential Remodelers

(NAICS code 236118). The count of establishments and housing starts for each housing start size class were summed across these four sectors, yielding the total establishment and housing starts data used as inputs for Pechan's analysis (see Table 2). Pechan did not consider establishments with zero housing starts for this analysis. As this analysis does not consider multifamily housing starts, these data were also omitted from Table 2.

Table 2. Distribution of 2002 Residential Construction Sector Establishments and Single-Family Housing Starts by Housing Starts Size Category

Housing Starts Size Category	Number of Establishments	Number of Single-Family Housing Starts		Percentage of Single-Family Housing Starts	
		Detached	Attached	Detached	Attached
1 to 4 housing starts	21,721	41,156	3,258	6%	3%
5 to 9 housing starts	7,427	41,892	4,643	7%	5%
10 to 24 housing starts	5,595	66,165	11,229	10%	12%
25 to 99 housing starts	3,038	97,614	19,157	15%	20%
100 to 499 housing starts	1,328	173,678	25,517	27%	27%
500+ housing starts	313	217,000	29,604	34%	32%

Step 4: Estimate revenues accruing from housing unit sales data. To estimate revenues, Pechan first multiplied the number of housing units sold (from Step 1) by the average sales price for each sales price category (Table 1), and by the appropriate percentage of single family housing unit starts from establishments within each housing starts size category (Table 2). These calculations were performed separately for detached and attached housing units within each housing starts size category. In order to present the estimated revenue for establishments from single-family housing units in 2008 dollars, the 2002 revenue estimates were multiplied by a factor representing the change in housing price over this period. This factor was computed from Census Bureau price indices for sales of new single-family houses (U.S. Census, 2009d).

Example: To estimate the revenue for establishments constructing 1-4 detached housing units, multiplied the number of detached housing units sold for each lot size and sales price category by the appropriate average sales price (second column in Table 1), then multiplied the result by the percentage of single-family detached housing unit starts from establishments with 1-4 housing unit starts (6 percent; from Table 2). The resulting 2002 year revenue estimates were then adjusted to reflect 2008 prices by multiplying by 1.22, representing the change in price for single-family housing between 2002 and 2008.

Step 5: Estimate the number of single-family housing units sold by establishments within each housing starts size class. This step first involved estimating the total number of housing units sold by housing price category for establishments in each housing starts size category. First, Pechan multiplied the percentage of housing starts for each housing starts size category (Table 2) by the total number of housing units sold for each price category. Next, Pechan applied the distribution of housing units by lot size within each price category (from Step 1) to the total estimated number of housing units sold within each price category. This step yielded estimates of number of housing units sold by price and lot size for each of the six housing starts size categories identified in Table 2 (e.g., 1 to 4 housing starts).

Step 6: Estimate the average lot size for homes in each lot size range. Using the SOC microdata, Pechan identified the average lot size of detached and attached housing units for each of the lot size ranges in Table 1. These average values are displayed in Table 3.

Table 3. Average Lot Size by Lot Size Category (square feet)

Lot Size Category	Average Lot Size (Detached)	Average Lot Size (Attached)
Under 7000	5,300	3,100
7,000 to 8,999	7,800	8,000
9,000 to 10,999	10,100	9,900
11,000 to 21,999	15,500	14,700
22,000 and Over	50,900	45,500

Step 7: Estimate the disturbed acreage for single-family housing units sold by establishments for each housing starts size category. First, Pechan multiplied the number of housing units sold by price and lot size for each housing starts size category (Step 5) by the assumed average lot size for each lot size category (Table 3). The result was then multiplied by an "overhead" factor EPA estimated to account for road development associated with new construction activity (1.13 as reported in Table 4-1 of EPA's Economic Analysis (EPA, 2008). Pechan then converted square feet into acres.

Step 8: Estimate the disturbed acreage affected by Option 2 for single-family housing units sold by establishments for each housing start size category. Pechan applied a factor of 45% to each of the disturbed acreage values calculated in Step 7 to represent the estimated proportion of acreage affected by Option 2. The 45% value was computed from EPA estimates that 62.7% of residential construction acreage occurs on projects with at least 30 acres and that 71.2% of 30+ acre projects will be impacted by Option 2.

Step 9: Estimate Option 2 costs by price sales and lot size category for establishments in each housing starts size category. This step was accomplished by multiplying an estimated cost of $22,000 per disturbed acre by the estimated disturbed acreage affected by Option 2 by sales price and lot size category for establishments within each housing starts size category (from Step 8). It is important to note that unlike the cost per acre estimates developed by EPA, this cost estimate reflects an estimated 18-month project duration and the cost per disturbed acre (EPA assumed a 9-month project duration and the cost per total construction site acreage). The 18-month project duration estimate was computed for construction sites of 30+ acres from permit data reported in EPA's Notice of Intent database. Pechan derived the estimated cost/disturbed acre for Option 2 from information provided by URS Corporation (URS, 2009).[3] As a conservative assumption Pechan utilized URS cost information reflecting freeze protection for ATS equipment, but excluding a polishing filter due to uncertainty about need for this filter to meet EPA's standard.

[3] In developing the $22,000 cost/disturbed acre estimate, Pechan implemented a number of revisions to the cost estimates developed by URS. These included: revising several cost items to reflect 18-month system operation; using a fuel cost of $3/gallon rather than $5/gallon; revising the cost for chitosan per million gallons treated to $4,500, which is the mid-point of the Clear Creek cost range ($1,000-$8,000/Mgal) identified both in EPA's cost model and in EPA-HQ-OW-2008-0465-0495; and dividing total Option 2 costs by disturbed acreage rather than total acreage (an assumption that 90% of site is disturbed was adopted from EPA's cost model).

Step 10: Compute cost-to-revenue estimates. In this step, Pechan divided the cost values from Step 9 by the revenue values from Step 4. These calculations were performed for each sales price and lot size category for each of the six housing starts size categories.

Step 11: Estimate the number of establishments building single-family attached or detached housing units by each housing starts size, price, and lot size category. This step, which is necessary to determine the number of establishments with cost-to-revenue estimates at or above the 1% and 3% thresholds, assumes that the distribution of establishments by housing starts size category is equivalent to the distribution of number of housing units sold. This step was performed as follows:

1. *Divide the number of housing starts for each price category and lot size class by the total number of housing starts.*
2. *Multiply the appropriate percentage of single-family housing starts from Table 2 by the total number of establishments in the appropriate housing starts size category.*
3. *Multiply the result of (2) by the result of (1).*

Step 12: Estimate the number of establishments building single-family attached/detached housing units that are affected by Option 2. Pechan estimated the number of establishments building single-family housing units by multiplying the results of Step 11 by the 45% value used to represent the proportion of total residential construction acreage affected by Option 2 (explained in Step 8).

Step 13: Calculate the number of establishments with cost-to-revenue impacts of 1+% and the number with impacts of 3+%. Pechan finally summed the number of establishments computed in Step 12 having cost-to-revenue percentages of 1% and 3% or greater.

Results

Table 4 presents the following values estimated from the analysis described above:

- Number of residential construction establishments building detached single-family housing units and the number building attached single-family housing units by housing starts size category;
- Number of residential construction establishments building detached single-family housing units and the number building attached single-family housing units by housing starts size category for which Option 2 will result in compliance costs of at least 1% and 3% of revenues;
- Percentage of establishments with cost-to-revenue impacts of 1+% and 3+%.

As indicated by Table 4, approximately 7,800 establishments are projected to incur costs of at least 1% of revenues from Option 2. Furthermore, approximately 1,800 establishments are estimated to incur costs of at least 3% of revenues under this option. This contrasts with EPA's estimates that only 774 C&D industry firms will incur costs of 1+% of revenues, and that only 33 such firms will incur costs of 3+% of revenues.

Table 4: Estimated Number of Establishments by Cost-to-Revenue Threshold

Housing Starts Size Category	Total Number of Establishments	Number of Establishments with Cost-to-Revenue of 1+%	Number of Establishments with Cost-to-Revenue of 3+%
Single-Family Detached Housing			
1 to 4 housing starts	19,797	4,429	1,034
5 to 9 housing starts	6,494	1,453	339
10 to 24 housing starts	4,485	1,004	234
25 to 99 housing starts	2,154	482	112
100 to 499 housing starts	857	192	45
500+ housing starts	213	48	11
Total	***34,001***	***7,607***	***1,775***
	% of Total	**22%**	**5%**
Single-Family Attached Housing			
1 to 4 housing starts	1,567	84	4
5 to 9 housing starts	720	37	2
10 to 24 housing starts	766	40	2
25 to 99 housing starts	423	22	1
100 to 499 housing starts	126	7	0
500+ housing starts	29	2	0
Total	***3,631***	***193***	***9***
	% of Total	**5%**	**0%**
Total Single-Family Residential			
1 to 4 housing starts	21,364	4,514	1,038
5 to 9 housing starts	7,214	1,490	341
10 to 24 housing starts	5,251	1,044	236
25 to 99 housing starts	2,577	504	114
100 to 499 housing starts	983	198	45
500+ housing starts	242	49	11
Total	***37,631***	***7,800***	***1,785***
	% of Total	**21%**	**5%**

There are at least three major reasons why EPA's analysis is flawed. First, as detailed in a separate document, EPA's cost estimates are underestimated in a number of important ways (URS, 2009). Second, EPA's analysis is limited to firms that EPA estimates as capable of building 30+ acres in a given year. EPA's analysis of this issue is deficient in two very different ways: (a) EPA's acreage intensity approach to estimating firm revenues associated with a 30+ acre sites does not account for project durations that significantly exceed one year, which is typical for sites of this size; and (b) it is quite common for sites of this size to involve multiple construction firms (a more reasonable approach, adopted in this analysis, is to apportion total site compliance costs based on the acreage of lots built by each firm). Third, EPA's approach relies on aggregate data that do not account for differences in lot size or housing price. Such aggregate data masks the likely impacts of EPA's regulation.

Limitations and Uncertainty

It is not possible to perform an analysis that captures all of the complexities of the C&D industry due to the breadth of the industry and associated data limitations. The ideal data would identify the number of single-family housing starts (attached and detached) per establishment, the revenue to each construction firm for each housing start, the lot size for each housing start, project duration, and the total size of the development on which each housing start is constructed. Because this information is not available, the analysis is subject to a number of limitations, which are highlighted in this section.

First, it should be emphasized that this is an analysis of one sector (single-family residential construction) within the overall C&D industry. Although it is not possible to speculate as to whether impacts in other sectors will be higher or lower than estimated here, it seems reasonable to assume that many more establishments in other industry sectors will incur similar impacts as those estimated in this analysis.

In order to address data gaps, it was necessary for Pechan to assume the following parameters were constant across each of the single-family attached/detached housing starts size categories:

- The proportion of units sold by lot size and price (Step 1);
- Sales price per housing unit (Step 2);
- Lot size per housing unit (Step 6);
- Percentage of disturbed acreage, establishments, and housing units affected by Option 2 (Step 8); and
- Cost of Option 2 per disturbed acre (Step 9).

Without better information on how these parameters may differ across establishment size, it is not possible to more accurately estimate the impacts of the proposed rule.

Pechan developed revenue estimates from the sales price data provided by the Census. The Census sales price data overstates revenue accruing to building firms in that it will include revenues that accrue to other entities. In particular, such revenues include those that are paid to market the property (e.g., real estate commissions and real estate overhead), as well as closing costs that are often included in the sales price reported by the Census. On the other hand, firms that build new single-family housing units can obtain revenues from other lines of business that are not the subject of this regulation (e.g., renovations). The SBA argues, however, that the cost-to-revenue analysis is most appropriately performed using only the revenues for activities that are impacted by the regulation. To the extent that the analysis has overstated revenues, then it has underestimated the impacts of the proposed regulation (and vice-versa).

It was also necessary for Pechan to assume that the number of establishments building attached or detached housing units for each housing starts size category is proportional to the number of attached and detached housing starts reported in the 2002 *Economic Census*.

The per disturbed acre cost of Option 2 is assumed as the same across each affected entity based on national total Option 2 costs and national total estimated disturbed acreage associated with this option. All else being equal, economies of scale are expected from Option 2 because there are a number of compliance cost elements that are not proportional to site size. Such economies of scale indicate that the cost per acre for smaller construction sites will be higher than the national average (and vice-versa). The impacts estimated in this analysis do not attempt to account for such cost differentials because it is not known how they will be distributed among establishments of different sizes/revenues.

The analysis includes an overhead factor from EPA (13%) to account for non-lot size construction site acreage that is disturbed to build roads in each development. It is not clear if this factor is sufficient to cover all non-lot acreage that may be disturbed (e.g., for utilities, stormwater treatment, other purposes).

Summary

Using Census Bureau home construction data, Pechan developed a bottom-up approach to estimate the revenue generated by establishments that are responsible for the construction of single-family housing starts. The results project that thousands of these establishments will incur Option 2 compliance costs of at least 1% of revenues. This analysis only analyzed the portion of the residential construction sector dedicated to single-family housing construction. It is likely that establishments in other construction sectors – including multifamily housing construction within the residential construction sector – would also incur similar cost-to-revenue impacts from EPA's proposed regulation.

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