United States
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Agency

Economic Analysis of Proposed Effluent Limitation Guidelines and Standards for the Construction and Development Industry

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1 Introduction

EPA is proposing to establish effluent limitations guidelines (ELGs) and new source performance standards (NSPS) for stormwater discharges from the Construction and Development (C&D) industry. These guidelines and standards would require discharges from certain construction sites to meet a numeric turbidity limit. The guidelines and standards would also require all construction sites currently required to obtain a National Pollutant Discharge Elimination System (NPDES) to implement a variety of best management practices (BMPs) designed to limit erosion and control sediment discharges from construction sites. This Economic Analysis (EA) report assesses the overall cost and impact of three regulatory options, which are described below:

- *Option 1* establishes minimum sizing criteria for sediment basins used at construction sites with 10 or more disturbed acres draining to one location. Under this option, permittees would be required to install sediment basins that provide *either* 3,600 cubic feet per acre of runoff storage, or be designed to store runoff from the local 2-year, 24-hour storm event, whichever is less expensive. This option also includes requirement for implementing a variety of erosion and sediment controls on all construction sites that are required to obtain a permit.
- *Option 2* incorporates the same requirements as Option 1, but in addition, requires construction sites of 30 or more acres to meet a numeric turbidity limit in stormwater discharges from the site. The numeric turbidity standard would be applicable to stormwater discharges for all storm events up to the local 2-year, 24-hour event. The turbidity standard would only apply to construction sites located in areas where the rainfall runoff erosivity factor (R-factor) as defined in the Revised Universal Soil Loss Equation (RUSLE) is greater than or equal to 50 and if the soils on the site contain 10% or more by mass of soil particles smaller than 2 microns in diameter.
- *Option* 3 incorporates the same requirements as Option 1, but in addition, requires all sites with 10 or more acres of disturbed land to meet a numeric turbidity standard. The turbidity standard would apply to all sites, regardless of soil types or R-factor. The turbidity standard would apply to all stormwater discharges for all storm events up to the local 2-year, 24-hour event.

EPA estimates that Option 1 would cost approximately $132 million dollars per year, reduce sediment discharges from construction sites by approximately 670 million pounds per year, and result in monetized benefits of $18 million per year. EPA estimates that Option 2 would cost approximately $1.9 billion dollars per year, reduce sediment discharges from construction sites by approximately 26 billion pounds per year, and result in monetized benefits of $333 million per year. EPA estimates that Option 3 would cost approximately $3.8 billion dollars per year, reduce sediment discharges from construction sites by approximately 50 billion pounds per year, and result in monetized benefits of $471 million per year.

This EA presents analyses and findings pertaining to:

- Baseline business performance and condition of the C&D industry sectors and firms that would be affected by the proposed regulation;
- Cost and economic/financial impact of the regulatory options to these firms and to the C&D industry as a whole;
- Potential impact on the price and affordability of new single-family housing expected to be affected by the regulation;
- Total cost to society, accounting both for the cost of meeting compliance requirements and for potential changes in C&D industry output and the associated loss in societal economic welfare;

- Economy wide effects, accounting for inter-industry linkages, in terms of net change in economic output and employment;
- Potential impact on small businesses and governments in accordance with requirements of the Regulatory Flexibility Act (RFA) and the Unfunded Mandates Reform Act (UMRA); and,
- Comparison of total social costs and estimated benefits.

This chapter provides an overview of the proposed rule, the affected industries, the approach for estimating costs and impacts, and the key data sources within the economic analysis. *Section 1.1* describes the background and the purpose of the proposed rule, highlighting requirements of the effluent limitation guidelines. *Section 1.2* reviews the sectors within the C&D industry that are expected to be affected by the regulatory requirements. *Section 1.3* summarizes the analyses undertaken for assessing the costs and impacts of the regulatory options. *Section 1.4* summarizes the approach for estimating the benefits of the regulatory options. *Section 1.5* reviews key findings from the economic analysis of the regulatory options.

1.1 Background and Purpose of the Proposed Rule

The U.S. Environmental Protection Agency (EPA) is proposing Effluent Limitation Guidelines for discharges associated with construction and development activities under the authority of Sections 301, 304, 306, 308, 402, and 501 of the Clean Water Act (CWA) (the Federal Water Pollution Control Act), 33 United States Code (U.S.C.) 1311, 1314, 1316, 1318, 1342, and 1361.

Effluent Limitation Guidelines Schedule and Previous Actions Related to Construction and Development

CWA section 304(m) requires EPA to publish a plan every 2 years that consists of three elements. First, under section 304(m)(1)(A), EPA is required to establish a schedule for the annual review and revision of existing effluent guidelines in accordance with section 304(b). Section 304(b) applies to ELGs for direct dischargers and requires EPA to revise such regulations as appropriate. Second, under section 304(m)(1)(B), EPA must identify categories of sources discharging toxic or nonconventional pollutants for which EPA has not published BAT ELGs under section 304(b)(2) or new source performance standards under section 306. Finally, under section 304(m)(1)(C), EPA must establish a schedule for the promulgation of BAT and NSPS for the categories identified under subparagraph (B) not later than three years after being identified in the 304(m) plan. Section 304(m) does not apply to pretreatment standards for indirect dischargers, which EPA promulgates pursuant to sections 307(b) and 307(c) of the Act.

On October 30, 1989, Natural Resources Defense Council, Inc. (NRDC), and Public Citizen, Inc., filed an action against EPA in which they alleged, among other things, that EPA had failed to comply with section 304(m). Plaintiffs and EPA agreed to a settlement of that action in a consent decree entered on January 31, 1992 (*Natural Resources Defense Council et al v. Whitman, D.D.C.* Civil Action No. 89-2980). The consent decree, which has been modified several times, established a schedule by which EPA is to propose and take final action for 11 point source categories identified by name in the decree and for eight other point source categories identified only as new or revised rules, numbered 5 through 12. EPA selected the Construction and Development (C&D) category as the subject for new or revised rule #10. The modified decree called for the Administrator to sign a proposed ELG for the C&D category no later than May 15, 2002, and to take final action on that proposal no later than March 31, 2004. A settlement agreement between the parties, signed on June 28, 2000, requires that EPA develop regulatory options applicable to discharges from construction, development and redevelopment, covering site sizes included in the Phase I and Phase II NPDES storm water rules (i.e., 1 acre or greater). EPA is required to develop options including numeric effluent limitations for sedimentation and turbidity; control of construction site pollutants other than sedimentation and turbidity (e.g., discarded building materials, concrete truck washout,

trash); best management practices (BMPs) for controlling post-construction runoff; BMPs for construction sites; and requirements to design storm water controls to maintain pre-development runoff conditions where practicable.

On June 24, 2002, EPA published a proposed rule for the C&D category that contained several options for the control of storm water discharges from construction sites, including effluent limitation guidelines and new source performance standards. (67 FR 42644; June 24, 2002). In a final action on April 26, 2004, EPA determined that national effluent limitations guidelines would not be the most effective way to control discharges from construction sites, and instead chose to rely on the range of existing programs, regulations, and initiatives that already existed at the federal, state and local level. (69 FR 22472; April 26, 2004).

On October 6, 2004, NRDC and Waterkeeper Alliance, as well as the States of New York and Connecticut filed a motion against EPA alleging that EPA failed to promulgate ELGs and NSPSs as required by the Clean Water Act. On December 1, 2006 the district court, in *Natural Resources Defense Council, et al. v. U.S. Environmental Protection Agency, et al.*, C.D. Cal. 2006, Case No. CV 04-8307-GHK (RCx), held that CWA section 304(m), read together with CWA section 304(b), imposes on EPA a mandatory duty to promulgate effluent limitations guidelines and new source performance standards for industrial point source categories named in a CWA section 304(m) plan. The court ordered EPA to publish proposed regulations in the *Federal Register* by December 1, 2008 and to promulgate ELGs and NSPSs for the C&D category as soon as practicable, but no later than December 1, 2009. This proposal addresses the court order.

NPDES Phase I and II Storm Water Rules

As authorized by the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program was established to control water pollution by regulating point sources that discharge pollutants into waters of the United States. Storm water runoff from construction activities can have a significant impact on water quality. The NPDES storm water program requires operators of construction sites to apply for either a general permit or an individual permit under the NPDES Phase I and II storm water rules. Phase I of EPA's storm water program was promulgated in 1990 under the CWA and addresses, among other things, discharges from construction activities disturbing 5 acres or more of land. Phase II of the NPDES storm water program, promulgated in 1999, expands the Phase I Rule by addressing storm water discharges from small construction sites disturbing between 1 and 5 acres. In addition, operators of small construction sites are also required to develop and implement a storm water pollution prevention plan (SWPPP), which includes implementation of the appropriate erosion and sediment control BMPs. The BMP selection and design are at the discretion of permittees (in conformance with applicable state or local requirements). Moreover, construction activities disturbing less than 1 acre are also included in Phase II of the NPDES storm water program if they are part of a larger common plan of development or sale with a planned disturbance of greater than or equal to 1 acre and less than 5 acres, or if they are designated by the NPDES permitting authority.

Most states are authorized to implement the storm water NPDES permitting program. However, EPA remains the permitting authority in a few states, territories, and on most land in Indian Country. For construction (and other land disturbing activities) in areas where EPA is the permitting authority, operators must meet the requirements of the EPA Construction General Permit (CGP).

The current CGP became effective on July 1, 2003 (as modified effective January 21, 2005) and expires on July 1, 2008. The permit expands coverage from the 1998 CGP that provided coverage for large construction sites (i.e., those disturbing greater than 5 acres) to include both small and large construction activities (i.e., any project disturbing greater than 1 acre). Small construction activity was added to the CGP in response to the promulgation of the NPDES Phase II Rule.

1.2 Industries and Activity Affected by the Proposed Regulation

Table 1-1 presents the C&D industry sectors that are expected to be affected by the regulatory requirements. These industries are reported in the current North American Industrial Classification System (NAICS) framework. A detailed characterization of the industry sectors and of those sectors included within this EA is provided in the Economic Profile of the Construction and Development Industry (*Chapter 2*). The following *Table 1-2* summarizes the number of firms by principal industry segment and associated construction activity (in acreage) that are estimated to incur costs under the regulatory options considered in this EA.

Table 1-1: Industries Potentially Affected by the Proposed Rulemaking

NAICS Code	Sector Name	Sector Description
236	**Construction of buildings**	
2361	Residential building construction	
236115	New Single-Family Housing Construction (except Operative Builders)	General contractor establishments primarily responsible for the entire construction of new single-family housing, such as single-family detached houses and town houses or row houses where each housing unit is either separated from its neighbors by a ground-to-roof wall or has no housing units constructed above or below. This industry includes general contractors responsible for the on-site assembly of modular and prefabricated houses. Single-family housing design-build firms and single-family construction management firms acting as general contractors are included in this industry.
236116	New Multifamily Housing Construction (except Operative Builders)	General contractor establishments responsible for the construction of new multifamily residential housing units (e.g., high-rise, garden, and town house apartments and condominiums where each unit is not separated from its neighbors by a ground-to-roof wall). Multifamily design-build firms and multifamily housing construction management firms acting as general contractors are included in this industry.
236117	New Housing Operative Builders	Operative builders primarily responsible for the entire construction of new houses and other residential buildings, single-family and multifamily, on their own account for sale. Operative builders are also known as speculative or merchant builders.
2362	Nonresidential building construction	
236210	Industrial Building Construction	Establishments primarily responsible for the construction (including new work, additions, alterations, maintenance, and repairs) of industrial buildings (except warehouses). The construction of selected additional structures, whose production processes are similar to those for industrial buildings (e.g., incinerators, cement plants, blast furnaces, and similar nonbuilding structures), is included in this industry. Also included in this industry are industrial building general contractors, industrial building operative builders, industrial building design-build firms, and industrial building construction management firms.
236220	Commercial and Institutional Building Construction	Establishments primarily responsible for the construction (including new work, additions, alterations, maintenance, and repairs) of commercial and institutional buildings and related structures, such as stadiums, grain elevators, and indoor swimming pools. This industry includes establishments responsible for the on-site assembly of modular or prefabricated commercial and institutional buildings. Included in this industry are commercial and institutional building general contractors, commercial and institutional building operative builders, commercial and institutional building design-build firms, and commercial and institutional building project construction management firms.
237	**Heavy and civil engineering construction**	
2371	Utility system construction	
237110	Water and Sewer Line and Related Structures Construction	Establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to water and sewer line and related structures construction. All structures (including buildings) that are integral parts of water and sewer networks (e.g., storage tanks, pumping stations, water treatment plants, and sewage treatment plants) are included in this industry.
237120	Oil and Gas Pipeline and Related Structures Construction	Establishments primarily engaged in the construction of oil and gas lines, mains, refineries, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to oil and gas pipeline and related structures construction. All structures (including buildings) that are integral parts of oil and gas networks (e.g., storage tanks, pumping stations, and refineries) are included in this industry.
237130	Power and Communication Line and Related Structures Construction	Establishments primarily engaged in the construction of power lines and towers, power plants, and radio, television, and telecommunications transmitting/receiving towers. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to power and communication line and related structures construction. All structures (including buildings) that are integral parts of power and communication networks (e.g., transmitting towers, substations, and power plants) are included.
2372	Land Subdivision	
237210	Land Subdivision	Establishments primarily engaged in servicing land and subdividing real property into lots, for subsequent sale to builders. Servicing of land may include excavation work for the installation of roads and utility lines. The extent of work may vary from project to project. Land subdivision precedes building activity and the subsequent building is often residential, but may also be commercial tracts and industrial parks. These establishments may do all the work themselves or subcontract the work to others. Establishments that perform only the legal subdivision of land are not included in this industry.
2373	Highway, Street, and Bridge Construction	

Table 1-1: Industries Potentially Affected by the Proposed Rulemaking

NAICS Code	Sector Name	Sector Description
237310	Highway, Street, and Bridge Construction	Establishments primarily engaged in the construction of highways (including elevated), streets, roads, airport runways, public sidewalks, or bridges. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to highway, street, and bridge construction (e.g., installing guardrails on highways).
2379	Other Heavy and Civil Engineering Construction	
237990	Other Heavy and Civil Engineering Construction	Establishments primarily engaged in heavy and engineering construction projects (excluding highway, street, bridge, and distribution line construction). The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to engineering construction projects (excluding highway, street, bridge, distribution line, oil and gas structure, and utilities building and structure construction). Construction projects involving water resources (e.g., dredging and land drainage), development of marine facilities, and projects involving open space improvement (e.g., parks and trails) are included in this industry.

Source: U.S. Census Bureau's Economic Census (2005a)

EPA anticipates that some businesses and activities in the *Heavy Construction* sector (NAICS 237) will be affected by the Construction rule. However, with the exception of NAICS 237310 (*Highway, street, and bridge construction*), data are not available to support an assessment of the number and character of projects performed by NAICS 237 sector businesses that would be subject to compliance requirements and incur compliance costs. For this reason, of the sectors in NAICS 237, only NAICS 237310 (*Highway, street, and bridge construction*) is considered in the cost and impact analysis for the Construction rule.

Table 1-2: Firms and Activity (Acreage) Estimated to Incur Costs because of the Proposed Rule

NAICS Code	Sector Name	Option 1	Option 2	Option 3
Firms (Number)				
236115	New Single-Family Housing Construction (except Operative Builders)	325	598	1,396
236116	New Multifamily Housing Construction (except Operative Builders)	122	263	514
236117	New Housing Operative Builders	724	1,536	2,967
236210	Industrial Building Construction	118	272	430
236220	Commercial and Institutional Building Construction	1,422	2,853	6,365
237310	Highway, Street, and Bridge Construction	495	873	2,093
Total		**3,207**	**6,396**	**13,765**
Activity (Acreage)				
236115	New Single-Family Housing Construction (except Operative Builders)	12,268	29,891	56,008
236116	New Multifamily Housing Construction (except Operative Builders)	6,582	14,144	29,321
236117	New Housing Operative Builders	40,049	94,566	172,880
236210	Industrial Building Construction	6,018	16,468	22,954
236220	Commercial and Institutional Building Construction	42,198	100,416	191,162
237310	Highway, Street, and Bridge Construction	12,021	34,133	51,727
Total		**119,136**	**289,617**	**524,052**

EPA Estimates

1.3 Overview of Approach for Assessing Cost and Impact of the Proposed Rule

For each of the regulatory options, EPA estimated total affected acreage and compliance cost from an engineering assessment of compliance requirements and construction activity that is likely to be affected by the specific requirements of a regulatory option. The costs were broken out by state, project size, and by the general industry sector (i.e., residential, non-residential, and transportation). To analyze the costs and impact of the proposed C&D industry regulation, EPA first identified and described the baseline condition of the economic entities expected to be subject to the regulation. EPA then used multiple approaches to assess the incremental changes in the baseline conditions of the affected entities and industries incurring compliance costs. *Chapter 2, Economic Profile of the Construction and Development Industry* identifies and characterizes the establishments, firms, employees, and revenue by the specific industry segments at the establishment- and firm-level. The profile also presents recent industry trends, industry characteristics, industry dynamics and an industry forecast. This information is important

for establishing and understanding C&D industry analysis baseline, which is detailed in *Chapter 4 Developing the Analysis Baseline.*

EPA used a number of methods to assess the economic impacts of the regulatory options on C&D businesses and consumers at the project-level, firm- and industry-level, regional-level, and at the state- and national-level. The methodologies developed within each of these sections – along with information from the industry profile – also provide the framework for developing key baseline metrics (*Chapter 4*).

EPA undertook six analyses to examine the costs and impacts of the proposed rule. Additional analyses describing small business impacts and government-level impacts are also included within this EA. However, the key analysis for estimating the impact of the proposed rule is the Firm- and Industry-Level Analysis. This analysis provides total cost and impact measures based on the model firm. Brief summaries of the six analyses conducted by EPA are below. More detailed descriptions of the methodologies for each of these analyses can be found in *Chapter 3*.

- *Analysis of Project-Level Costs and Economic Impacts*. Assessment of compliance costs and economic impacts for model C&D projects. The primary purpose of the model building project framework is to develop the incremental compliance cost multipliers that are used to incorporate overhead, debt, and equity cost considerations into the per-acre engineering compliance cost estimates in subsequent analyses outlined in this document.
- *Analysis of Firm- and Industry-Level Economic Impacts*. Assessment of the cost and economic/financial impact of regulatory requirements on C&D industry firms, and the potential industry-level effects in terms of numbers of firms that may be adversely affected, potential employment at risk, and total costs to the C&D industry for regulation compliance.
- *Analysis of Single-Family Housing Affordability Impacts.* A regional assessment of housing affordability, where effects are assessed in terms of the expected change in price for median- and lower-quartile priced new single-family homes and the associated number of prospective home buyers whose purchasing decision may be affected due to these potential price effects.
- *Analysis of Social Cost.* A state-level assessment of partial equilibrium market effects in the C&D industry building sectors is used to adjust the initial firm-level analysis estimate of resource cost of compliance for the likely reduction in the quantity of C&D industry output. The analysis also estimates the overall deadweight welfare loss to society arising from the change in each market's equilibrium point. The quantity-effect-adjusted resource cost of compliance and the total dead weight loss comprise two components of the total social cost of the proposed rule. The analysis also estimates administrative costs to governments, which is an additional component of total social cost.
- *Analysis of Economy-Wide Economic Effects.* An input-output analysis is performed that considers total economy effects – in terms of output and employment – by estimating the total change in demand for society's resources arising from (1) compliance outlays, (2) the reduction in C&D industry output, and (3) administrative costs to governments. The analysis also estimates the net change in demand for society's resources based on the economic effects arising from these two mechanisms of effect, i.e. output and employment.
- *Future Projections of Compliance Cost* and Acreage. Analysis that projects forward the estimated quantity of compliance acreage and cost to more accurately reflect the industry's anticipated activity level during 2009, when regulatory compliance begins, and beyond. This analysis accounts for the expected phase-in of compliance cost over the first five years after promulgation reflecting the renewal of CGP permits by states in different years.

1.4 Summary of Approach for Assessing Benefits of the Proposed Rule

EPA analyzed four categories of quantifiable monetary benefits from the proposed C&D regulation:

- ***Benefits to Navigation***. Navigable waterways are often dredged to maintain their navigable depth and width. Reduced sediment settling in navigable channels is expected to reduce the frequency and therefore cost of dredging in these channels, as frequency and cost are related to the amount of sediment accumulated over time and therefore needed to be dredged;
- ***Benefits to Water Storage***. Water storage facilities, commonly called reservoirs, may also be dredged in order to regain capacity lost to sediment build-up. Reduced sediment settling in reservoirs is also expected to reduce the frequency and cost of dredging in reservoirs that are dredged;
- ***Benefits to Drinking Water Treatment***. Drinking water must be treated for sediment in turbidity, among other things, and treatment costs are related to the sediment and turbidity levels of the influent water. Reducing sediment and subsequently the turbidity that must be treated by drinking water treatment plants reduces the amount of chemicals needed for treatment, and also the amount of sludge generated from this treatment that must be disposed; and,
- ***Water Quality Benefits.*** Reducing sediment levels in waterways has the general effect of improving water quality, as suspended sediment is one of the determinants of water quality. Increased water quality increases both the use and non-use value of waterbodies. EPA quantified the increased use value using willingness-to-pay estimates based on a meta-analysis of existing willingness-to-pay studies for improved water quality.

The analysis methodology and findings for these benefit categories are presented in *Sections 6.1 – 6.6*. The total benefit resulting from the reduced sediment and turbidity levels in U.S. waters induced by this regulation is estimated as the sum of these four mutually exclusive categories of monetary benefits. Total benefits are summarized in *Section 6.5*. Lastly, *Section 6.6* summarizes the key uncertainties and limitations underlying the analyses presented for each benefits category.

1.5 Overview of Economic Analysis Results

1.5.1 Firm- and Industry-Level Impact Results

The estimated levels of cost, affected acreage, and resulting firm and industry impacts reported in *Table 1-3* vary substantially over the three primary regulatory options analyzed.

- For *Option 1*, the least costly of the three options, EPA estimates total costs of $132 million ($2008) occurring on a total of 119,000 affected acres. A total of 3,200 firms are estimated to incur compliance costs under this option. Out of these 3,200 firms, none are estimated to incur costs exceeding 1 or 3 percent of revenue, while 17 firms are estimated to incur financial stress. These 17 firms represent 0.5 percent of all firms incurring cost and essentially zero percent of all firms in the affected industry sectors. A total of 18 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.
- For *Option 2*, EPA estimates total costs of $1,890 million ($2008) occurring on a total of 290,000 affected acres. Thus, cost and affected acreage under Option 2 are approximately 14.3 and 2.4 times the corresponding values under Option 1. A total of 6,400 firms are estimated to incur compliance costs under this option. Out of these 6,400 firms, 774 are estimated to incur costs exceeding 1 percent of revenue, and

33 are estimated to incur costs exceeding 3 percent of revenue. The 774 firms incurring cost exceeding 1 percent of revenue represent 12 percent of the firms that are estimated to incur costs, but less than 1 percent of all firms in the affected industry sectors. When the effect of cost pass-through is accounted for in the cost-to-revenue analysis – i.e., costs are reduced by the amount of estimated offsetting revenue increase – 15 firms are estimated to incur (*net*) costs exceeding 1 percent of revenue. A total of 147 firms are estimated to incur financial stress as a result of regulatory requirements. These 147 firms represent 2.3 percent of all firms incurring cost but less than 0.1 percent of all firms in the affected industry sectors. A total of 103 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

- For *Option 3*, the most costly option, EPA estimates total costs of $3,797 million ($2008) occurring on a total of 524,000 affected acres. Thus cost and affected acreage under Option 3 are approximately of 2.0 and 1.8 times the corresponding values under Option 2. A total of 13,800 firms are estimated to incur compliance costs under this option. Out of these 13,800 firms, 2,475 are estimated to incur costs exceeding 1 percent of revenue, and 146 are estimated to incur costs exceeding 3 percent of revenue. The 2,475 firms with cost greater than 1 percent of revenue represent 18 percent of firms estimated to incur costs and 2.4 percent of all firms in the affected industry sectors. The 220 firms incurring cost greater than 3 percent of revenue represent 1.6 percent of firms estimated to incur costs. When the effect of cost pass-through is accounted for in the cost-to-revenue analysis – i.e., costs are reduced by the amount of estimated offsetting revenue increase – 39 firms are estimated to incur (*net*) costs exceeding 1 percent of revenue. A total of 445 firms are estimated to incur financial stress as a result of regulatory requirements. These 445 firms represent 3.2 percent of all firms incurring cost but 0.3 percent of all firms in the affected industry sectors. A total of 389 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

Table 1-3: Summary of Cost and Economic Impact Analysis for Proposed Rule Options

Impact Analysis Concept		Option 1	Option 2	Option 3
Resource Cost of Compliance and Affected Acreage and Firms (before market adjustments)				
Total Costs (millions of $2008)		$132	$1,890	$3,797
Total Acreage Incurring Cost[a]		119,136	289,617	524,052
Number of Firms	All Firms	152,298	152,298	152,298
	Firms In-Scope	81,628	81,628	81,628
	Firms Incurring Cost	3,207	6,396	13,765
Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact				
Costs Unadjusted for Effect of Cost Pass-Through				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	774	2,475
	% of All Firms	0.0%	0.5%	1.6%
	% of Firms In-Scope	0.0%	0.9%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	33	146
	% of All Firms	0.0%	0.0%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.2%
Costs Adjusted for Effect of Cost Pass-Through[b]				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	15	39
	% of All Firms	0.0%	0.0%	0.0%
	% of Firms In-Scope	0.0%	0.0%	0.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	0
	% of All Firms	0.0%	0.0%	0.0%
	% of Firms In-Scope	0.0%	0.0%	0.0%
Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance				
Firms Incurring Financial Stress	Number Incurring Effect	17	147	445
	% of All Firms	0.0%	0.1%	0.3%
	% of Firms In-Scope	0.0%	0.2%	0.5%
Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)				
Firms with Negative Business Value Because of Regulation (Potential Closures)	Number Incurring Effect	18	103	389
	% of All Firms	0.0%	0.1%	0.3%
	% of Firms In-Scope	0.0%	0.1%	0.5%

a Option costs for the economic impact analysis vary slightly from the engineering compliance cost estimates due to the reconciliation process described in *Chapter **4***.

b Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors.

EPA Estimates

1.5.2 Single-Family Housing Affordability Analysis Results

EPA assessed the potential affordability effects of the proposed regulation on prospective purchasers of new single-family homes. EPA performed this assessment on a MSA-by-MSA basis, accounting for differences in home prices and household incomes by MSA and differences in compliance costs by state. To account for potential differences in effect by housing price and by the numbers of households with incomes able to *just* afford a given home, EPA performed the assessment at two baseline single-family home price levels – median- and lower-quartile price home, by MSA.

Table 1-4 reports, by regulatory option, the results of the affordability analysis for the *median price* home. The table reports the estimated dollar value and percentage change in the price for a new single-family home and the number of households in the market for a new, median-priced single family home whose purchasing decision may be practically affected by the price change. The price increase assumes: (1) a compliance cost based on the median lot size, 0.23 acres, for all new single-family housing as reported in the Census of Housing and (2) that compliance costs are fully passed through as an increased price to the home purchaser.[1] This table also reports the number of affected households as a percentage of the total number of home-purchasing households that also

[1] The 0.23 acre lot size is the median value for new single-family housing as reported in the Census' *2006 Characteristics of New Housing*, adjusted for additional land development associated with roadways, which is not accounted for in the Census' lot size data.

qualify to purchase the median-priced home, before compliance cost effect. The key conclusion from this analysis is that, for all regulatory options, the total number of households incurring an affordability effect is small in comparison to the number of all likely single-family home buyers in any given year who can also afford the same home. For Option 2, this percentage is less than 0.1 percent.

Table 1-4 also reports the effect of the estimated national average change in home prices on a typical monthly payment by comparing the baseline and post-compliance monthly payments for each option. For example, the median home price analysis shows increases in monthly payments of $1 for *Option 1*, $14 for *Option 2*, and $15 for *Option 3*. In each case, the percentage increase in the monthly payment due to regulatory requirements is low – for example, 0.69 percent for Option 2.

The table also presents the fraction of household income required to be saved to offset the effect of the regulation on the monthly mortgage payment via an increase in the initial down-payment. The table shows the fraction of income required to be saved in order to accumulate the increase in down-payment over 3, 6, and 12 month periods. In each case, the income used in the calculation is the income at which the prospective home buyer would just be able to purchase the home at the baseline price under conventional financing criteria. The results show, for example, that under Option 2, a household would need to set-aside 5.7% of their income over a 6-month period to offset the regulation's effect on the mortgage payment. The fraction of income required to be saved decreases, *for any savings time period*, for households that earn income in excess of this minimum income requirement. Therefore, the affordability effects in this table are overstated to the extent that the income of the households that are interested in purchasing the median-priced home exceeds the minimum income threshold value.

Table 1-4: Median-Price, Single-Family Housing Affordability Analysis (2006$)

Price and Household Affordability Effects				
		Option 1	**Option 2**	**Option 3**
National Average Price Change per New Single-Family Home	Price Change[a]	$330	$2,061	$2,242
	Percent Change[b]	0.10%	0.64%	0.70%
Number of Households with an Affordability Effect	Number	39	2,195	4,523
	As % of qualifying single-family buyers	0.00%	0.08%	0.17%
Change in the Monthly Mortgage Payment[c]				
		Option 1	**Option 2**	**Option 3**
Baseline Weighted Average Monthly Mortgage Payment		$1,971	$1,971	$1,971
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,972	$1,985	$1,986
	Percent Change	0.02%	0.69%	0.75%
Change in Down-Payment Required to Offset Effect of the Regulation				
	Baseline	**Option 1**	**Option 2**	**Option 3**
Income necessary to pay baseline mortgage PITI	$72,464			
Required increase in down-payment to offset regulation price effect	$0	$330	$2,064	$2,245
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.5%	2.8%	3.1%
6 months	0.0%	0.9%	5.7%	6.2%
3 months	0.0%	1.8%	11.4%	12.4%

a These are national average price changes estimated from the national average engineering estimate of per acre compliance cost converted to the equivalent of compliance costs per housing unit. Price changes for MSAs are estimated individually using engineering estimates of state-level compliance costs.

b The national average percent change in home price is estimated using the national average price change and the weighted-average median home price across all 543 MSAs.

c These values are weighted by the number of households within each state.

EPA Estimates

Below, *Table 1-5* presents the results of the affordability analysis for the *lower-quartile* priced home. In performing this analysis, EPA used an additional, *smaller lot size* case to reflect the observation, from Census data, that lot size tends to decline with home price. As a result, the compliance cost burden and potential price increase for the lower quartile price home will tend to be lower than the values for the median price home. The smaller lot size is based on the *median* of lot sizes for *attached* new single-family housing, 0.08 acres, as reported

in the Census of Housing for 2006. The table reports, by regulatory option and for the two lot size cases, the estimated dollar value and percentage change in the price for a new single-family home and the number of households with an affordability effect. As expected, the number of households estimated to incur annually the affordability effect is smaller under the smaller lot size case of 0.08 acres (based on the median lot size for *attached* new single-family housing) than under the larger lot size of 0.23 acres (based on the median lot size for *all* new single-family housing): under Option 2, the estimated number of affected households declines from 3,243 to 1,165. Because, from Census data, lot size tends to decline with home price, EPA judges that the smaller lot size provides a better basis for assessing the affordability effect for the lower-quartile price analysis than the larger lot size used in the analysis for the median price. Regardless of the lot size case, the number of affected home buyers is small in relation to the number of single-family home purchasers who qualify to purchase the lower-quartile price home in the baseline (e.g., about 0.03% to 0.08% of such households, depending on the lot size case).

Table 1-5 also reports the effect of the estimated national average change in lower-quartile home prices on the total monthly payment by comparing the baseline and post-compliance monthly payments for each option and for the two lot size cases outlined above. The analysis shows small increases in monthly payments, ranging from 0.36% - 1% for Option 2, depending on the lot size case.

Lastly, the table presents the fraction of household income required to be saved to offset the effect of the regulation on the monthly mortgage payment via an increase in the initial down-payment. For Option 2, a household would need to set-aside between 3% and 8.5% of its income over a 6-month period to offset the regulation's effect on the mortgage payment.

Table 1-5: Lower-Quartile Price, Single-Family Housing Affordability Analysis (2006$)

Price and Household Affordability Effects				
		Option 1	**Option 2**	**Option 3**
Using Median Lot Size (0.23 acres) for All New Single-Family Housing as Basis for Compliance Cost				
National Average Price Change per New Single-Family Home	Price Change[a]	$330	$2,061	$2,242
	Percent Change[b]	0.16%	1.03%	1.12%
Number of Households with an Affordability Effect	Number	53	3,243	6,633
	As % of qualifying single-family home buyers	0.00%	0.08%	0.16%
Using Median Lot Size (0.08 acres) for Attached New Single-Family Housing as Basis for Compliance Cost				
National Average Price Change per New Single-Family Home[a]	Price Change	$118	$738	$803
	Percent Change	0.06%	0.37%	0.40%
Number of Households with an Affordability Effect	Number	19	1,165	2,384
	As % of qualifying single-family home buyers	0.00%	0.03%	0.06%
Change in the Monthly Mortgage Payment[c]				
		Option 1	**Option 2**	**Option 3**
Using Median Lot Size (0.23 acres) for All New Single-Family Housing as Basis for Compliance Cost				
Baseline Weighted Average Monthly Mortgage Payment		$1,358	$1,358	$1,358
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,359	$1,372	$1,373
	Percent Change	0.04%	1.00%	1.09%
Using Median Lot Size (0.07 acres) for Attached New Single-Family Housing as Basis for Compliance Cost				
Baseline Weighted Average Monthly Mortgage Payment		$1,358	$1,358	$1,358
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,359	$1,363	$1,364
	Percent Change	0.01%	0.36%	0.39%
Change in Down-Payment Required to Offset Effect of the Regulation				
	Baseline	**Option 1**	**Option 2**	**Option 3**
Using Median Lot Size (0.23 acres) for All New Single-Family Housing as Basis for Compliance Cost				
Income necessary to pay baseline mortgage PITI	$49,660			
Required increase in down-payment to offset regulation price effect	$0	$330	$2,064	$2,245
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.7%	4.2%	4.5%
6 months	0.0%	1.3%	8.5%	9.0%
3 months	0.0%	2.7%	16.9%	18.1%
Using Median Lot Size (0.07 acres) for Attached New Single-Family Housing as Basis for Compliance Cost				
Income necessary to pay baseline mortgage PITI	$49,660			
Required increase in down-payment to offset regulation price effect	$0	$118	$739	$804
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.2%	1.5%	1.6%
6 months	0.0%	0.5%	3.0%	3.2%
3 months	0.0%	1.0%	6.0%	6.5%

a These are national average price changes estimated from the national average engineering estimate of per acre compliance cost converted to the equivalent of compliance costs per housing unit. Price changes for MSAs are estimated individually using engineering estimates of state-level compliance costs.

b The national average percent change in home price is estimated using the national average price change and the weighted-average lower-quartile home price across all 543 MSAs.

c These values are weighted by the number of households within each state.

EPA Estimates

1.5.3 Social Cost of the Proposed Options

The total social cost of the regulatory options is comprised of the quantity-adjusted resource cost of compliance, the deadweight welfare loss to society, and administrative costs to governments. The results of the social cost analysis are presented in *Table 1-6*.

For *Option 1*, the least costly option, the total social cost is approximately $132 million with the total deadweight loss under $1 million (approximately $40,000). For *Option 2*, the total social cost is approximately $1,887 million with approximately $3.5 million in deadweight loss. *Option 3*, the most costly option, has a total social cost of approximately $3,790 million with approximately $8.2 million in deadweight loss.

Table 1-6: Total Social Cost of the Proposed Regulation (millions of $2008)

	Option 1	Option 2	Option 3
Total Resource Costs, Unadjusted for Quantity Effect	$132	$1,890	$3,797
Change in Resource Costs Due to Quantity Effect	$0.1	$7	$16
Total Resource Costs, Adjusted for Quantity Effect	$132	$1,883	$3,780
Deadweight Loss	$0.0	$3.5	$8.2
Federal, State, and Local Government Cost for DMR Review & Processing	$0.0	$0.7	$1.2
Total Social Cost of the Regulation	$132	$1,887	$3,790
Total Acreage Incurring Cost	119,071	288,757	522,300

EPA Estimates

1.5.4 Economy-Wide Effects of the Proposed Options

EPA also estimated the total economic effects on output and employment due to the direct effects of the regulatory options. The analysis of total economic effects accounts for inter-industry linkages in the national economy by estimating the magnitude of output and employment changes derived from the resource cost of compliance, the direct change C&D industry output, and the output and employment effects resulting from administrative activities performed by Federal, State, and Local governments. EPA used input-output multipliers from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) to estimate the total economic effects of each option on the overall U.S. economy. The results are presented in *Table 1-7*.

Table 1-7: Total Economic Output and Employment Effects (millions of $2008)

	Option 1	Option 2	Option 3
Economic Effects Arising from the Resource Cost of Compliance			
Total Change in Economic Output Arising from Compliance Cost Outlays	$271	$3,856	$7,743
Total Change in Employment Arising from Compliance Cost Outlays (jobs)	471	6,698	13,450
Economic Effects Arising from the Change in C&D Industry Output			
Change in C&D Industry Output	($126)	($3,102)	($3,500)
Direct Employment Effect from Reduced C&D Industry Output (jobs)	(4)	(87)	(98)
Total Change in Economic Output from Reduced C&D Industry Output	($257)	($6,345)	($7,159)
Total Change in Employment from Reduced C&D Industry Output (jobs)	(98)	(2,407)	(2,716)
Economic Effects Arising from Government Administrative Cost			
Total Change in Economic Output Arising from Government Admin Cost	$0	$1.2	$2.0
Total Change in Employment Arising from Government Admin Cost (jobs)	0	0.1	0.3
Net Economic Effects on Output and Employment			
Net Change in Demand for Society's Resources, Measured in Economic Output	$14	($2,489)	$584
Net Change in Demand for Society's Resources, Measured in Employment (jobs)	373	4,291	10,734

EPA Estimates

1.5.5 Projection of Costs and Acreage

Because the detailed cost and economic impact analysis was performed for the baseline analysis year of 2002, EPA projected total social cost to 2010 to reflect the C&D industry's anticipated activity level at the time the rule would be effective. EPA also projected total social cost to 2025 to capture the fuller cost effect of the rule over time. In this analysis, EPA accounted for the expected phase-in of compliance across over the first five years after promulgation as states renew their Construction General Permit, which will adopt and apply the provisions of this regulation to construction and development activities in their states (i.e., not all states will come into compliance during 2009; compliance will phase-in from 2010 to 2014).

The results presented below in *Table 1-8* differ in two important ways from the primary estimates of total social cost in *Table 1-6*: they account for the phase-in of compliance from 2010 to 2014 as states renew their CGPs, and they account for the expected change in industry activity from 2002 to each year from 2010 and beyond. In *Table*

1-8, the first year of full compliance is 2014 because this is the first year when all states will have renewed their CGPs. In that year, the estimated total cost for Option 2 is $2,178 million. The difference between the 2002 estimate of $1,887 million and the estimate of $2,178 in 2014 results from the expected increase in overall C&D industry activity. In 2010, the total cost of Option 2 is expected to be $173 million; this lower value reflects the fact that not all states are expected to have adopted the rule at that time, based on the expected schedule for states' renewal of their CGPs.

Table 1-8: Total Value of Construction Activity and Social Cost, by Year (Accounting for State-Specific Phase-In Beginning 2009 (millions of $2008))

	2010	2011	2012	2013	2014	2020	2025
Total Value of Construction	$1,214,460	$1,283,936	$1,316,002	$1,351,038	$1,387,007	$1,623,850	$1,851,833
annual percent change	*5.1%*	*5.7%*	*2.5%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*
Total Estimated Acreage	595,473	629,538	645,261	662,440	680,076	796,204	907,989
Annual percent change	*5.1%*	*5.7%*	*2.5%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*
Intensity (acres per $million)	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Estimated Compliance Cost and In-Scope Acreage							
Option 1							
Cost	$0	$10	$49	$149	$153	$179	$204
Acres Incurring Cost	0	15,932	49,035	133,708	137,268	160,707	183,270
Cost as % of Value	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%
Option 2							
Cost	$173	$292	$583	$1,831	$2,178	$2,550	$2,908
Acres Incurring Cost	23,789	45,998	94,514	270,161	333,695	390,676	445,526
Cost as % of Value	0.01%	0.02%	0.04%	0.14%	0.16%	0.16%	0.16%
Option 3							
Cost	$284	$518	$1,115	$3,724	$4,376	$5,123	$5,842
Acres Incurring Cost	41,105	77,289	167,050	481,995	603,809	706,914	806,162
Cost as % of Value	0.02%	0.04%	0.08%	0.28%	0.32%	0.32%	0.32%

EPA Estimates

Table 1-9 presents EPA's estimate of the annualized value of total social cost from 2009 through 2025, using both a 3% and 7% discount rate (in 2008 dollars). The annualized cost of Option 2 is $1,829 to $1,970 million, depending on the discount rate.

Table 1-9: Annualized Total Social Cost of the Proposed Regulation, 2009 - 2025 (millions of $2008)

Regulatory Option	Net Present Value of Social Cost		Annualized Social Cost	
	3%	*7%*	*3%*	*7%*
Option 1	$1,737	$1,212	$138	$128
Option 2	$24,744	$17,280	$1,970	$1,829
Option 3	$49,578	$34,590	$3,947	$3,662

EPA Estimates

1.5.6 Regulatory Flexibility Analysis Results (RFA)

The RFA provides that EPA generally define small businesses according to the size standards established by SBA. Based on SBA's size criteria, EPA estimates that, of the 152,300 firms in the C&D industry sectors of concern for this regulation, approximately 148,800 firms – or about 98 percent – are defined as small businesses. Although a large percentage, and large absolute number, of C&D businesses are small businesses, EPA's analysis found that many of these firms are not likely to complete projects that fall within the coverage size thresholds of the regulatory options considered in this analysis. As shown in *Table 1-10*, EPA estimated that a much smaller number of small businesses – approximately 78,100 firms – are capable of performing in-scope projects than the total of small businesses, approximately 148,800, in the total Construction industry. From this analysis, 70,700, or 47 percent, of the small businesses in the Construction industry sectors of concern are estimated *not* to be capable of performing in-scope projects.

The impacts of these regulatory options on small businesses are summarized below:

- For *Option 1,* EPA estimates that approximately 2,300 small businesses will incur costs. These 2,300 firms represent about 1.5 percent of all estimated small businesses in the affected C&D sectors and 3 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. EPA estimates that none of these small businesses incur costs exceeding 1 or 3 percent of revenue, regardless of whether the expected increased revenue offset to compliance costs is accounted for in the cost-to-revenue comparison. In these 2,300 firms, EPA estimates that 12 will potentially incur financial stress as a result of the regulatory option and 14 would potentially incur negative net business value – an indicator of potential closure. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive. The number of small businesses estimated to incur financial stress or potential closure, represent approximately 0.01 percent of the total small businesses in the C&D sectors and about 0.02 percent of those estimated potentially in-scope small businesses.
- For *Option 2,* EPA estimates that approximately 3,700 small businesses will incur costs. These 3,700 firms represent about 2.5 percent of all estimated small businesses in the affected C&D sectors and 5 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. For this option, EPA estimates that about 395 small businesses would incur costs exceeding 1 percent of revenue and 17 small businesses would incur costs exceeding 3 percent of revenue – without accounting for the expected cost pass-through offset to compliance costs. Both numbers represent very small percentages of the small firm universes. The 395 firms estimated to incur costs exceeding 1 percent of revenue represent about 0.2 percent of all small C&D sector firms and 0.5 percent of estimated potentially in-scope small businesses. The 17 firms estimated to incur costs exceeding 3 percent of revenue are less than one-tenth of a percent of both small business counts. If the expected cost pass-through offset to compliance costs is accounted for in the cost-to-revenue calculation, 7 small businesses are estimated to incur costs exceeding 1 percent of revenue and none are estimated to incur costs exceeding 3 percent of revenue. EPA estimates that 81 small businesses will potentially incur financial stress and 56 are potential closures. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive. Although these impact values are higher than the numbers for Option 1, the Option 2 estimates remain small percentages of the small firm counts.
- *Option 3* imposes a higher economic/financial burden on small businesses than Option 2, although the impact values, when considered as percentages of total and in-scope small businesses, remain small. For Option 3, EPA estimates that approximately 10,200 small businesses will incur costs. These 10,200 firms represent about 7 percent of all estimated small businesses in the affected C&D sectors and 13 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. For this option, EPA estimates that 1,868 small businesses would incur costs exceeding 1 percent of revenue and 111 small businesses would incur costs exceeding 3 percent of revenue – again, without accounting for the expected cost pass-through offset to compliance costs. The 1,868 firms estimated to incur costs exceeding 1 percent of revenue represent about 1 percent of all small C&D sector firms and 2 percent of estimated potentially in-scope small businesses. The 111 firms estimated to incur costs exceeding 3 percent of revenue are 0.1 percent of the small in-scope firms. If the expected cost pass-through offset to compliance costs is accounted for in the cost-to-revenue calculation, 28 small businesses are estimated to incur costs exceeding 1 percent of revenue and no small businesses are estimated to incur costs exceeding 3 percent of revenue. EPA estimates that 318 small businesses will potentially incur financial stress and 295 are potential closures. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

Table 1-10: Summary of Small Business Cost and Impact Analysis for C&D Rule Options

Impact Analysis Concept		Option 1	Option 2	Option 3
Resource Cost of Compliance and Affected Acreage and Firms				
Total Costs in Small Businesses (millions of $2008)		$41	$350	$1,213
Total Small Business Activity Acreage Incurring Cost		36,808	60,318	167,566
Number of Small Firms	All Small Firms	148,760	148,760	148,760
	Small Firms In-Scope	78,090	78,090	78,090
	Small Firms Incurring Cost	2,337	3,660	10,227
Small Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact				
Costs Unadjusted for Effect of Cost Pass-Through				
Small Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	395	1,868
	% of All Small Firms	0.0%	0.3%	1.3%
	% of Small Firms In-Scope	0.0%	0.5%	2.4%
Small Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	17	111
	% of All Small Firms	0.0%	0.0%	0.1%
	% of Small Firms In-Scope	0.0%	0.0%	0.1%
Costs Adjusted for Effect of Cost Pass-Through[a]				
Small Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	7	28
	% of All Small Firms	0.0%	0.0%	0.0%
	% of Small Firms In-Scope	0.0%	0.0%	0.0%
Small Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	0
	% of All Small Firms	0.0%	0.0%	0.0%
	% of Small Firms In-Scope	0.0%	0.0%	0.0%
Small Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance				
Small Firms Incurring Financial Stress	Number Incurring Effect	12	81	318
	% of All Small Firms	0.0%	0.1%	0.2%
	% of Small Firms In-Scope	0.0%	0.1%	0.4%
Small Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)				
Small Firms with Negative Business Value Because of Regulation (Potential Closures)	Number Incurring Effect	14	56	295
	% of All Small Firms	0.0%	0.0%	0.2%
	% of Small Firms In-Scope	0.0%	0.1%	0.4%

[a] Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors.

EPA Estimates

1.5.7 Estimated Benefits of the Regulatory Options

EPA estimated the total benefits under each regulatory option by summing the benefits estimated for each of four monetized benefits categories: benefits to navigation, water storage, drinking water treatment, and water quality. *Table 1-11* presents low, midpoint, and high estimates of benefits under each regulatory option.

Table 1-11 summarizes monetized benefits for navigable waterway dredging and water storage calculated using both 3 and 7 percent discount rates. Benefits for for drinking water and WTP were calculated using a single year timeframe and did not require annualizing. Total national benefits vary significantly among the three regulatory options: under Option 1, the estimated benefits range from approximately $6 million to about $39 million, while benefits under Option 3 are estimated to range from $210 million to $956 million (assuming a 3 percent discount rate).

Under EPA's preferred regulatory option (Option 2) assuming a 3 percent discount rate, the estimated benefits range from $136 million to $683 million. The midpoint estimate is $332.9 million. Non-market benefits estimated based on household WTP for surface water quality improvements account for the majority of total benefits from the C&D regulation. The estimated WTP for water quality improvements from reduced sediment discharges from construction sites under Option 2 ranges from $104.6 to $634.7 million with a mean value of $295.0 million. The estimated cost savings to industry and government through reduced costs of navigable waterway maintenance,

reservoir dredging, and drinking water treatment ranges $31.3 million to $48.8 million, with a midpoint estimate of $37.9 million. Under Option 2, avoided cost benefits account for 7 to 23 percent of total benefits.

Under the most stringent option (Option 3), the expected cost savings are $70.9 million per year; WTP also increases to a mean value of $398.5 million. The estimated midpoint total national benefits are $469.5 million.

Table 1-11: Total Annual National Benefits by Benefit Category (million 2008$)

Benefit Category	3% Discount Rate			7% Discount Rate		
	Low	Mid	High	Low	Mid	High
Option 1						
Navigation	$0.7	$1.0	$1.6	$0.7	$0.9	$1.8
Water Storage[a]	$0.6	$0.6	$0.6	$0.5	$0.5	$0.6
Drinking Water[a]	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Avoided Costs	*$1.4*	*$1.8*	*$2.5*	*$1.3*	*$1.7*	*$2.6*
WTP[a]	$4.9	$16.6	$36.6	$4.9	$16.6	$36.6
Total[b]	**$6.4**	**$18.4**	**$39.1**	**$6.3**	**$18.3**	**$39.2**
Option 2						
Navigation	$8.9	$12.9	$22.1	$8.8	$12.6	$23.8
Water Storage[a]	$16.5	$17.6	$18.7	$13.7	$15.9	$18.3
Drinking Water[a]	$5.8	$7.4	$8.0	$5.8	$7.4	$8.0
Avoided Costs	*$31.3*	*$37.9*	*$48.8*	*$28.3*	*$35.9*	*$50.1*
WTP[a]	$104.6	$295.0	$634.7	$104.6	$295.0	$634.7
Total[b]	**$135.9**	**$332.9**	**$683.5**	**$132.9**	**$330.9**	**$684.8**
Option 3						
Navigation	$18.9	$27.2	$45.7	$18.7	$26.5	$49.2
Water Storage[a]	$28.7	$30.6	$32.5	$23.8	$27.6	$31.8
Drinking Water[a]	$10.4	$13.1	$14.5	$10.4	$13.1	$14.5
Avoided Costs	*$58.0*	*$70.9*	*$92.6*	*$52.9*	*$67.3*	*$95.5*
WTP[a]	$151.5	$398.5	$863.5	$151.5	$398.5	$863.5
Total[b]	**$209.6**	**$469.5**	**$956.1**	**$204.4**	**$465.8**	**$959.0**

[a] These savings were calculated as a constant annual value, and are therefore equal under both discount rates

[b] Totals may not equal sum of categories due to rounding

EPA Estimates

1.5.8 Comparison of Total Social Cost and Monetized Benefits

EPA estimated and compared the total expected social cost and monetized benefits for each regulatory option.

The estimated total social cost includes:

1. The resource costs of compliance to the private sector and to governments. The resource cost to society of each regulatory option refers to compliance outlays after adjusting for the expected C&D market contraction due to the proposed options.
2. The deadweight loss to society. The deadweight loss to society refers to the net losses of both consumer and producer surplus arising from the post-compliance market equilibrium adjustment associated with each option.
3. Administrative costs to federal, state, and local governments. The expected administrative costs refer to state and local governments' administration of federal rule requirements to regulated entities within their jurisdictions. EPA expects a relatively small administrative burden to government entities under the proposed options for the review and processing of Discharge Monitoring Reports (DMRs) for projects that incur cost under the proposed rule.

The reduction of sediment and other pollutants entering surface waters from construction sites as a result of the C&D regulation will have a wide range of market and nonmarket benefits, as described in *Chapter 6*. As described in *Chapter 6* and emphasized here, EPA's estimate of total monetized benefits does not represent the

full-range and magnitude of benefits expected from this rule because certain categories of benefits are not able to be monetized. These non-monetized categories include primarily benefits to commercial fishing and shellfishing or benefits to industrial and agricultural water use. Total estimated monetized benefits in the table below include benefits to navigation, benefits to water storage, benefits to drinking water treatment, and benefits to water quality.

Table 1-12 presents the estimated total social cost and monetized benefits. The estimated social costs exceed the monetized benefits. It is important to emphasize that *Chapter 6* discusses several other classes of benefits that could not be monetized but that are likely to provide social benefits, and therefore, the estimate of monetized benefits is not as complete an estimate as that of total social cost.

Table 1-12: Comparison of Social Costs and Benefits (millions of 2008$)

	Option 1	Option 2	Option 3
Social Costs[a]			
Resource Cost of Compliance (adjusted for market-effect in C&D industry)	$132.3	$1,882.6	$3,780.2
Government Administrative Cost	$0.0	$0.7	$1.2
Deadweight Loss to Society	$0.0	$3.5	$8.2
Total Social Cost of the Regulation	**$132.4**	**$1,886.8**	**$3,789.6**
Monetized Benefits[a]			
Benefits to Navigation[b]	$1.0	$12.9	$27.2
Benefits to Water Storage	$0.6	$17.6	$30.6
Benefits to Drinking Water Treatment	$0.2	$7.4	$13.1
Water Quality Benefits	$16.6	$295.0	$398.5
Total Monetized Benefits[b]	**$18.4**	**$332.9**	**$469.5**
Net Benefits (Benefits Minus Costs)	**-$114**	**-$1,553.9**	**-$3,320.1**

[a] Totals may not sum due to rounding.

[b] Based on a 3% social discount rate, previously described in *Chapter 6*.

Source: EPA Estimates

1.5.9 Unfunded Mandates Reform Act Analysis Results (UMRA)

Table 1-13 reports the total compliance and administrative costs that are estimated to be incurred by Federal, State and Local government entities for each regulatory option. *Table 1-14* reports the findings from comparing the total State and Local government compliance and administrative costs with three baseline measures: total government revenue, capital outlay, and capital outlay for construction only (pre-regulation government revenue and outlay baseline values are option independent).

Estimated impacts on *small* government entities are reported within *Chapter 9: Assessing the C&D Regulatory Options in Accordance with Unfunded Mandates Reform Act (UMRA) Requirements*.

Table 1-13: Total Government Compliance and Administrative Costs (millions of $2008)

	Option 1	Option 2	Option 3
Compliance Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.1	$128.6
Local[a]	$26.0	$390.6	$738.1
Administrative Costs			
Federal	$0.0	$0.0	$0.0
State[a]	$0.0	$0.1	$0.2
Local[a]	$0.0	$0.6	$1.0
Total Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.2	$128.8
Local[a]	$26.0	$391.2	$739.1

a State and Local compliance costs were split-out from the State and Local total based on the proportion of total project value in state and local governments from Reed Construction Data.

Source: Reed (2008), U.S. Census Bureau's Government Organization (2002), EPA Estimates

Table 1-14: Impacts of Regulatory Option Compliance and Administrative Costs on State and Local Governments (millions of $2008)

	Option 1	Option 2	Option 3
State Governments Impact Analysis Concepts			
Total Revenues	1,097,829	1,097,829	1,097,829
Total Costs as % of Total Revenues	0.00%	0.01%	0.01%
Capital Outlay	89,919	89,919	89,919
Total Costs as % of Total Capital Outlay	0.01%	0.08%	0.14%
Construction Outlay Only	71,035	71,035	71,035
Total Costs as % of Total Construction Outlay	0.01%	0.10%	0.18%
Local Governments Impact Analysis Concepts			
Total Revenues	1,083,129	1,083,129	1,083,129
Total Costs as % of Total Revenues	0.00%	0.04%	0.07%
Capital Outlay	142,209	142,209	142,209
Total Costs as % of Total Capital Outlay	0.02%	0.28%	0.52%
Construction Outlay Only	107,588	107,588	107,588
Total Costs as % of Total Construction Outlay	0.02%	0.36%	0.69%

a State and Local compliance costs were split-out from the State and Local total based on the proportion of total project value in state and local governments from Reed Construction Data.

Source: Reed (2008), U.S. Census Bureau's Compendium of Government Finances (2005c), U.S. Census Bureau's Government Organization (2002), EPA Estimates

1.6 EA Report Organization

This EA report is organized as follows:

Chapter 2: Economic Profile of the Construction and Development Industry presents a profile of the entities within the C&D industry that are subject to the regulatory requirements.

Chapter 3: Economic Impact Analysis Methodology presents EPA's methodology for analyzing the economic impacts of the proposed regulatory options covering the C&D industry.

Chapter 4: Developing the Analysis Baseline summarizes the development of three key baselines metrics – the industry, firm, and acreage metrics – that underlie the analysis of C&D rule options.

Chapter 5: Economic Impact Analysis Results presents the impacts from the project-level analysis, firm- and industry-level analysis, consumer affordability analysis, national-level analysis, and government analysis.

Chapter 6: Benefits Assessment Methodology and Results presents estimates of the monetized benefits of the regulatory options arising from benefits to navigation, water storage, drinking water treatment, and water quality.

Chapter 7: Social Costs and Benefits of the Proposed Rule compares the total social costs and monetized benefits estimated for each regulatory option.

Chapter 8: Assessing the Impact of the C&D Regulatory Options on Small Entities – Regulatory Flexibility Act (RFA) Analysis presents the number of small C&D firms expected to be subject to the rule and estimates the potential economic impacts on small entities based on a sales test (cost-to-revenue analysis) and other financial stress measures.

Chapter 9: Assessing the C&D Regulatory Options in Accordance with Unfunded Mandates Reform Act (UMRA) Requirements presents the impacts of the Proposed Rule on (1) government entities, (2) small governments, and (3) private entities.

2 Economic Profile of the Construction and Development Industry

2.1 Introduction

The Construction and Development (C&D) industry plays an integral role in the nation's economy, contributing approximately five percent of Gross Domestic Product. Furthermore, approximately 10 percent of the nation's nearly 7 million total business establishments are in the C&D industry, demonstrating the dominance of small firms in this industry. The number of paid employees in the C&D industry accounts for 6.6 percent of total U.S. employment (U.S. Census Bureau, 2005a). Establishments in this industry are involved in a wide variety of activities, including land development and subdivision, homebuilding, remodeling, construction of nonresidential buildings and other structures, and heavy construction work (including roadways and bridges). Establishments are also involved in a myriad of special trades, such as plumbing, roofing, electrical, excavation, and demolition work. Some of these activities result in land disturbance, which can cause erosion and transport soil and sediment in stormwater runoff. The regulatory options presented in this economic analysis report address these concerns.

Several characteristics of the C&D industry affect the structure of this economic analysis:

- Residential construction represents a large percentage of construction industry activity. Approximately 50 percent of the establishments included within the following analysis are residential contractors. In addition, approximately 32 percent of the total value of construction comes from residential construction. Therefore, individuals (e.g., homebuyers) are often the direct customers of the C&D industry. With residential housing representing a substantial share of total C&D industry activity, it is important to understand the potential effect of the C&D regulation on housing prices and housing affordability.
- Developers and builders work under a range of relationships in performing construction services. For example, developers may undertake all site improvements and sell completed lots directly to builders, or act as builders themselves and remain onsite to build out the development, or some combination of the two. Thus, both developers and builders may be the parties that are directly subject to the C&D regulation's compliance requirements.
- The C&D industry includes a very large number of small businesses. Therefore, EPA carefully considered the impacts on small businesses in accordance with RFA requirements in developing the options considered for this regulatory proposal and in choosing the option for proposal. As reported in *Section 2.4.4* of this chapter, EPA estimates that 95 percent or more of the firms in the C&D industry are small businesses according to Small Business Administration criteria.
- C&D activities are undertaken in markets in which business conditions vary substantially both over time and space. Furthermore, these regional variations in business conditions can persist for several years because of the immobile and long-lived character of the C&D industry's output product. Some factors affecting business conditions in C&D markets are national in character – e.g., interest rates and overall performance of the national economy – while other factors are more local in character – e.g., differences in regional economic and population growth patterns, differences in performance of sectors that are regionally concentrated, and the character of the supply/demand balance in a given local market. The highly local and varying character of C&D markets means that the economic analysis for the C&D regulation must account for these variations in market conditions, both over time and across local markets.

- Under the standard C&D industry definitions, the industry includes a large number of establishments primarily engaged in remodeling activities and special trades (e.g., plumbing, electrical). These establishments, however, are less likely to be involved in land-disturbing activities and thus are not likely to be subject the C&D regulation's requirements. *Chapter 4* describes in more detail the breakout of the entities within the C&D industry that would either not engage in land-disturbing activities or would not be an NPDES permittee or co-permittee. Since these entities are not likely to be affected by this regulation, they will not be included in the cost and economic impact analysis for the C&D rule.
- The C&D regulation will apply only to activities that occur on land in the United States. Accordingly, competition from production of C&D industry products in international markets is not important for analyzing the impacts of this rule. If international firms engage in C&D production activities on U.S. land, they will be subject to the C&D regulation in the same way as U.S. firms and can gain no competitive advantage from a different level of regulation in their home countries. Similarly, any requirements applicable to U.S. firms in their domestic operations will not apply to their production activities in other countries. As a result, the C&D regulation will not affect U.S. firms' competitiveness in supplying their products in foreign countries.
- Since late 2006, residential construction has experienced a slowdown in housing starts: 2005 was a peak year for residential construction but current forecasts for the remainder of 2008 and continuing into 2009 remain weak. On the other hand, nonresidential construction has been on a positive growth trend. Though the non-residential sector may experience declines starting in late 2008 through early 2010, the performance of the sector is expected to resume positive growth in 2010. The average consensus from the American Institute of Architects (comparing six different forecasts from January 2008, see *Table 2-26*) forecasts 2008 to experience a 0.57 percent *increase* in the number of nonresidential construction starts and a 1.03 percent *decrease* in 2009 (AIA, 2008).[2]

The C&D industry, as defined for this rule, is comprised of three main industry groups.

1. Construction of buildings
    a. Residential: single-family, multifamily, remodelers, and operative construction
    b. Non-Residential: industrial and commercial/institutional building construction
2. Heavy and civil engineering construction
3. Specialty trade contractors: excavation contractors, wrecking and demolition contractors, and all other heavy construction.

Of these three industry groups, only the first two are likely to engage in land-disturbing activities and could be an NPDES permittee or co-permittee, and thus be within the scope of the proposed C&D rule. Furthermore, within the building construction category, residential remodelers are *not* included as a category that would be likely to engage in land-disturbing activities. EPA is concerned with stormwater runoff from construction sites, which carries sediment (and potentially metals and nutrients) into receiving waters, impairing water quality. These activities include site clearing or site preparation activities, such as tree removal, excavation, blasting, scraping, grading, etc. These activities can destabilize soils and create conditions that allow stormwater to accumulate and flow across the site. This increase in stormwater flow can cause erosion and lead to the transport of soil particles and attached pollutants, which eventually can be conveyed offsite and discharged into receiving waters. Both the

[2] The current economic situation is still continuing to evolve since events taking place during the later part of 2008 have triggered further downturns in the economy. Therefore, since many of the forecasts listed within this profile generally reflect conditions present in the earlier part of 2008, the recovery projected here may be further in the future. For example, Global Insight's *October* 2008 "U.S. Executive Summary" expects that housing starts will not hit bottom until the second quarter of 2009 at around 740,000 units, to gradually improve thereafter, and not reach the estimated trend until 2012/2013.

increased flow and associated pollutant and sediment loads that result from land-disturbing activities can negatively impact the biological, physical, and chemical characteristics of the receiving waters.

EPA believes that many establishments in North American Industry Classification System (NAICS) 236 (*Construction of Buildings*) and NAICS 237 (*Heavy and Civil Engineering Construction*) are likely to engage in such activities on a regular basis. However, as described above and within *Chapter 4*, although establishments within selected five-digit industries that are part of NAICS 238 (*Specialty Trade Contractors*) could engage in land-disturbing activities[3], they are generally contracted by the NPDES permit holder and therefore will not be directly affected by the proposed regulation. *Table 2-1* lists the industry groups whose activities will likely be within the scope of the regulation. *Table 2-1* lists these industry groups according to the 2002 NAICS framework and with the correspondence to the previous 1997 NAICS framework. As described below, changes in the NAICS framework definitions between 1997 and 2002 affect the analysis of industry data over time and the ability to merge data from separate sources.

[3] Namely, NAICS 23593 (*Excavation Contractors*), 23594 (*Wrecking and Demolition Contractors*), and NAICS 23499 (*All Other Heavy Construction: Construction Equipment Rental with Operator and Right-Of-Way Clearing and Line Slashing, Blasting, and Trenching Contractors*) (all 1997 classifications).

Table 2-1: Industry Definitions for C&D Industry Profile

2002 NAICS	Description	Relevant 1997 NAICS
236	**Construction of buildings**	
2361	Residential building construction	
236115	New single-family general contractors	233210 Single-family housing construction (general contractors)
236116	New multifamily general contractors	233220 Multifamily housing construction (general contractors)
236117	New housing operative builders	233210 Single-family housing construction (operative builders) 233220 Multifamily housing construction (operative builders)
2362	Nonresidential building construction	
236210	Industrial building construction	233310 Manufacturing and industrial building construction (Other manufacturing and industrial building construction) 234930 Industrial nonbuilding structure construction (Other industrial nonbuilding construction) 234990 All other heavy construction (waste disposal plant)
236220	Commercial and institutional building construction	233220 Multifamily housing construction (barrack and dormitory) 233310 Manufacturing and industrial building construction (grain elevators, dry cleaning plants, and manufacturing and industrial warehouses construction) 233320 Commercial and institutional building construction 235990 All other special trade contractors (indoor swimming pool)
237	**Heavy and civil engineering construction**	
2371	Utility system construction	
237110	Water and sewer line and related structures construction	234910 Water, sewer, and pipeline construction (water and sewer line, mains, and related structures (including pumping stations, etc.) construction 234990 All other heavy construction (sewage and water treatment plants and irrigation systems construction 235810 Water well drilling contractors
237120	Oil and gas pipeline and related structures construction	213112 Support activities for oil and gas operations (partial) 234910 Water, sewer, and pipeline construction (Oil and gas pipelines, mains, and related structures (including oil storage)) 234930 Industrial nonbuilding structure construction
237130	Power and communication line and related structures construction	234920 Power and communication transmission line construction 234930 Industrial nonbuilding structure construction (power generation plants and transformer stations, except hydroelectric)
2372	Land subdivision	
237210	Land subdivision	233110 Land subdivision
2373	Highway, street, and bridge construction	
237310	Highway, street, and bridge construction	234110 Highway and street construction 234120 Bridge and tunnel construction (bridge construction) 235210 Painting and wall covering contractors (highway and traffic line painting contractors)
2379	Other heavy and civil engineering Construction	
237990	Other heavy and civil engineering Construction	234120 Bridge and tunnel construction (tunnel construction) 234990 All other heavy construction (all other heavy and civil engineering construction 235990 All other special trade contractors (anchored earth retention)

Source: U.S. Census Bureau (2007a)

As shown in *Table 2-1*, each 2002 NAICS industry includes one or more industry groups defined under the former 1997 NAICS industry codes. For the 2002 Economic Census, the Census Bureau redefined the NAICS code structure for certain C&D industry segments, making direct comparisons between the 2002 and 1997 Economic Census data not straightforward. Furthermore, in the 1997 Economic Census, the Census Bureau switched from reporting data on a Standard Industrial Classification (SIC) basis to a NAICS basis, adding to the difficulty of comparing data from 2002 and 1997 with that from the 1992 and earlier Economic Census-reporting periods (comparison of these industries is found in *Appendix 2-1*). Within this economic profile, the objective is to

provide data at the most detailed level possible, while still maintaining the ability to provide meaningful comparisons between 2002 and earlier Economic Census periods.

With this goal in mind, EPA identified and characterized the specific industry segments that meet the criteria of performing land development and disturbance activities that are within the scope of the proposed regulation and that will be subject to regulatory requirements based on the NPDES permitting process. The presentation in this chapter and *Chapter **4*** of this regulatory analysis attempts to achieve consistency of data over the three reporting frameworks covering the C&D industry data over this time frame. In some instances, the adjustments to support comparisons involve estimations and reclassifications that are likely to contain an unknown degree of error.

As a result of these adjustments, the NAICS segments covered in this regulatory analysis include:

- NAICS 236 – *Construction of buildings (all subsectors except residential remodelers)*
- NAICS 237310 – *Heavy and civil engineering construction*[4]

2.1.1 Data Sources Used

This profile uses several data sources to characterize the C&D industry. The primary data source is the 2002 Economic Census, conducted every five years by the U.S. Census Bureau. The U.S. Small Business Administration (SBA) and Census Bureau also provide important information in Statistics of U.S. Business (SUSB). SUSB provides firm-level data that is particularly important for the firm and industry impact assessment and for the small entity analysis (the Economic Census data is reported at the level of the construction establishment, not the firm). *Table 2-2*, below, compares the Economic Census and SBA data to further clarify the differences and identify how each data source is used in this regulatory analysis. To a large degree, this chapter relies on data from the 2002 Economic Census to profile the C&D industry, since that source provides a greater level of detail on industry characteristics.

Table 2-2: Comparison of Major Data Sources

	Economic Census	SBA
Level of Detail	Establishment[a]	Firm[b] and establishment
Source of Data	Survey (sent to approximately 130,000 establishments from a universe of 650,000)	SUSB report, which relies on administrative records data
How the Data are Applied in this Analysis	Industry-level analysis to determine the number of potentially affected establishments	Firm- and industry-level analysis, and also for determining the number of potentially affected firms considered "small" by SBA size standards

[a] The Census Bureau defines an establishment as "a relatively permanent office, or other place of business, where the usual business activities related to construction are conducted" (U.S. Census Bureau, 2005a).

[b] 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." (U.S. SBA, 2004). Therefore, one firm could comprise several establishments.

2.1.2 Organization of this Chapter

The purpose of this profile is to provide an overview of the C&D industry, describe its key characteristics and structure, and analyze current and historical trends. *Section 2.2* presents key findings concerning the C&D industry and the potential economic/financial impact of the proposed regulation. *Section 2.3* includes a summary of recent trends regarding the industry characteristics and the industry's financial condition. *Section 2.4* presents

[4] EPA anticipates that some businesses and activities in the *Heavy Construction* sector (NAICS 237) will be affected by the C&D rule. However, with the exception of NAICS 237310 (*Highway, street, and bridge construction*), data are not available to support an assessment of the number and character of projects performed by NAICS 237 sector businesses that would be subject to compliance requirements and incur compliance costs. For this reason, of the sectors in NAICS 237, only NAICS 237310 (*Highway, street, and bridge construction*) is considered in the cost and impact analysis for the C&D rule.

detailed characteristics of the C&D industry, including both industry and firm-level data. *Section 2.5* covers the industry economic and financial outlook.

2.2 Key Findings

Overall, the Construction and Development industry has shown a substantial increase in the number of establishments and employees over the past 10 years. Although some segments of the industry are experiencing substantial economic weakness during the near term – due to weakness in residential housing markets, difficult credit markets, and weakness in the general economy – total economic activity and economic/financial performance in the industry is projected to remain strong over the longer term. Department of Labor projections indicate the industry will add approximately 1 million new construction jobs between 2002 and 2012 (U.S. Department of Labor, 2006).

SBA data on births and deaths of establishments and employment also show that the number of establishments and employees has generally grown over the past 10 years. At the same time, the industry has experienced periods of economic weakness, with year-to-year losses in establishments in 2001/2002, employees in 1999/2000, and in both establishments and employees in 2000/2001. This period of sector weakness reflects the overall weakness of the U.S. economy in the period, leading up to and through the short recession of 2002. More recently (2006/2008), the housing-related segments of the C&D industry are in a period of substantial business weakness, resulting in large part from an aggressive pace of new construction, fueled in part by low interest rates and "easy credit" from 2003 to 2007, followed by housing supply growth outpacing demand growth in a substantial number of U.S. markets. The current weakness accelerated during 2007 as the result of a tightening in residential financing terms and the deterioration of credit markets and the general economy in 2008. The consequent slow-down in residential construction caused a substantial weakening of business performance for C&D businesses whose activity is concentrated in the residential market.

Regionally, the decline in the housing market has been most evident in the Southwest, Florida, and some areas in the Northeast. In California, Florida, Nevada, Arizona and Massachusetts, large home price increases were a major factor underlying a surge of new and existing home inventory; the inventory surge was followed by price declines. Even so, these recent home price decreases are small relative to housing prices (Global Insight, September 2007). Florida and Nevada also experienced the largest decrease in new housing starts from 2005 to 2007, dropping approximately 58 and 47 percent, respectively. These states also hold the highest shares of construction activity compared to total Gross State Product (GSP) (Florida 7.5 and Nevada 9.8 percent) and total state employment (Florida 7.6 and Nevada 11.0 percent). Global Insight expects that home prices will continue to drop in only a handful of states, including California and Arizona, until 2009 and 2010 when a recovery is expected. Part of the recovery will be due to the forecasted increase of population, employment, and personal income growth among Florida and the Southwestern states.

Unlike residential construction, non-residential construction has continued to achieve moderate business performance and growth. This performance in non-residential construction has partially offset the decline in the residential sector. Since the cyclical low in non-residential construction in 2003, this sector remained relatively flat until the end of 2005 when a steady recovery began. Retail construction (generally coinciding with residential construction trends) continued to have strong growth until mid-2007, even with residential construction beginning to decline during 2006. The lodging sector, although very cyclical, saw a sharp increase in growth from 2005 until mid-2007. And, in general, healthcare construction also experienced strong growth in 2006. However, more recent forecasts by industry analysts indicate that the non-residential construction market is expected to moderate with flat growth for the next few years.

A key consideration for the analysis of the proposed rule concerns the extent to which any rule-related increase in construction costs will be passed through to consumers of the C&D industry. A number of market factors will influence the extent to which construction cost increases will be passed through to consumers at a given point in time, in a given market segment (e.g., commercial real estate vs. residential real estate), and in a given location. In general, elasticities of supply and demand in a market will influence the extent of cost pass-through. Many factors contribute to the relationship between supply and demand elasticities and overall market conditions in a given market and at a given point in time. These factors include general economic factors – *for example, monetary and credit conditions, condition of the overall economy, etc.* – and factors that are more local in character – *for example, regional economic strength; extent to which a particular market has seen a substantial recent increase in supply in a particular real estate segment, which has exceeded the underlying strength in demand, etc.*

Currently, the national residential real estate housing market is experiencing a period of considerable weakness, due, as described above, to several factors, including "over-building" in some markets through the middle of the decade, difficult access to credit, increased supply of existing housing from foreclosures, and more recently, general economic weakness. However, the extent of the residential market weakness varies substantially over specific regional and local markets. As noted above, markets in the Southwest, Florida and areas of the Northeast are experiencing relatively greater price and sales volume weakness. At the same time, some markets that recently experienced less growth in supply and prices (e.g., parts of the Southeast and Pacific Northwest), are experiencing much less of a fall-off in prices and sales volume. In those markets with greater weakness in prices and sales volume, there is a greater likelihood that near-term increases in construction costs may be not be fully passed through to customers. In these instances, increased construction costs may be absorbed by the owners of the undeveloped land, project developers, and the builders of new construction. Based on recent forecasts by real estate industry analysts (e.g., Global Insight), this period of general weakness in residential real estate markets may persist through 2008 and into 2010. Nevertheless, over the longer term, it is reasonable to expect that market conditions will adjust to any changes in construction costs and that regulation-induced cost increases will become part of the "new equilibrium" and will be passed through in prices to consumers.

Similar considerations will apply to other segments of real estate markets (e.g., commercial real estate) whose supply costs may be affected by a C&D regulation. Currently, the general conditions in these other segments are sufficiently stronger overall than in the residential segment such that there is a greater likelihood that all or most of any rule-related construction cost increase will be passed through to consumers. However, should these segments weaken over the next few years, which is discussed as possible in the final section of this chapter, the likelihood that cost increases might not be able to be recovered fully in increased prices would increase.

As described in the final part of this chapter (*Section 2.5: Industry Dynamics and Forecast*, page 2-38), overall, the construction industry is expected to experience continuing weakness until residential markets work through the current inventory of unsold homes and credit markets and the general economy return to a better condition. A recent (October 2008) Global Insight forecast suggests that the industry is expected to witness further declines for both the residential, non-residential, and non-building sectors. Housing starts, a good indicator of the strength of the residential sector, are expected to hit bottom in mid to late 2009 and gradually improve thereafter. Non-residential spending, which often lags behind the pattern in the residential sector, is expected to see declines in private non-residential building through late 2008 into the first quarter of 2010. Furthermore, the non-building sector (i.e. publicly-funded projects), is expected to see further declines due to the slowing of revenue growth. In short, though the industry is expected to experience declines over the next couple years, the industry is expected to achieve expected positive business performance over the longer-term and beginning around 2010/2011. Given this outlook, EPA judges that the construction industry will be on the path to achieve a sufficient recovery to sustain the compliance costs of the C&D rule without substantial economic/financial burden during the period in which compliance with the regulation would begin.

2.3 Recent Trends in the C&D Industry

This section reviews recent trends in the number of establishments, firms, and employees in the C&D industry and in the value of construction by key activity segments. Overall, these data show that the industry has grown substantially over the past 10-15 years in terms of total value of business performed. However, the data also show that the various segments of the industry have experienced periods of weakness with brief declines in value of business performed. These periods of weakness don't necessarily occur simultaneously in all segments of the industry. Declines in commercial real estate occurred during the earlier years of the current decade while residential real estate construction was growing strongly. Currently, the residential segment is experiencing weakness while the commercial segment remains relatively strong.

2.3.1 Establishments by C&D Industry Segment

Table 2-3 and *Table 2-4* present the number of C&D establishments in 1992, 1997, and 2002. Between 1992 and 1997, the number of C&D industry establishments with payroll increased 12.8 percent, from 214,435 to 241,840. Between 1997 and 2002, the number of establishments with payroll increased an additional 8.2 percent to 261,585 (see *Table 2-3* and *Table 2-4*). However, the modest increase in total number of establishments masks some significant offsetting changes in establishment counts among groups within the industry as defined by NAICS.

These data are reported below in two tables that distinguish between the different 1997 and 2002 NAICS frameworks.[5] The 1997 NAICS framework reported the *All Other Heavy Construction* category as NAICS 23499, and thus as a part of the NAICS 234 3-digit sector. The 2002 NAICS framework reassigned the 1997 *All Other Heavy Construction* category over three different 3-digit sectors: NAICS 236 (*Construction of Buildings*), NAICS 237 (*Heavy and Civil Engineering Construction*), and NAICS 238 (*Specialty Trade Contractors*). To facilitate comparisons of activity data over the period 1992-2002, *Table 2-3* maintains the 1997 grouping method in displaying the 2002 data – that is, the *All Other Heavy Construction* categories data within 2002 NAICS 236, 237, and 238 were reassigned back into their 1997 classification of NAICS 234990. *Table 2-4* displays the data according to the NAICS framework definitions applicable during each reporting period – that is, for 1992 and 1997, *All Other Heavy Construction* remains within NAICS 234; for 2002, this sector is reported in NAICS 236 and 237. The two different classifications in these tables result in offsetting differences in the values for NAICS 237 in 2002.

The summaries below are derived from the data in *Table 2-3*, which provides the more consistent comparison of establishment counts by NAICS sector over the full analysis period. However, the rest of the data reporting and analysis in this chapter will be derived from the current NAICS framework.

- The number of establishments in the *Land Subdivision* industry group (NAICS 2372) *decreased* by 7.5 percent between 1992 and 1997 and *increased* by 2.7 percent between 1997 and 2002.
- Between 1992 and 1997, the number of establishments in *Residential and Nonresidential Construction* (NAICS 236) *increased* by 13.5 percent. The number of establishments *increased* by another 10.7 percent between 1997 and 2002.
- The number of establishments in *Heavy Construction increased* by 14.5 percent between 1992 and 1997 and continued to *increase* by 16.2 percent from 1997 to 2002.

[5] This profile uses the 2002 NAICS framework. Since the 2002 NAICS classification reassigned the *Specialty Trade Contractors* section, some 1997 classifications have been used to further divide this section. *Appendix 2-1* at the end of this chapter provides a cross-walk to the complete 2002 NAICS classifications for the C&D industry. The Census Bureau classifies industries according to the North American Industry Classification System (NAICS). Under NAICS, economic activity is divided into twenty broad two-digit industry codes. One of these is Construction (NAICS 23), which is further divided into three-, four-, five-, and six-digit levels, as described in this chapter.

Table 2-3: Number of Establishments in the C&D Industry, 1992, 1997, and 2002, Economic Census Data

2002 Data Grouped by 1997 Categories

NAICS	Description	1992	1997	2002	Percent Change 1992-1997	Percent Change 1997-2002
236	Construction of Buildings, except All other Heavy Construction[a]	168,407	191,101	211,629	13.5%	10.7%
237, except 237210	Heavy construction, except Land Subdivision	37,180	42,554	49,433	14.5%	16.2%
237210	Land Subdivision	8,848	8,185	8,403	-7.5%	2.7%
TOTAL		**214,435**	**241,840**	**269,465**	**12.8%**	**11.4%**

[a] In the 2002 NAICS classification framework, *All Other Heavy Construction* was assigned among NAICS 236, 237, and 238. To maintain relevant comparisons, 2002 *All Other Heavy Construction* data were reassigned back into NAICS 237 (*Heavy Construction*). Since residential remodelers are not broken out in the 1997 and 1997 frameworks, they are included in these counts (although not presented in the proceeding analysis).
Figures do not necessarily add to totals due to rounding.
Source: U.S. Census Bureau's Economic Census (2005a)

Table 2-4: Number of Establishments in the C&D Industry, 1992, 1997, and 2002, Economic Census Data

Data Grouped by Corresponding Year's Standards

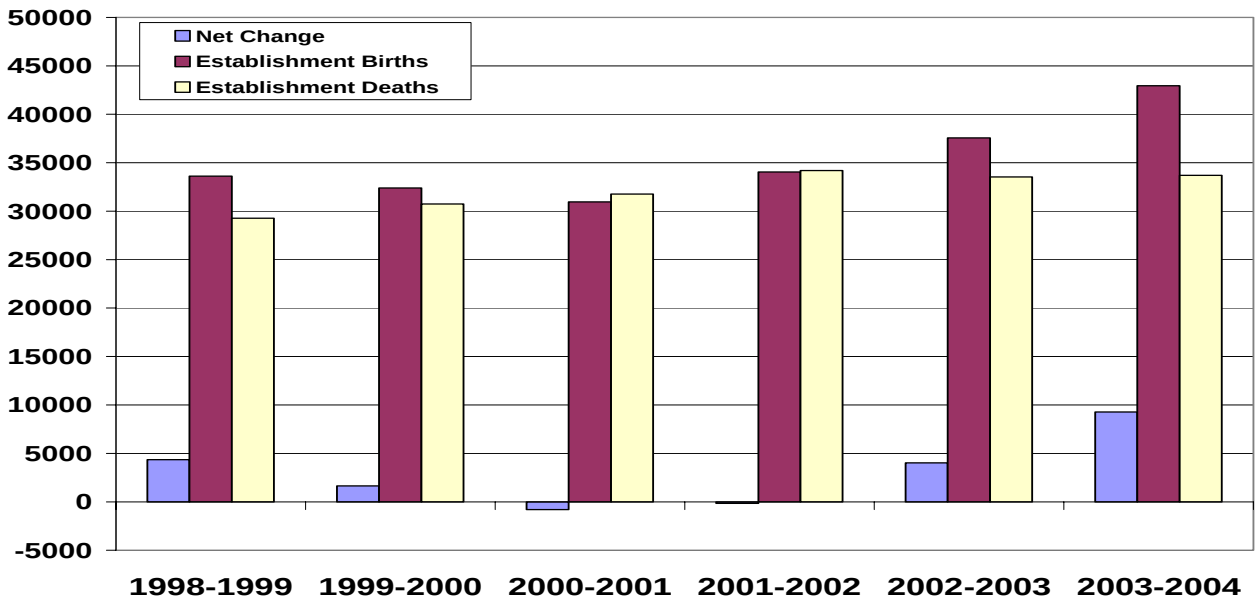
NAICS	Description	1992	1997	2002	Percent Change 1992-1997	Percent Change 1997-2002
236	Construction of Buildings[a]	168,407	191,101	211,647	13.5%	10.8%
237, except 237210	Heavy construction, except Land Subdivision	37,180	42,554	41,535	14.5%	-2.4%
237210	Land Subdivision	8,848	8,185	8,403	-7.5%	2.7%
TOTAL		**214,435**	**241,840**	**261,585**	**12.8%**	**8.2%**

[a] Since residential remodelers are not broken out in the 1997 and 1997 frameworks, they are included in these counts (although not presented in the proceeding analysis).
Figures do not necessarily add to totals due to rounding.
Source: U.S. Census Bureau's Economic Census (2005a)

2.3.2 Firm/Establishment and Employment Births and Deaths

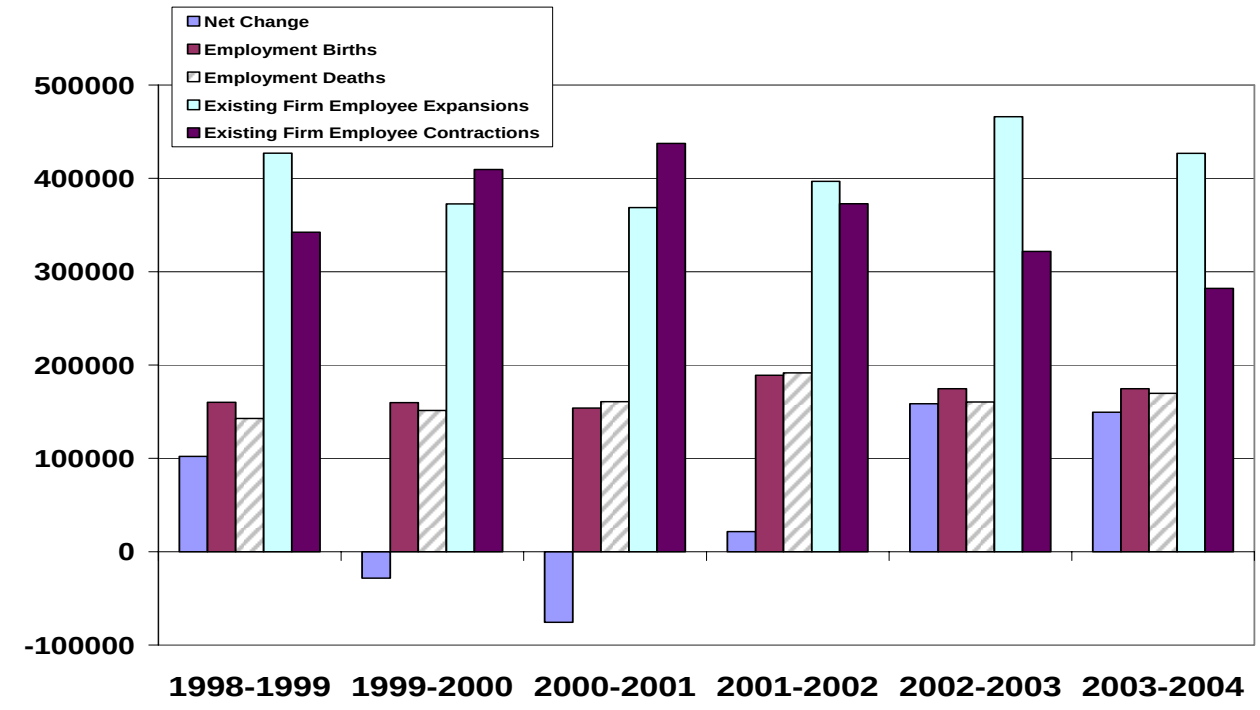
Figure 2-1 through *Figure 2-4* report year-to-year changes in firm, establishment, and employment counts for the U.S construction industry and for the U.S economy as a whole, over the period 1998-2004. These values are reported in terms of net changes, births, and deaths of establishments. The *Net Change* values, determined by subtracting total firm deaths from total firm births during the one-year time period, indicate the total gains or losses during the time period. Comparing the net change in the construction industry to the U.S. total demonstrates that this industry does not always follow the same pattern as the national economy. Though the construction industry has generally experienced growth of establishments and employment over this period, the industry has shown more variability than the total economy.

Figure 2-1: Construction Industry: Establishment Births, Deaths, and Net Change



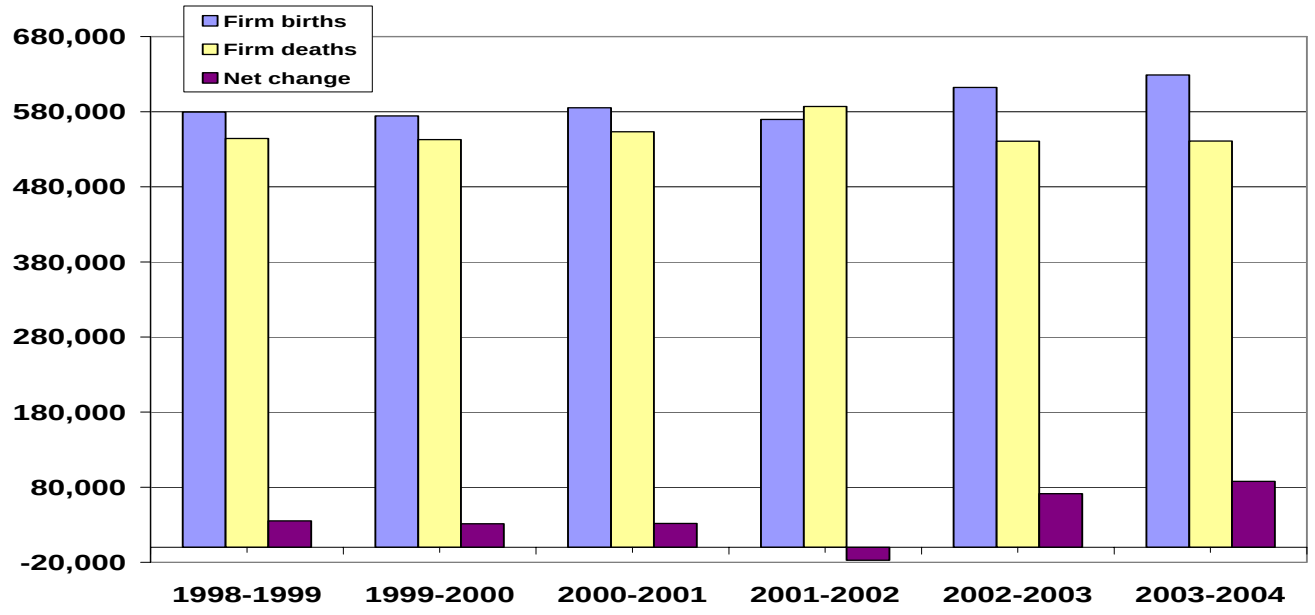
Source: U.S. SBA (2004)

Figure 2-2: Construction Industry: Employment Births, Deaths, and Net Change



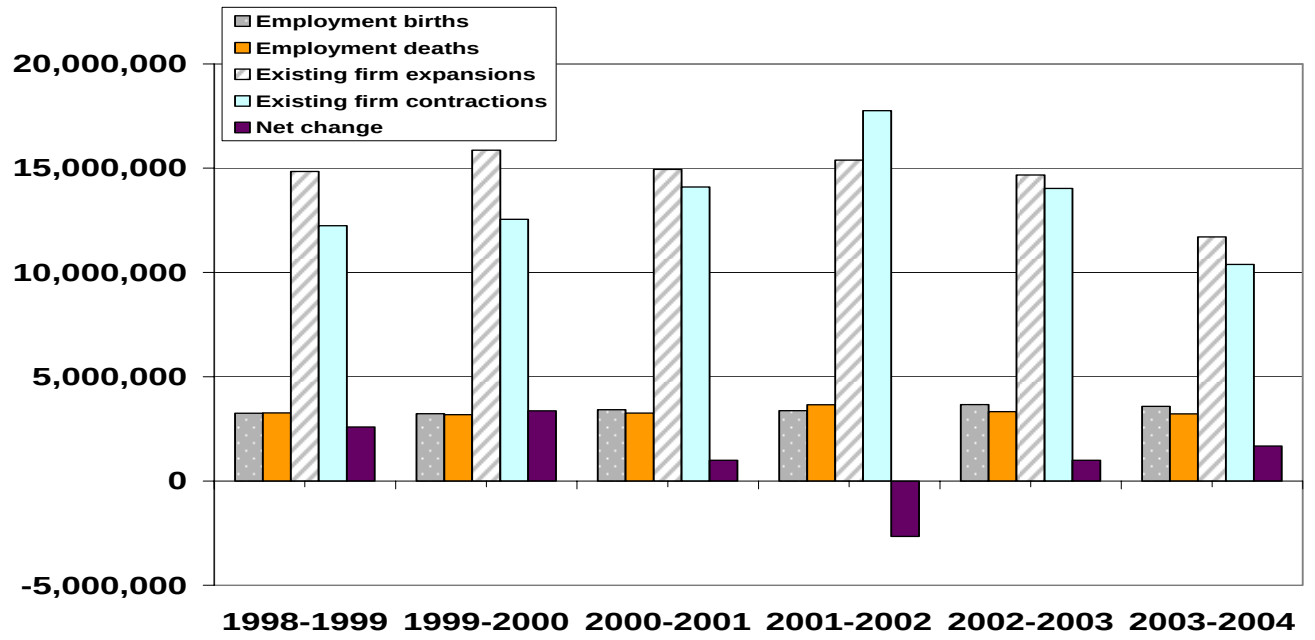
Note: Employment net change is calculated by subtracting employment losses in "deaths" from employment gains in "births" and adding the net change from existing firm expansions and existing firm contractions.
Source: U.S. SBA (2004)

Figure 2-3: U.S. Total: Firm Births, Deaths, and Net Change



Source: U.S. SBA (2004)

Figure 2-4: U.S. Total: Employment Births, Deaths, and Net Change



Source: U.S. SBA (2004)

2.3.3 Value of Construction by C&D Industry Segment

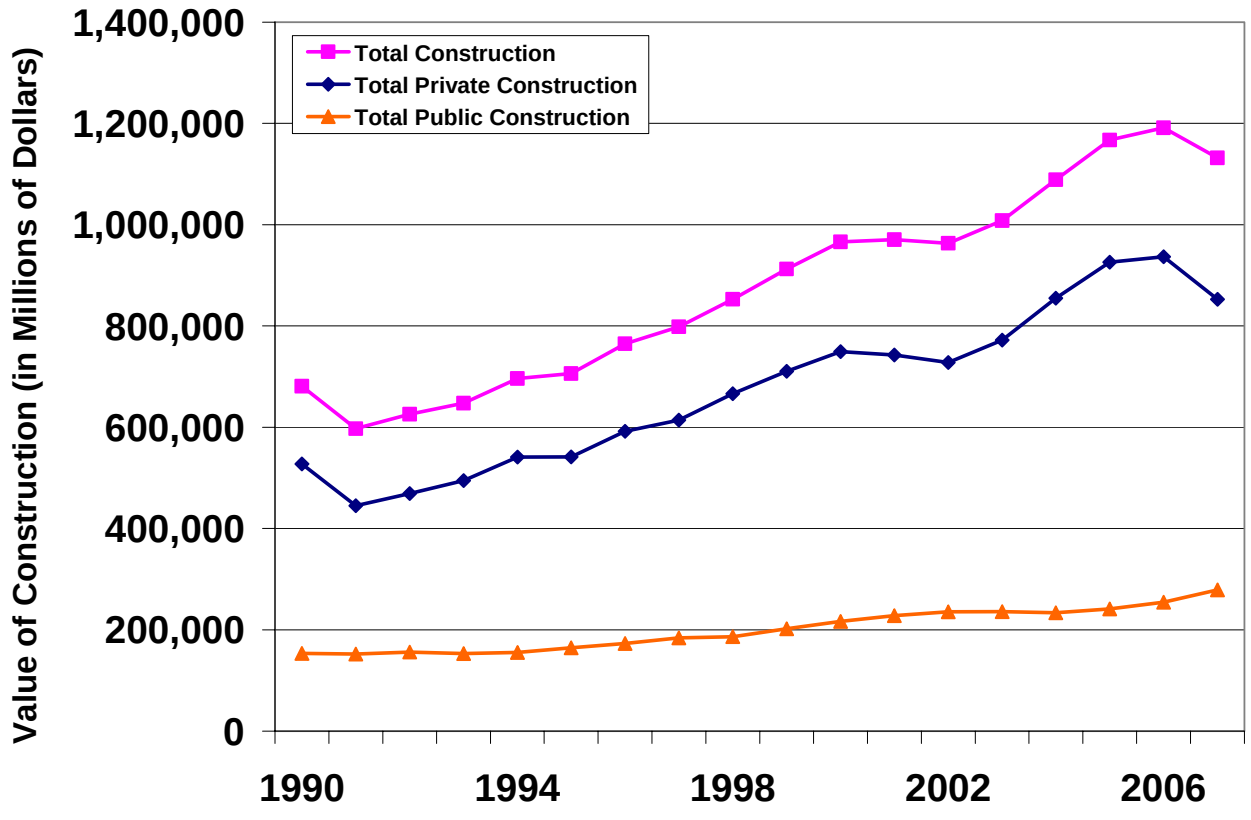
Figure 2-5 through *Figure 2-7* report the value of construction in key industry segments – Total Construction, Private Construction, and Public Construction – from 1990 to 2007.

As shown in *Figure 2-5*, the industry generally experienced stable growth from 1990 through 2000. More recently, the value of *total* construction from 2005 to 2006 grew slightly, from $1.16 trillion to $1.19 trillion ($2006), an increase of 2.1 percent. However, the value of *total* construction from 2006 to 2007 decreased approximately 5 percent. The Private Construction segment is considerably larger than the Public Construction segment, accounting for approximately 80 percent of the total value of construction in recent years and most of the growth. Thus, the private construction sector generally determines the status of the construction industry.

Within the Private Construction segment (see *Figure 2-6*, following page), the Private Residential segment showed the most growth over the analysis period and generally grew consistently from 1990 to the present. The turndown of 3.1 percent in 2006 marks the beginning of the recent weakness in this industry segment. The turndown of 18.1 percent in 2007 demonstrates the continued weakness. Private Non-Residential construction grew less over this period and shows more variability in total value of activity by year. Overall, reflecting the turndown in the Residential Segment, the total value of Private Construction increased by only 1.2 percent from 2005 to 2006 and decreased by 8.9 percent from 2006 to 2007.

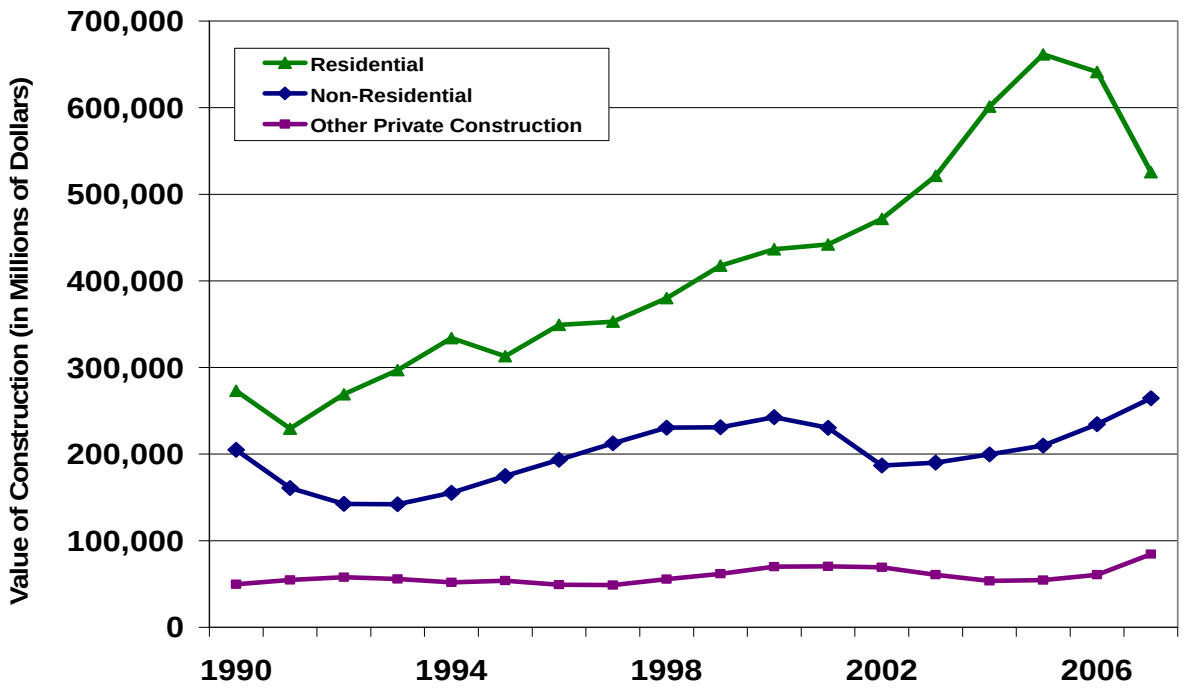
The Public Construction segment has also grown substantially since 1990 (see *Figure 2-7: Annual Value of Public Construction from 1990 to 2006 ($2006 Dollars)*. And overall, the Public Construction segment shows less volatility than the Private Construction segment. Over this period, only the Non-Residential segment recorded a material decline, during the period 2002-2004. The total value of public construction increased by 5.6 percent from 2005 to 2006, and increased by 9.6 percent from 2006 to 2007.

Figure 2-5: Annual Value of Total, Private, and Public Construction from 1990 to 2006 ($2006 Dollars)



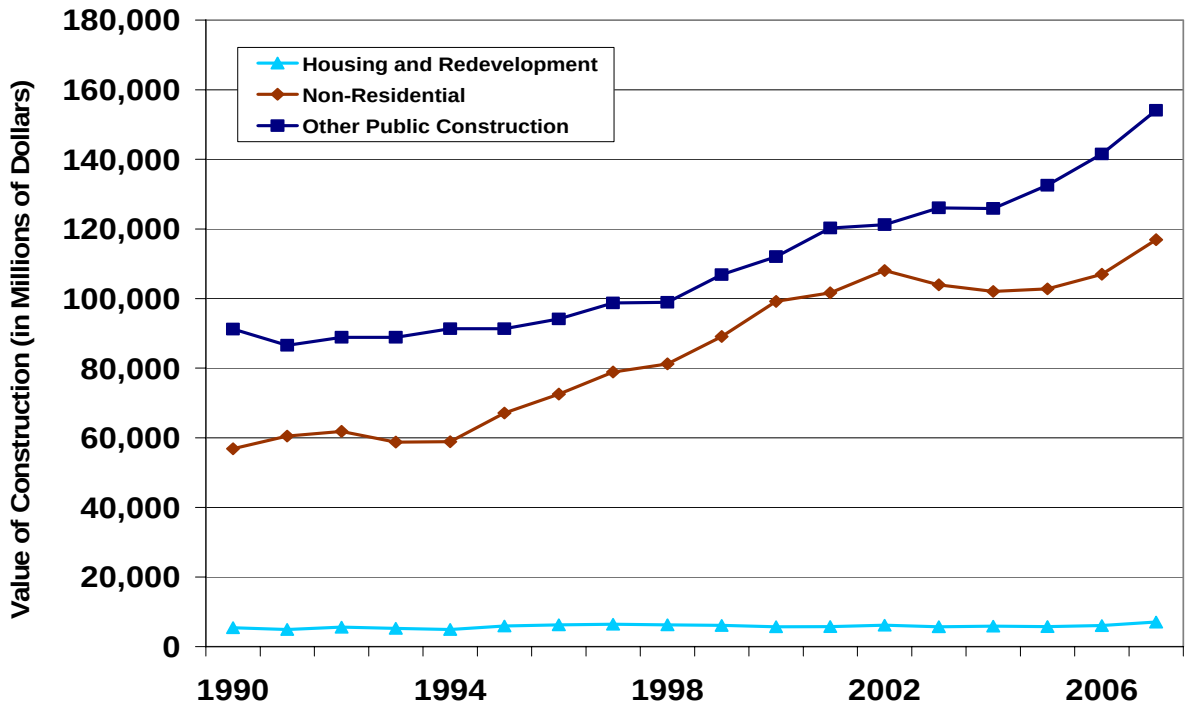
Source: U.S. Census Bureau (2008a)

Figure 2-6: Annual Value of Private Construction from 1990 to 2006 ($2006 Dollars)



Source: U.S. Census Bureau (2008a)

Figure 2-7: Annual Value of Public Construction from 1990 to 2006 ($2006 Dollars)



Source: U.S. Census Bureau (2008a)

2.4 Industry Characteristics

The following section defines and describes the construction industry based on establishment and firm-level data. Based on data from the most recent Economic Census (2002), the industry includes 178,835 establishments, 2,573,215 employees, and has approximately $678 billion in value. In addition, the industry is dominated by small businesses, with approximately 93% of establishments, 45% of employees, and 31% of value in the industry being in single-establishment firms that would be classified as a small business according to Small Business Administration business size criteria.

EPA used two steps to define the number of C&D establishments that could be affected by the various options that EPA considered for the C&D regulation. First, EPA identified all C&D establishments using data from the 2002 Economic Census (see *Table 2-1*). Second, EPA estimated the number of these establishments that will be affected by this action. *Section 2.4.1* examines industry-wide characteristics, including the number and size of establishments. *Section 2.4.2* examines employment and payroll data for the industry. *Section 2.4.3* describes firm-level data for the C&D industry. *Section 2.4.4* presents the number of small entities.

2.4.1 Establishment-Level Data

This section presents data for all establishments within the C&D industry as defined in *Section 2.1*, based primarily on the 2002 Economic Census. Data presented include the number, size, value of construction, employment, legal form of organization, seasonality, payroll and benefits, and level of specialization of establishments, by principal industry sector.

2.4.1.1 Total Number of Establishments

Economic Census indicates that the C&D industry had a total of 178,835 establishments with payrolls in 2002 (i.e., 2002 NAICS 236, 237, see *Table 2-3*, *Table 2-4*, and *Table 2-5*). Of these establishments, the largest numbers are in NAICS 236 (*Construction of Buildings*). This subsector includes 128,897 establishments, representing 72.7 percent of all C&D industry establishments. Within NAICS 236, three categories fall in *Residential Home Construction*: 1) *New Single-Family General Contractors* (NAICS 236115), 2) *New Multifamily General Contractors* (NAICS 236116), and 3) *New Housing Operative Builders* (NAICS 236117). These three categories account for the majority of C&D industry establishments: 88,912 out of 128,897 or 69 percent. Also within NAICS 236 are two categories of *Non-Residential Building Construction*: 1) *Industrial Building Construction* (NAICS 236210) and 2) *Commercial and Institutional Building Construction* (NAICS 236220). Non-residential construction accounts for the other 31 percent (39,985 establishments) within NAICS 236 (*Construction of Buildings*).

The other segments of the C&D industry include establishments in *Heavy and Civil Engineering Construction* (NAICS 237). *Heavy and Civil Engineering Construction* accounts for 49,938 establishments, or 27.92 percent of the total C&D industry. Within NAICS 237 (*Heavy and Civil Engineering Construction*), *Land Subdivision* (NAICS 2372) accounts for 8,403 establishments, or 4.7 percent of all establishments in the C&D industry. Of the remaining heavy and civil engineering construction establishments, 22.5 percent (11,239 establishments) are primarily *Highway, Street, and Bridge Construction* contractors, while 39.6 percent (19,794 establishments) are contractors that work on *Water, Sewer, Pipeline, Communications, and Power Line* projects and 21.0 percent (10,502 establishments) are engaged in *Other Types of Heavy Construction*.

In addition to the establishments with payrolls, a large number of establishments – 531,952 in 2002[6] – reported no paid employees and are not included in the totals in the following tables. These establishments are nonemployers, typically self-employed individuals, which are not subject to payroll tax. Available data suggest these establishments are very small relative to establishments with payrolls. While employer establishments in NAICS 236 and 237 had $723.3 billion in receipts for 2002, non-employer establishments had only $46.9 billion in receipts, which represents only 6.5 percent of the receipts of employee establishments.

Table 2-5: Value of Construction (in $1000's) and Number of Establishments with Payrolls, 2002

NAICS	Description	Establishments	Percent of Total Establishments	Value of Construction	Percent of Total Value of Construction
236	*Construction of buildings*	*128,897*	*72.08%*	*$475,569,974*	*70.11%*
236115	New single-family general contractors	58,472	32.70%	$61,781,469	9.11%
236116	New multifamily general contractors	4,397	2.46%	$16,672,531	2.46%
237117	New housing operative builders	26,043	14.56%	$139,021,424	20.50%
236210	Industrial building construction	2,777	1.55%	$17,029,276	2.51%
236220	Commercial and institutional building construction	37,208	20.81%	$241,065,274	35.54%
237	*Heavy and civil engineering construction*	*49,938*	*27.92%*	*$202,713,062*	*29.89%*
237110	Water and sewer line and related structures construction	12,357	6.91%	$32,501,442	4.79%
237120	Oil and gas pipeline and related structures construction	1,403	0.78%	$11,458,718	1.69%
237130	Power and communication line and related structures construction	6,034	3.37%	$34,810,458	5.13%
237210	Land subdivision	8,403	4.70%	$20,480,936	3.02%
237310	Highway, street, and bridge construction	11,239	6.28%	$81,660,219	12.04%
237990	Other heavy and civil engineering construction	10,502	5.87%	$21,801,289	3.21%
TOTAL		**178,835**	**100%**	**$678,283,036**	**100%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

[6] This figure includes establishments in NAICS 236 and 237. Data on non-employer establishments was not broken out at the 6 digit NAICS level, thus, residential remodelers are included in this figure.

2.4.1.2 Number of Establishments, Employees, and the Value of Construction by Establishment Employee Size

As viewed in a number of data frameworks, C&D industry groups are dominated by small establishments.[7] *Table 2-6* through *Table 2-8* shows the number of establishments, employees, and the value of construction by the establishment's employee size. *Table 2-9* through *Table 2-11* shows the number of establishments, employees, and the value of construction by the establishment's value of business size.

As shown in *Table 2-6*, the Economic Census reports that 55.1 percent of establishments with payrolls have fewer than 5 employees, 75.0 percent have fewer than 10 employees, and 95.3 percent have fewer than 50 employees.[8] Overall, less than 0.2 percent of C&D establishments with payrolls have 500 or more employees. On average, establishments in NAICS 237 (*Heavy Construction*) are somewhat larger than those in the other NAICS industry groups, with a lower percentage of establishments appearing in each of the smaller establishment size classes.

[7] The SBA uses size standards based on either the number of employees or annual revenue to classify firms as small. Qualifying revenue levels differ among NAICS industry groups, and, within the C&D industries, there is a range of revenue levels, from $6.5 million for NAICS 237210 (*Land Subdivision*) to $31.0 million for the majority of industry groups within NAICS 236 and 237 (U.S. SBA, 2006). A more detailed review of industry size distribution based on the SBA definitions will be presented as part of the Small Entity Impact Analysis.

[8] 531,952 establishments in the C&D industry report *no* employees.

Table 2-6: Number of Establishments with Payrolls in the C&D Industry, by Employment Size Class

			Establishments with less than 5 employees		Establishments with less than 10 employees		Establishments with less than 50 employees		Establishments with less than 100 employees		Establishments with less than 500 employees	
NAICS	Description	Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*128,897*	*75,944*	*58.9%*	*101,975*	*79.1%*	*124,845*	*96.9%*	*127,242*	*98.7%*	*128,756*	*99.9%*
236115	New single-family housing construction	58,472	41,602	71.1%	53,171	90.9%	58,211	99.6%	58,387	99.9%	58,468	100.0%
236116	New multifamily housing construction	4,397	2,522	57.4%	3,358	76.4%	4,259	96.9%	4,351	99.0%	4,395	100.0%
236117	New housing operative builders	26,043	16,439	63.1%	21,789	83.7%	25,267	97.0%	25,697	98.7%	26,028	99.9%
236210	Industrial building construction	2,777	993	35.8%	1,630	58.7%	2,505	90.2%	2,633	94.8%	2,750	99.0%
236220	Commercial and institutional building	37,208	14,388	38.7%	22,027	59.2%	34,603	93.0%	36,174	97.2%	37,115	99.8%
237	*Heavy and civil engineering construction*	*49,938*	*22,565*	*45.2%*	*32,184*	*64.4%*	*45,616*	*91.3%*	*47,890*	*95.9%*	*49,714*	*99.6%*
237110	Water and sewer line and related structures construction	12,357	5,181	41.9%	7,948	64.3%	11,538	93.4%	12,047	97.5%	12,338	99.8%
237120	Oil and gas pipeline and related structures construction	1,403	280	20.0%	491	35.0%	1,093	77.9%	1,230	87.7%	1,377	98.1%
237130	Power and communication line	6,034	1,984	32.9%	3,284	54.4%	5,269	87.3%	5,668	93.9%	5,973	99.0%
237210	Land subdivision	8,403	6,268	74.6%	7,413	88.2%	8,281	98.5%	8,346	99.3%	8,394	99.9%
237310	Highway, street, and bridge construction	11,239	3,071	27.3%	5,211	46.4%	9,360	83.3%	10,330	91.9%	11,163	99.3%
237990	Other heavy and civil engineering construction	10,502	5,781	55.0%	7,837	74.6%	10,075	95.9%	10,269	97.8%	10,469	99.7%
TOTAL		**178,835**	**98,509**	**55.1%**	**134,159**	**75.0%**	**170,461**	**95.3%**	**175,132**	**97.9%**	**178,470**	**99.8%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

The total number of employees in establishments (*Table 2-7,* following page) by employee-size follows a similar trend by sector. Again, heavy construction stands out as having many more employees within the establishments employing over 100 people (54.3%). As expected, a much smaller fraction of total employees are within the category of establishments with fewer than 5 employees. Within this category, the percentage of total establishments is nearly 7 times greater than the percentage of total employees.

Table 2-7: Number of Employees with Payrolls in the C&D Industry, by Employment Size Class

			Employees in Establishments with less than 5 employees		Employees in Establishments with less than 10 employees		Employees in Establishments with less than 50 employees		Employees in Establishments with less than 100 employees		Employees in Establishments with less than 500 employees	
NAICS	Description	Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*1,367,558*	*161,401*	*11.8%*	*327,476*	*23.9%*	*764,482*	*55.9%*	*929,168*	*67.9%*	*1,201,566*	*87.9%*
236115	New single-family housing construction	273,055	86,849	31.8%	158,886	58.2%	243,330	89.1%	255,031	93.4%	268,688	98.4%
236116	New multifamily housing construction	44,384	5,144	11.6%	10,570	23.8%	28,219	63.6%	34,796	78.4%	39,930	90.0%
236117	New housing operative builders	240,292	34,724	14.5%	69,153	28.8%	134,177	55.8%	164,370	68.4%	226,476	94.3%
236210	Industrial building construction	93,931	2,180	2.3%	6,389	6.8%	24,075	25.6%	32,803	34.9%	44,457	47.3%
236220	Commercial and institutional building	715,896	32,504	4.5%	82,478	11.5%	334,681	46.7%	442,168	61.8%	622,015	86.9%
237	*Heavy and civil engineering construction*	*1,205,657*	*47,549*	*3.9%*	*109,098*	*9.0%*	*394,141*	*32.7%*	*550,841*	*45.7%*	*866,997*	*71.9%*
237110	Water and sewer line and related structures	204,085	11,137	5.5%	29,139	14.3%	105,768	51.8%	140,451	68.8%	191,235	93.7%
237120	Oil and gas pipeline and related structures	93,176	705	0.8%	1,958	2.1%	16,074	17.3%	25,733	27.6%	42,130	45.2%
237130	Power and communication line construction	253,506	4,499	1.8%	12,728	5.0%	53,995	21.3%	81,611	32.2%	142,851	56.4%
237210	Land subdivision	66,105	11,938	18.1%	18,806	28.4%	34,322	51.9%	38,779	58.7%	44,636	67.5%
237310	Highway, street, and bridge construction	434,714	7,179	1.7%	21,068	4.8%	114,986	26.5%	182,236	41.9%	341,856	78.6%
237990	Other heavy and civil engineering construction	154,071	12,091	7.8%	25,399	16.5%	68,996	44.8%	82,031	53.2%	104,289	67.7%
TOTAL		**2,573,215**	**208,950**	**8.1%**	**436,574**	**17.0%**	**1,158,623**	**45.0%**	**1,480,009**	**57.5%**	**2,068,563**	**80.4%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

Table 2-8 reports the value of construction by establishment size. The value of construction, by establishment size, correlates closely with employment by establishment size. Again, a larger relative share of total business value occurs in the larger employment size categories.

Table 2-8: Value of Construction with Payrolls in the C&D Industry, by Employment Size Class (in $1000's)

NAICS	Description	Total	Value of Construction in Establishments with less than 5 employees		Value of Construction in Establishments with less than 10 employees		Value of Construction in Establishments with less than 50 employees		Value of Construction in Establishments with less than 100 employees		Value of Construction in Establishments with less than 500 employees	
			Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*$475,569,974*	*$45,736,358*	*9.6%*	*$88,657,258*	*18.6%*	*$223,103,464*	*46.9%*	*$292,038,213*	*61.4%*	*$422,537,863*	*88.8%*
236115	New single-family housing construction	$61,781,469	$21,793,366	35.3%	$36,478,924	59.0%	$54,625,158	88.4%	$57,788,631	93.5%	$59,911,206	97.0%
236116	New multifamily housing construction	$16,672,531	$1,276,547	7.7%	$2,648,533	15.9%	$8,928,221	53.6%	$12,223,500	73.3%	$14,748,503	88.5%
236117	New housing operative builders	$139,021,424	$15,732,340	11.3%	$30,325,999	21.8%	$63,876,017	45.9%	$84,221,767	60.6%	$131,771,816	94.8%
236210	Industrial building construction	$17,029,276	$426,963	2.5%	$1,265,910	7.4%	$4,889,191	28.7%	$6,677,073	39.2%	$9,591,627	56.3%
236220	Commercial and institutional building	$241,065,274	$6,507,142	2.7%	$17,937,892	7.4%	$90,784,877	37.7%	$131,127,242	54.4%	$206,514,711	85.7%
237	*Heavy and civil engineering construction*	*$202,713,062*	*$8,432,679*	*4.2%*	*$17,156,991*	*8.5%*	*$60,702,284*	*29.9%*	*$88,527,335*	*43.7%*	*$146,439,254*	*72.2%*
237110	Water and sewer line and related structures	$32,501,442	$1,415,430	4.4%	$3,595,293	11.1%	$14,980,586	46.1%	$21,346,472	65.7%	$30,887,395	95.0%
237120	Oil and gas pipeline and related structures	$11,458,718	$76,428	0.7%	$204,478	1.8%	$1,604,355	14.0%	$2,758,431	24.1%	$4,934,845	43.1%
237130	Power and communication line	$34,810,458	$366,360	1.1%	$1,230,831	3.5%	$5,825,476	16.7%	$9,003,657	25.9%	$16,326,786	46.9%
237210	Land subdivision	$20,480,936	$4,349,376	21.2%	$6,323,548	30.9%	$10,484,766	51.2%	$11,693,997	57.1%	$12,583,532	61.4%
237310	Highway, street, and bridge construction	$81,660,219	$879,611	1.1%	$2,797,973	3.4%	$18,876,026	23.1%	$32,669,113	40.0%	$66,818,535	81.8%
237990	Other heavy and civil engineering construction	$21,801,289	$1,345,474	6.2%	$3,004,868	13.8%	$8,931,075	41.0%	$11,055,665	50.7%	$14,888,161	68.3%
TOTAL		**$678,283,036**	**$54,169,037**	**8.0%**	**$105,814,249**	**15.6%**	**$283,805,748**	**41.8%**	**$380,565,548**	**56.1%**	**$568,977,117**	**83.9%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

2.4.1.3 Number of Establishments, Employees, and the Value of Construction by Establishment Revenue Size

The dominance of small establishments in the C&D industry is also apparent when analyzed on the basis of revenue size class. In 2002, 27.4 percent of establishments with payrolls had annual revenue below $250,000, 44.8 percent had annual revenue below $500,000, 61.6 percent had annual revenue below $1.0 million, 88.0 percent had annual revenue below $5.0 million, and 93.6 percent had annual revenue below $10 million. These data are shown in *Table 2-9,* following page. Only 11,463 establishments, representing 6.4 percent of the total, had annual revenue in excess of $10.0 million.

Table 2-9: Number of Establishments in the C&D Industry, by Annual Revenue

NAICS	Description	Total	Establishments with less than $250,000 in Annual Revenue		Establishments with less than $500,000 in Annual Revenue		Establishments with less than $1 million in Annual Revenue		Establishments with less than $5 million in Annual Revenue		Establishments with less than $10 million in Annual Revenue	
			Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*128,897*	*34,668*	*26.9%*	*57,606*	*44.7%*	*79,703*	*61.8%*	*114,220*	*88.6%*	*121,163*	*94.0%*
236115	New single-family housing construction	58,472	20,804	35.6%	33,524	57.3%	44,581	76.2%	56,520	96.7%	57,759	98.8%
236116	New multifamily housing construction	4,397	1,260	28.7%	2,135	48.6%	2,779	63.2%	3,798	86.4%	4,050	92.1%
236117	New housing operative builders	26,043	4,675	18.0%	8,889	34.1%	13,134	50.4%	22,163	85.1%	24,032	92.3%
236210	Industrial building construction	2,777	514	18.5%	880	31.7%	1,336	48.1%	2,265	81.6%	2,529	91.1%
236220	Commercial and institutional building	37,208	7,415	19.9%	12,178	32.7%	17,873	48.0%	29,474	79.2%	32,793	88.1%
237	*Heavy and civil engineering construction*	*49,938*	*14,303*	*28.6%*	*22,440*	*44.9%*	*30,387*	*60.8%*	*43,146*	*86.4%*	*46,209*	*92.5%*
237110	Water and sewer line and related structures construction	12,357	3,258	26.4%	5,530	44.8%	7,781	63.0%	10,879	88.0%	11,612	94.0%
237120	Oil and gas pipeline and related structures construction	1,403	222	15.8%	431	30.7%	590	42.1%	1,071	76.3%	1,211	86.3%
237130	Power and communication line construction	6,034	1,630	27.0%	2,618	43.4%	3,467	57.5%	5,221	86.5%	5,586	92.6%
237210	Land subdivision	8,403	3,111	37.0%	4,573	54.4%	5,824	69.3%	7,851	93.4%	8,216	97.8%
237310	Highway, street, and bridge construction	11,239	2,171	19.3%	3,321	29.5%	4,988	44.4%	8,304	73.9%	9,425	83.9%
237990	Other heavy and civil engineering construction	10,502	3,911	37.2%	5,967	56.8%	7,737	73.7%	9,820	93.5%	10,159	96.7%
TOTAL		**178,835**	**48,971**	**27.4%**	**80,046**	**44.8%**	**110,090**	**61.6%**	**157,366**	**88.0%**	**167,372**	**93.6%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

As shown in *Table 2-10,* only 3.6 percent of all employees fall into establishments with less than $250,000 in value of business done as compared to 45 percent of employees within establishments of less than $10 million.

Table 2-10: Number of Employees in the C&D Industry, by Annual Revenue

			Employees in Establishments with less than $250,000 in Annual Revenue		Employees in Establishments with less than $500,000 in Annual Revenue		Employees in Establishments with less than $1 million in Annual Revenue		Employees in Establishments with less than $5 million in Annual Revenue		Employees in Establishments with less than $10 million in Annual Revenue	
NAICS	Description	Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*1,367,558*	*66,711*	*4.9%*	*143,061*	*10.5%*	*248,686*	*18.2%*	*558,077*	*40.8%*	*698,363*	*51.1%*
236115	New single-family housing construction	273,055	41,087	15.0%	82,279	30.1%	130,806	47.9%	218,945	80.2%	239,650	87.8%
236116	New multifamily housing construction	44,384	2,007	4.5%	4,829	10.9%	8,281	18.7%	18,722	42.2%	23,750	53.5%
236117	New housing operative builders	240,292	8,005	3.3%	19,808	8.2%	35,505	14.8%	88,115	36.7%	110,784	46.1%
236210	Industrial building construction	93,931	900	1.0%	2,754	2.9%	5,616	6.0%	19,250	20.5%	28,330	30.2%
236220	Commercial and institutional building	715,896	14,712	2.1%	33,391	4.7%	68,478	9.6%	213,045	29.8%	295,849	41.3%
237	*Heavy and civil engineering construction*	*1,205,657*	*26,902*	*2.2%*	*60,247*	*5.0%*	*116,618*	*9.7%*	*330,299*	*27.4%*	*459,594*	*38.1%*
237110	Water and sewer line and related structures construction	204,085	5,845	2.9%	14,829	7.3%	30,803	15.1%	84,204	41.3%	112,761	55.3%
237120	Oil and gas pipeline and related structures construction	93,176	639	0.7%	2,167	2.3%	4,094	4.4%	16,824	18.1%	25,803	27.7%
237130	Power and communication line construction	253,506	3,446	1.4%	8,794	3.5%	16,244	6.4%	55,625	21.9%	79,383	31.3%
237210	Land subdivision	66,105	5,048	7.6%	9,451	14.3%	14,929	22.6%	29,519	44.7%	36,333	55.0%
237310	Highway, street, and bridge construction	434,714	5,064	1.2%	9,926	2.3%	23,783	5.5%	82,299	18.9%	128,475	29.6%
237990	Other heavy and civil engineering construction	154,071	6,860	4.5%	15,080	9.8%	26,765	17.4%	61,828	40.1%	76,839	49.9%
TOTAL		**2,573,215**	**93,613**	**3.6%**	**203,308**	**7.9%**	**365,304**	**14.2%**	**888,376**	**34.5%**	**1,157,957**	**45.0%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

As shown in *Table 2-11*, the total value of construction by establishment revenue class follows the same profile as seen in the previous tables, with a very high percentage of total construction value occurring in the higher revenue class establishments. Over half of the total value of annual revenue in the C&D sectors is generated in establishments with at least $10 million, although these establishments represent fewer than 7 percent of total establishments in this industry.

Table 2-11: Value of Construction in the C&D Industry, by Annual Revenue (in $1000's)

			Value of Construction in Establishments with less than $250,000 in Annual Revenue		Value of Construction in Establishments with less than $500,000 in Annual Revenue		Value of Construction in Establishments with less than $1 million in Annual Revenue		Value of Construction in Establishments with less than $5 million in Annual Revenue		Value of Construction in Establishments with less than $10 million in Annual Revenue	
NAICS	**Description**	**Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**
236	*Construction of buildings*	*$475,569,974*	*$4,525,301*	*1.0%*	*$12,756,624*	*2.7%*	*$28,315,588*	*6.0%*	*$103,668,145*	*21.8%*	*$150,810,613*	*31.7%*
236115	New single-family housing construction	$61,781,469	$2,708,376	4.4%	$7,257,487	11.7%	$14,980,754	24.2%	$39,031,735	63.2%	$47,236,528	76.5%
236116	New multifamily housing construction	$16,672,531	$140,521	0.8%	$450,834	2.7%	$895,825	5.4%	$3,250,934	19.5%	$4,942,393	29.6%
236117	New housing operative builders	$139,021,424	$635,721	0.5%	$2,163,061	1.6%	$5,185,010	3.7%	$25,109,207	18.1%	$37,512,292	27.0%
236210	Industrial building construction	$17,029,276	$60,605	0.4%	$198,854	1.2%	$535,534	3.1%	$2,492,871	14.6%	$4,349,956	25.5%
236220	Commercial and institutional building	$241,065,274	$980,078	0.4%	$2,686,388	1.1%	$6,718,465	2.8%	$33,783,398	14.0%	$56,769,444	23.5%
237	*Heavy and civil engineering construction*	*$202,713,062*	*$1,728,506*	*0.9%*	*$4,630,104*	*2.3%*	*$10,217,938*	*5.0%*	*$38,714,981*	*19.1%*	*$59,688,164*	*29.4%*
237110	Water and sewer line and related structures	$32,501,442	$422,643	1.3%	$1,225,288	3.8%	$2,820,890	8.7%	$9,743,281	30.0%	$14,780,221	45.5%
237120	Oil and gas pipeline and related structures	$11,458,718	$34,501	0.3%	$113,835	1.0%	$231,607	2.0%	$1,347,896	11.8%	$2,325,083	20.3%
237130	Power and communication line	$34,810,458	$191,227	0.5%	$534,643	1.5%	$1,143,503	3.3%	$5,102,546	14.7%	$7,604,600	21.8%
237210	Land subdivision	$20,480,936	$318,156	1.6%	$857,673	4.2%	$1,725,426	8.4%	$6,057,496	29.6%	$8,467,937	41.3%
237310	Highway, street, and bridge construction	$81,660,219	$301,951	0.4%	$708,561	0.9%	$1,877,940	2.3%	$9,724,026	11.9%	$17,419,028	21.3%
237990	Other heavy and civil engineering	$21,801,289	$460,028	2.1%	$1,190,104	5.5%	$2,418,572	11.1%	$6,739,736	30.9%	$9,091,295	41.7%
TOTAL		**$678,283,036**	**$6,253,807**	**0.9%**	**$17,386,728**	**2.6%**	**$38,533,526**	**5.7%**	**$142,383,126**	**21.0%**	**$210,498,777**	**31.0%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

Legal Form of Organization

The Economic Census also reports construction establishments according to how they are organized legally, using the following classification scheme: (a) corporations, (b) proprietorships, (c) partnerships, and (d) other. In 2002, of establishments with payrolls, a total of 130,253(72.8 percent of the total, only of establishments with payrolls – as distinguished from total establishments) were organized as corporations (see *Table 2-12*). A further 33,184 (18.5 percent) were organized as proprietorships, while 13,642 (7.6 percent) operated as partnerships and 1,838 (1.0 percent) operated under some other legal form of organization.

Table 2-12: Number of Establishments in the C&D Industry with Payrolls, by Legal Form of Organization

		Corporations		Proprietorships		Partnerships		Other		Total	
NAICS	Description	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
236	*Construction of buildings*	*92,436*	*71.6%*	*26,084*	*20.2%*	*9,405*	*7.3%*	*1,168*	*0.9%*	*129,098*	*100.0%*
236115	New single-family housing construction	36,968	63.2%	17,004	29.1%	3,839	6.6%	677	1.2%	58,489	100.0%
236116	New multifamily housing construction	3,332	76.2%	552	12.6%	447	10.2%	40	0.9%	4,372	100.0%
236117	New housing operative builders	19,856	76.2%	3,338	12.8%	2,684	10.3%	168	0.6%	26,047	100.0%
236210	Industrial building construction	2,298	82.1%	328	11.7%	164	5.9%	8	0.3%	2,799	100.0%
236220	Commercial and institutional building	29,982	80.2%	4,862	13.0%	2,271	6.1%	275	0.7%	37,391	100.0%
237	*Heavy and civil engineering construction*	*37,817*	*75.9%*	*7,100*	*14.2%*	*4,237*	*8.5%*	*670*	*1.3%*	*49,830*	*100.0%*
237110	Water and sewer line and related structures construction	9,101	73.4%	2,475	20.0%	721	5.8%	98	0.8%	12,396	100.0%
237120	Oil and gas pipeline and related structures construction	1,155	81.5%	116	8.2%	141	9.9%	5	0.4%	1,418	100.0%
237130	Power and communication line construction	4,825	80.5%	709	11.8%	417	7.0%	43	0.7%	5,995	100.0%
237210	Land subdivision	6,217	73.6%	503	6.0%	1,554	18.4%	169	2.0%	8,444	100.0%
237310	Highway, street, and bridge construction	9,270	81.7%	1,245	11.0%	675	5.9%	158	1.4%	11,349	100.0%
237990	Other heavy and civil engineering construction	7,249	70.9%	2,052	20.1%	729	7.1%	197	1.9%	10,228	100.0%
TOTAL		**130,253**	**72.8%**	**33,184**	**18.5%**	**13,642**	**7.6%**	**1,838**	**1.0%**	**178,928**	**100.0%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

2.4.1.4 Specialization

A construction establishment is classified within a type of construction according to the percentage of the construction work performed by that establishment. When 51 percent or more of the construction work done by the establishment falls within a specific type of construction, the establishment is considered *specialized*. Specialization data provide insight into the percentage of firms that perform work outside their firm's classification. Establishments report their degree of specialization to the Economic Census, based on the percentage of revenue earned from each type of construction work. For example, approximately 44.1 percent of establishments within NAICS 236115 (*New Single-Family Housing Construction)* perform 100 percent of their work within *New Single-Family Housing Construction*, 8.1 percent perform 80-99 percent of their work within *New Single-Family Housing Construction*, and 6.6 percent perform 51-79 percent of their work within *New Single-Family Housing Construction.*

As is the case with two other NAICS divisions (236117 and 236118), a large percentage of the establishments within *New Single-Family Housing Construction* did not report their degree of specialization. This could mean that this information was simply not provided to the Census or that these establishments in this sector often do not perform 51 percent or more of their work within one specified type of construction. Regardless, within every type of construction, *most* establishments reported that they were 51 percent or more specialized within the specified type of construction.

Since *most* establishments in any of the relevant segments reported that they were 51 percent or more specialized, for the economic analyses presented later in this document, it is reasonable to establish model firms according to the assumption that these firms perform all or nearly all business within their classified category. Thus, the assumption is made that these firms perform 100 percent of their business within their classified category. To the extent that a firm performs work in other types of construction that would not be affected by the regulation (such as those classified as *New Single-Family Housing Contractors* that also perform work as *Residential Remodelers)*, the assignment of compliance costs to *all* business performed by the firm may overstate the potential impact of the regulation on firms in those segments as part of the firm- and industry-level impact assessment.

Table 2-13: Percent of Establishments by Percent Specialization by Assigned Type of Construction

		Percent of Total Establishments			Percent of Total Value of Construction of Establishments		
NAICS	Description	100% Specialized	80-99% Specialized	51-79% Specialized	100% Specialized	80-99% Specialized	51-79% Specialized
236115	New single-family housing construction	44.1%	8.1%	6.6%	52.3%	12.5%	3.7%
236116	New multifamily housing construction	47.1%	14.6%	36.6%	35.3%	16.7%	26.6%
236117	New housing operative builders	54.2%	6.1%	5.3%	0.0%	14.4%	9.1%
236210	Industrial building construction	41.0%	19.1%	31.3%	28.9%	5.7%	0.0%
236220	Commercial and institutional building construction	30.9%	14.1%	28.3%	15.5%	10.3%	17.1%
237110	Water and sewer line and related structures construction	44.3%	7.4%	20.3%	0.0%	7.1%	12.1%
237120	Oil and gas pipeline and related structures construction	73.8%	12.0%	13.9%	51.0%	23.1%	14.2%
237130	Power and communication line and related structures construction	86.3%	6.6%	7.1%	67.7%	13.5%	10.4%
237210	Land subdivision	70.8%	3.6%	5.5%	70.8%	2.0%	5.7%
237310	Highway, street, and bridge construction	45.5%	19.6%	27.9%	0.0%	12.3%	20.9%
237990	Other heavy and civil engineering construction	53.4%	10.2%	12.7%	43.9%	8.4%	12.5%

Source: U.S. Census Bureau's Economic Census (2005a)

2.4.2 Employment and Payroll

The construction industry employs a substantial percentage of the total U.S. workforce. With approximately 2.6 million employees in 2002, the construction industry accounts for nearly 2.4 percent of the entire workforce (the total amount of employees is nearly 109 million). Total payroll (approximately $98.6 billion) is roughly the same percentage of the total U.S. payroll (approximately $3.7 trillion): 2.6 percent.

2.4.2.1 Total Number of Employees

In 2002, establishments with payrolls in the C&D industry employed nearly 2.6 million people. *Table 2-14* shows the distribution of employment by NAICS industry group. Combined, NAICS 236115, 236220, and 237310 accounts for over 50 percent of total employment. NAICS 236115 (*New Single Family Housing Construction*) accounts for 273,055 employees (10.6 percent of the total), NAICS 236220 (*Commercial and Institutional Building Construction*) accounts for 715,896 employees (27.8 percent of the total), and NAICS 237310 (*Highway, Street, and Bridge Construction*) accounts for 434,714 employees, or 16.9 percent of the total.

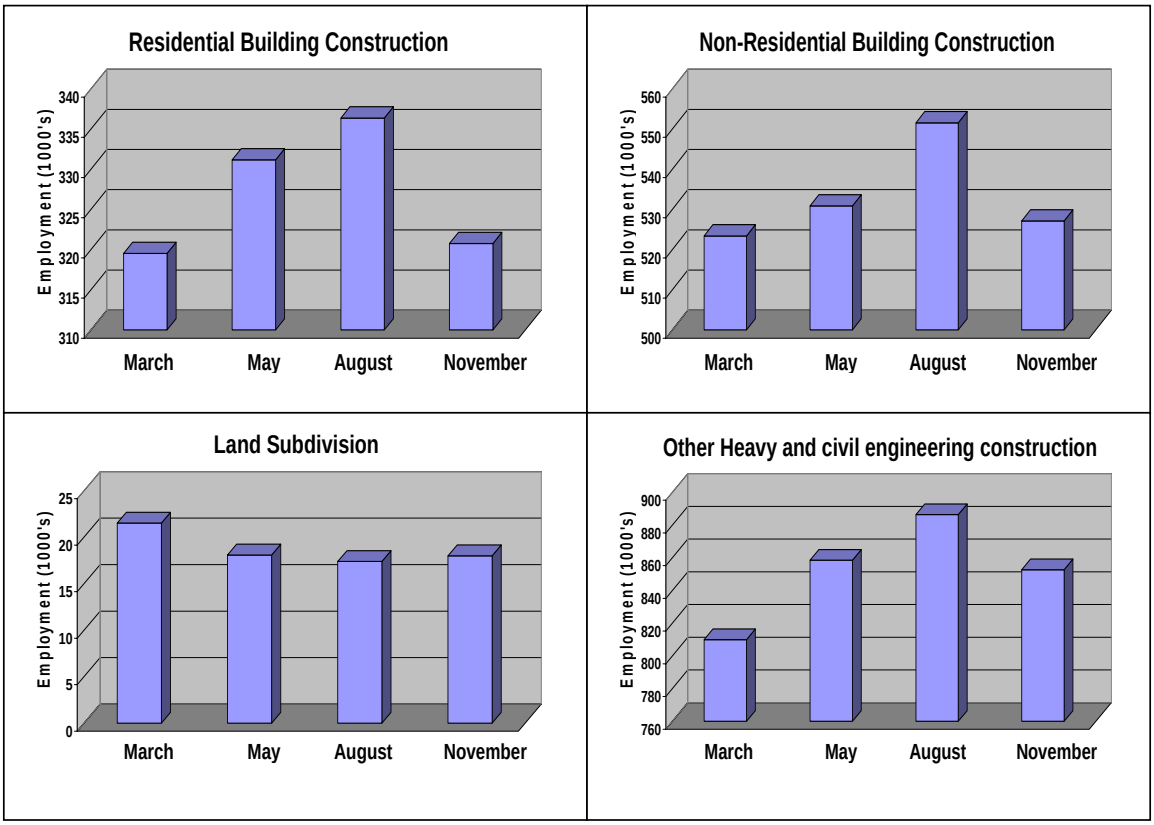
Table 2-14: Number of Employees in the C&D Industry, Establishments With Payrolls, in 2002

NAICS	Description	Number of Employees	Percent of Total
236	*Construction of buildings*	*1,367,558*	*53.2%*
236115	New single-family housing construction (except operative builders)	273,055	10.6%
236116	New multifamily housing construction (except operative builders)	44,384	1.7%
236117	New housing operative builders	240,292	9.3%
236210	Industrial building construction	93,931	3.7%
236220	Commercial and institutional building construction	715,896	27.8%
237	*Heavy and civil engineering construction*	*1,205,657*	*46.9%*
237110	Water and sewer line and related structures construction	204,085	7.9%
237120	Oil and gas pipeline and related structures construction	93,176	3.6%
237130	Power and communication line and related structures construction	253,506	9.9%
237210	Land subdivision	66,105	2.6%
237310	Highway, street, and bridge construction	434,714	16.9%
237990	Other heavy and civil engineering construction	154,071	6.0%
TOTAL		**2,573,215**	**100.0%**

Figures do not necessarily add to totals due to rounding.
Source: U.S. Census Bureau's Economic Census (2005a)

Construction is a seasonal activity in many parts of the country, and employment data from the industry reflect this fact. *Figure 2-8: Seasonal Trends in Employment in the C&D Industry, 2002*, following page, shows monthly employment data for all NAICS groups in the C&D industry. Total employment of construction workers was lowest in March, at 1.67 million, and highest in August at 1.79 million.

Figure 2-8: Seasonal Trends in Employment in the C&D Industry, 2002



Source: U.S. Census Bureau's Economic Census (2005a)

2.4.2.2 Payroll and Benefits

In 2002, the payrolls of all C&D industry groups totaled $98.6 billion. Of this number, $60.5 billion (61.3 percent) went to construction workers and $38.1 billion (38.7 percent) went to other employees.[9] In addition, the C&D industry incurred $13.2 billion in legally-required fringe benefit expenditures and $9.1 billion in voluntary fringe benefits expenditures, for a total of $22.3 billion in fringe benefits.[10] *Table 2-15*, following page, shows detailed data on payrolls and benefits for each of the C&D industry groups.

[9] *Construction workers* include all workers, through the working supervisor level, directly engaged in construction operations, such as painters, carpenters, plumbers, and electricians. Included are journeymen, mechanics, apprentices, laborers, truck drivers and helpers, equipment operators, and onsite recordkeepers and security guards. *Other employees* include employees in executive, purchasing, accounting, personnel, professional, technical and routine office functions.

[10] *Legally required contributions* include Social Security contributions, unemployment compensation, workman's compensation, and state temporary disability payments. *Voluntary expenditures* include life insurance premiums, pension plans, insurance premiums on hospital and medical plans, welfare plans, and union negotiated benefits.

Table 2-15: Payrolls and Benefits for Employees in the Construction & Development Industry (in $1000's)

		Payrolls[a]			Fringe Benefits (All Employees)		
NAICS	Description	Total	Other Employees[b]	Construction Worker[c]	Legally Required Expenditures[d]	Voluntary Expenditures[e]	Total Fringe Benefits[f]
236	*Construction of buildings*	*$53,488,317*	*$24,932,421*	*$28,555,896*	*$6,816,864*	*$4,091,629*	*$10,908,493*
236115	New single-family general contractors	$8,262,607	$3,780,204	$4,482,403	$1,020,034	$312,491	$1,332,525
236116	New multifamily general contractors	$1,730,843	$796,071	$934,772	$228,283	$116,543	$344,826
236117	New housing operative builders	$10,458,127	$6,371,039	$4,087,088	$1,075,153	$467,494	$1,542,647
236210	Industrial building construction	$3,826,648	$1,291,899	$2,534,749	$516,264	$348,233	$864,497
236220	Commercial building construction	$29,210,092	$12,693,208	$16,516,884	$3,977,130	$2,846,868	$6,823,998
237	*Heavy and civil engineering construction*	*$45,150,943*	*$13,206,331*	*$31,944,640*	*$6,429,632*	*$4,961,491*	*$11,391,123*
237110	Water and sewer system construction	$7,380,999	$2,069,415	$5,311,584	$1,036,078	$716,572	$1,752,650
237120	Oil and gas pipeline construction	$3,984,827	$812,781	$3,172,045	$599,899	$429,186	$1,029,085
237130	Power and communication line and related structures construction	$10,600,799	$2,857,301	$7,743,498	$1,430,879	$1,199,280	$2,630,159
237210	Land subdivision	$2,396,086	$1,696,602	$699,484	$282,350	$124,644	$406,993
237310	Highway and street construction	$15,790,835	$4,303,472	$11,487,363	$2,377,271	$1,966,930	$4,344,201
237990	Other heavy construction	$4,997,397	$1,466,760	$3,530,666	$703,155	$524,879	$1,228,035
TOTAL		**$98,639,260**	**$38,138,752**	**$60,500,536**	**$13,246,496**	**$9,053,120**	**$22,299,616**

[a] The payroll figures include the gross earnings paid in the calendar year 2002 to all employees on the payrolls of construction establishments. They include all forms of compensation, such as salaries, wages, commissions, bonuses, vacation allowances, and sick leave pay, prior to such deductions as employees' Social Security contribution, withholding taxes, group insurance, union dues, and savings bonds.

[b] Other employees include employees in executive, purchasing, accounting, personnel, professional, technical and routine office functions.

[c] Construction workers include all workers, through the working supervisor level, directly engaged in construction operations, such as painters, carpenters, plumbers, and electricians. Included are journeymen, mechanics, apprentices, laborers, truck drivers and helpers, equipment operators, and onsite record keepers and security guards.

[d] Legally required contributions include Social Security contributions, unemployment compensation, workman's compensation, and state temporary disability payments.

[e] Voluntary expenditures include life insurance premiums, pension plans, insurance premiums on hospital and medical plans, welfare plans, and union negotiated benefits.

[f] Total fringe benefits represent the expenditures made by the employer during 2002 for both legally required and voluntary fringe benefit programs for employees.

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a)

2.4.3 Firm-Level Data

The SBA Office of Advocacy works with the Census Bureau to produce firm-level data for U.S. industries. Currently, data on firms by employment size and receipt size for 2002 are available; as described previously, these data are reported in the 1997 NAICS framework.

The SBA data are based primarily on administrative records and are not directly linked to data collected for the Economic Census. As a result, data reported by SBA may differ from that reported by the Economic Census.[11] The SBA data, however, are the *only* firm-level data available for C&D industry groups, so EPA included them in this analysis. These data are important in the firm and industry-level impact analysis and the small entity analysis, both of which are focused at the firm, instead of establishment, level.[12]

2.4.3.1 Number of Firms, Employees, and Annual Payroll by Employment Size of Firm

Table 2-16 through *Table 2-18* present the number of firms, establishments, employees, and annual payroll totals for firms with payroll by employee size in the C&D industry in 2002, as reported by SBA.[13] Both the SBA data by employees and receipts are for the year 2002 but the NAICS sector classifications are based on the 1997 framework definitions. SBA did not report 2002 revenue and employment size class data in the 2002 NAICS format. Thus, the number of establishments reported here will differ from the number reported in previous tables due to the different sources used (see *Appendix 2-1*). Most notably, residential remodelers were not broken out in the 1997 NAICS framework. Thus, the number of firms, establishments, employees, and payroll is an overstatement. In the 2002 Economic Census data, residential remodelers account for 82,750 establishments.

Table 2-16, following page, presents the number of firms and establishments by employment size. These data indicate that *nearly all firms operate a single establishment and have fewer than 20 employees*. Of the 263,317 C&D firms listed within *Table 2-16*, approximately 98.8 percent operate only one establishment. Furthermore, 91.7 percent have fewer than 20 employees and less than 1 percent of firms have more than 500 employees (similar to *Table 2-6*). In 2002, there were 38,739 firms in heavy construction, which operated 39,949 establishments. Almost 97 percent of the heavy construction firms operate a single establishment, and approximately 80 percent of these firms have fewer than 20 employees.

[11] The SBA data, for example, provide estimates of the number of establishments operated by C&D firms. These establishment counts, however, do not match those reported in the Economic Census. This inconsistency is partially due to differences in coverage (the SBA data include administrative establishments while the Economic Census does not) as well as differences in data collection methods.

[12] For clarification, an *establishment* is defined as "a relatively permanent office or other place of business where the usual business activities related to construction are conducted" (U.S. Census Bureau, 2005). A *firm* refers to the aggregation of all establishments owned by one company; one firm, therefore, could consist of several establishments.

[13] "The data excludes non-employer businesses, thus excluding many self-employed individuals (employment is measured in March, so firms starting after March, firms closing before March, and seasonal firms can have zero employment)." (U.S. SBA, 2004)

Table 2-16: Firms and Establishments by Employment Size, 2002 (SBA Data)

Description	Firms					Establishments				
	Total	0 Employees	<20 Employees	<500 Employees	500+ Employees	Total	0 Employees	<20 Employees	<500 Employees	500+ Employees
Building, developing, & general contracting	*224,578*	*40,136*	*210,588*	*224,101*	*477*	*226,394*	*40,136*	*210,646*	*224,691*	*1,703*
Land subdivision & land development	13,860	2,804	12,935	13,766	94	14,044	2,804	12,952	13,858	186
Single-family housing construction	160,917	31,607	156,527	160,821	96	161,677	31,607	156,550	161,044	633
Multifamily housing construction	9,007	1,557	8,208	8,975	32	9,043	1,557	8,208	8,992	51
Mfg & industrial building construction	2,342	477	1,858	2,280	62	2,406	477	1,861	2,299	107
Commercial & institutional building construction	38,452	3,691	31,060	38,259	193	39,224	3,691	31,075	38,498	726
Heavy construction	*38,739*	*5,579*	*30,976*	*38,355*	*384*	*39,949*	*5,579*	*30,992*	*38,717*	*1,232*
Highway & street construction	10,507	1,478	7,874	10,405	102	10,985	1,478	7,877	10,546	439
Bridge & tunnel construction	792	83	490	760	32	833	83	490	773	60
Water, sewer, & pipeline construction	10,520	868	8,141	10,468	52	10,652	868	8,141	10,524	128
Power & communication transmission line construction	4,077	488	3,246	4,031	46	4,325	488	3,249	4,065	260
Industrial nonbuilding structure construction	470	56	285	414	56	527	56	285	426	101
All other heavy construction	12,373	2,606	10,940	12,277	96	12,627	2,606	10,950	12,383	244
TOTAL	**263,317**	**45,715**	**241,564**	**262,456**	**861**	**266,343**	**45,715**	**241,638**	**263,408**	**2,935**
Percent of Total	**100%**	**17.4%**	**91.7%**	**99.7%**	**0.3%**	**100%**	**17.2%**	**90.7%**	**98.9%**	**1.1%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. SBA (2004)

Compared to the number of firms by employment size, the number of employees by employment size of firm (*Table 2-17*) shows a higher percentage of employees within firms with fewer than 500 employees. Nearly 80 percent of construction employees fall in firms with fewer than 500 employees compared to 35.4 percent of employees in firms with fewer than 20 employees.

Table 2-17: Employees by Employment Size of Firm, 2002 (SBA Data)

	Employees			
Description	**Total**	**<20 Employees**	**<500 Employees**	**500+ Employees**
Building, developing, & general contracting	*1,585,717*	*713,062*	*1,352,351*	*233,366*
Land subdivision & land development	90,669	39,087	77,288	13,381
Single-family housing construction	696,886	459,873	637,023	59,863
Multifamily housing construction	73,965	31,447	65,991	7,974
Mfg & industrial building construction	86,859	8,396	33,834	53,025
Commercial & institutional building construction	637,338	174,259	538,215	99,123
Heavy construction	*856,312*	*150,925*	*588,730*	*267,582*
Highway & street construction	274,144	41,231	209,040	65,104
Bridge & tunnel construction	36,671	2,945	22,065	14,606
Water, sewer, & pipeline construction	198,821	46,770	170,174	28,647
Power & communication transmission line construction	98,465	16,991	61,950	36,515
Industrial nonbuilding structure construction	91,921	1,354	11,942	79,979
All other heavy construction	156,290	41,634	113,559	42,731
TOTAL	**2,442,029**	**863,987**	**1,941,081**	**500,948**
Percent of Total	**100%**	**35.4%**	**79.5%**	**20.5%**

Figures do not necessarily add to totals due to rounding.
Source: U.S. SBA (2004)

Similarly, as shown in *Table 2-18*, compared to the number of firms by employment size, a higher percentage of the total annual payroll falls in firms with less than 500 employees: 79.9 percent. Only 31.6 percent of the total annual payroll falls in firms with fewer than 20 employees and only 20.1 percent in firms with greater than 500 employees.

Table 2-18: Annual Payroll by Employment Size of Firm, 2002 (SBA Data) (in $1000's)

Description	Annual Payroll				
	Total	**0 Employees**	**<20 Employees**	**<500 Employees**	**500+ Employees**
Building, developing, & general contracting	*$65,730,491*	*$1,501,802*	*$24,493,876*	*$53,114,552*	*$12,615,939*
Land subdivision & land development	$4,100,107	$141,975	$1,677,639	$3,391,406	$708,701
Single-family housing construction	$25,396,809	$1,033,760	$14,330,522	$21,854,918	$3,541,891
Multifamily housing construction	$3,013,295	$66,323	$1,118,615	$2,599,681	$413,614
Mfg & industrial building construction	$3,828,813	$24,182	$328,447	$1,409,376	$2,419,437
Commercial & institutional building construction	$29,391,467	$235,562	$7,038,653	$23,859,171	$5,532,296
Heavy construction	*$42,673,726*	*$476,071*	*$9,708,025*	*$33,462,725*	*$9,211,001*
Highway & street construction	$13,767,501	$130,528	$2,269,776	$10,723,098	$3,044,403
Bridge & tunnel construction	$1,987,630	$15,070	$163,706	$1,234,340	$753,290
Water, sewer, & pipeline construction	$8,785,618	$68,245	$1,940,101	$7,382,229	$1,403,389
Power & communication transmission line construction	$3,909,650	N/A	$619,090	$2,246,478	$1,663,172
Industrial nonbuilding structure construction	$7,439,651	$157,498	$3,208,334	$7,173,693	$265,958
All other heavy construction	$6,783,676	$104,730	$1,507,018	$4,702,887	$2,080,789
TOTAL	**$108,404,217**	**$1,977,873**	**$34,201,901**	**$86,577,277**	**$21,826,940**
Percent of Total	**100%**	**1.8%**	**31.6%**	**79.9%**	**20.1%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. SBA (2004)

2.4.3.2 Number of Firms, Employees, and Annual Payroll by Firm Receipt Size

Table 2-19 through *Table 2-21* report 2002 data on the number of firms, establishments, annual payroll, receipts, and number of employees based on revenue size class. Again, the SBA data are for the year 2002, but the data are reported in the NAICS 1997 framework. *Table 2-19*, following page, shows SBA data on the number of employer firms and establishments, in 2002, based on revenue size class and 1997 NAICS industry groupings. These data show again that most segments of the C&D industry are dominated by small firms. Almost three-quarters (70 percent) of the firms in the target industry sectors reported under $1.0 million in revenue for 2002; 92.6 percent of firms reported revenue lower than $5.0 million.

Table 2-19: Firms and Establishments by Receipt Size, 2002 (SBA Data)

	Firms							Establishments						
Description	**Total**	**< $1 Million**	**< $5 Million**	**< $10 Million**	**< $50 Million**	**< $100 Million**	**More than $100 Million**	**Total**	**< $1 Million**	**< $5 Million**	**< $10 Million**	**< $50 Million**	**< $100 Million**	**More than $100 Million**
Building, developing, & general contracting	*224,578*	*161,023*	*210,748*	*217,230*	*223,097*	*223,793*	*785*	*226,394*	*161,030*	*210,801*	*217,356*	*223,421*	*224,340*	*2,054*
Land subdivision and Development	13,860	9,954	13,035	13,463	13,707	13,756	104	14,044	9,955	13,045	13,488	13,763	13,836	208
Single-family housing Construction	160,917	125,011	156,409	158,773	160,555	160,730	187	161,677	125,014	156,428	158,818	160,686	160,925	752
Multifamily housing Construction	9,007	6,063	8,290	8,581	8,907	8,956	51	9,043	6,063	8,291	8,584	8,917	8,968	75
Manufacturing and industrial building construction	2,342	1,354	1,964	2,107	2,252	2,272	70	2,406	1,354	1,966	2,115	2,263	2,289	117
Commercial and institutional building construction	38,452	18,641	31,050	34,306	37,676	38,079	373	39,224	18,644	31,071	34,351	37,792	38,322	902
Heavy construction	*38,739*	*23,185*	*33,182*	*35,581*	*37,999*	*38,304*	*435*	*39,949*	*23,186*	*33,211*	*35,638*	*38,199*	*38,604*	*1,345*
Highway and street construction	10,507	5,085	8,185	9,108	10,208	10,359	148	10,985	5,085	8,187	9,117	10,268	10,448	537
Bridge and tunnel construction	792	271	524	607	730	754	38	833	271	524	609	737	767	66
Water, sewer, and pipeline construction	10,520	5,666	8,972	9,756	10,424	10,468	52	10,652	5,666	8,973	9,759	10,457	10,521	131
Power and communication transmission line construction	4,077	2,704	3,675	3,879	4,013	4,035	42	4,325	2,705	3,682	3,894	4,045	4,074	251
Industrial nonbuilding structure construction	470	221	339	364	405	418	52	527	221	343	369	411	431	96
All other heavy construction	12,373	9,238	11,487	11,867	12,219	12,270	103	12,627	9,238	11,502	11,890	12,281	12,363	264
TOTAL	**263,317**	**184,208**	**243,930**	**252,811**	**261,096**	**262,097**	**1,220**	**266,343**	**184,216**	**244,012**	**252,994**	**261,620**	**262,944**	**3,399**
Percent of Total	**100%**	**70.0%**	**92.6%**	**96.0%**	**99.2%**	**99.5%**	**0.5%**	**100%**	**69.2%**	**91.6%**	**95.0%**	**98.2%**	**98.7%**	**1.3%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. SBA (2004)

Similar to the data reported by employment size classifications, data by receipt size classifications as shown in *Table 2-20*, shows a higher percentage of employees fall in the firms with the higher revenue classes. Although 70 percent of the firms fell into the revenue size class of less than $1 million, only 19.6 percent of employees fall in this same classification. Approximately 71.9 percent of employees fall in firms with less than $50 million in receipts.

Table 2-20: Employees by Receipt Size of Firm, 2002 (SBA Data)

	Employees						
Description	**Total**	**< $1 Million**	**< $5 Million**	**< $10 Million**	**< $50 Million**	**< $100 Million**	**More than $100 Million**
Building, developing, & general contracting	*1,585,717*	*400,687*	*825,818*	*970,528*	*1,233,903*	*1,309,200*	*276,517*
Land subdivision and Development	90,669	23,871	50,508	59,567	74,550	79,134	11,535
Single-family housing Construction	696,886	285,905	500,867	547,928	612,479	630,949	65,937
Multifamily housing Construction	73,965	17,655	39,583	46,495	59,613	63,197	10,768
Manufacturing and industrial building construction	86,859	4,352	13,713	18,076	31,152	33,198	53,661
Commercial and institutional building construction	637,338	68,904	221,147	298,462	456,109	502,722	134,616
Heavy construction	*856,312*	*78,309*	*235,250*	*323,108*	*522,640*	*587,321*	*268,991*
Highway and street construction	274,144	16,044	58,009	88,024	171,075	198,641	75,503
Bridge and tunnel construction	36,671	852	4,380	6,955	16,831	21,049	15,622
Water, sewer, and pipeline construction	198,821	22,295	76,111	105,053	161,175	173,543	25,278
Power and communication transmission line construction	98,465	12,210	32,437	43,571	59,581	64,028	34,437
Industrial nonbuilding structure construction	91,921	886	3,641	5,175	11,854	15,121	76,800
All other heavy construction	156,290	26,022	60,672	74,330	102,124	114,939	41,351
TOTAL	**2,442,029**	**478,996**	**1,061,068**	**1,293,636**	**1,756,543**	**1,896,521**	**545,508**
Percent of Total	**100%**	**19.6%**	**43.5%**	**53.0%**	**71.9%**	**77.7%**	**22.3%**

Figures do not necessarily add to totals due to rounding.

Source: U.S. SBA (2004)

Again, compared to the data by employment size classifications, according to *Table 2-21*, a greater amount of the total annual payroll falls within the firms in the larger receipt size classifications. A much smaller percentage of total annual payroll, 11.4 percent, falls within those firms with fewer than $1 million in receipts. Most of the annual payroll (64.6 percent) is within those firms that have less than $50 million in receipts. As for firms with more than $100 million in receipts, 28.3 percent of the total annual payroll falls into this size category.

Table 2-21: Annual Payroll by Receipt Size of Firm, 2002 (SBA Data) (in $1000's)

	Annual Payroll						
Description	**Total**	**< $1 Million**	**< $5 Million**	**< $10 Million**	**< $50 Million**	**< $100 Million**	**More than $100 Million**
Building, developing, & general contracting	*$65,730,491*	*$9,841,223*	*$25,380,538*	*$31,902,959*	*$45,338,394*	*$49,455,644*	*$16,274,847*
Land subdivision and Development	$4,100,107	$766,932	$1,937,669	$2,351,978	$3,133,152	$3,382,706	$717,401
Single-family housing Construction	$25,396,809	$6,731,744	$14,439,948	$16,598,807	$19,983,582	$20,950,921	$4,445,888
Multifamily housing Construction	$3,013,295	$443,853	$1,201,777	$1,484,787	$2,134,387	$2,353,392	$659,903
Manufacturing and industrial building construction	$3,828,813	$110,322	$438,278	$642,612	$1,222,167	$1,328,145	$2,500,668
Commercial and institutional building construction	$29,391,467	$1,788,372	$7,362,866	$10,824,775	$18,865,106	$21,440,480	$7,950,987
Heavy construction	*$39,321,547*	*$2,141,039*	*$8,300,356*	*$12,394,074*	*$22,512,332*	*$25,874,624*	*$13,446,923*
Highway and street construction	$13,767,501	$497,076	$2,320,042	$3,823,119	$8,217,132	$9,730,007	$4,037,494
Bridge and tunnel construction	$1,987,630	$27,081	$192,793	$326,536	$901,508	$1,151,619	$836,011
Water, sewer, and pipeline	$8,785,618	$596,161	$2,640,097	$3,976,847	$6,788,390	$7,344,222	$1,441,396
Power and communication transmission line construction	$3,909,650	$300,671	$998,753	$1,426,230	$2,083,707	$2,317,027	$1,592,623
Industrial nonbuilding structure construction	$4,087,472	$23,904	$120,039	$184,471	$496,099	$673,946	$3,413,526
All other heavy construction	$6,783,676	$696,146	$2,028,632	$2,656,871	$4,025,496	$4,657,803	$2,125,873
TOTAL	**$105,052,038**	**$11,982,262**	**$33,680,894**	**$44,297,033**	**$67,850,726**	**$75,330,268**	**$29,721,770**
Percent of Total	**100%**	**11.4%**	**32.1%**	**42.2%**	**64.6%**	**71.7%**	**28.3%**

Figures do not necessarily add to totals due to rounding.
Source: U.S. SBA (2004)

2.4.4 Number of Small Entities

EPA used the establishment-level Economic Census data and firm-level data from SBA to estimate the number of entities in the C&D industry that are small businesses in accordance with SBA criteria. SBA uses size standards based either on number of employees or on annual revenue to define small entities (13 CFR 121). For all of the C&D industry groups, SBA's business size standards are based on annual revenue. The SBA revenue thresholds for the C&D industry are, as follows:

- NAICS 236 (*Construction of Buildings*): $33.5 million
- NAICS 237 (*Heavy and Civil Engineering Construction*), except 2372: $33.5 million
- NAICS 2372 (*Land Subdivision* of NAICS 237): $7.0 million

The data sources reviewed above do not provide data according to these exact size standards. As a result, the number of firms falling within the SBA small business classifications cannot be determined precisely from these data sources but must be estimated, using the data-reporting range from each data source that most nearly matches the SBA size classifications.

In using the *SBA data*, the data-reporting ranges most closely corresponding to the SBA thresholds are as follows:

- NAICS 236: $50 million (Overstates number of small businesses)
- NAICS 237, except 2372: $50 million (Overstates number of small businesses)

- NAICS 2372: $5 million (Understates number of small businesses)

Table 2-22 and *Table 2-23* present estimates of the number of entities falling within the SBA small business criteria, based, respectively, on SBA firm-level data and on Economic Census establishment-level data. Based on the SBA firm-level data, an estimated 260,424 C&D firms, representing approximately 99 percent of all businesses in the C&D industry, have revenue below the corresponding SBA thresholds listed above and, therefore could qualify as small businesses under SBA definitions. As reported in *Table 2-22*, this estimate of the number of firms qualifying as a small business is likely to be an overestimate, given the relationship between the SBA data reporting ranges and the SBA small business criteria. Furthermore, since the SBA data was reported in the 1997 NAICS framework, these numbers include residential remodelers, which are not included within the Economic Census data presented below. Thus, this number could be overstated by approximately 80,000 firms since residential remodelers are not included within the EA.

As described previously, approximately 99 percent of firms operate only one establishment. Thus, looking at the Economic Census data, which are reported for establishments instead of firms, also provides significant insight into the presence of small entities in the C&D industry. As expected, given the large percentage of single-establishment firms in the C&D industry, the 2002 Economic Census and SBA report very nearly the same numbers of entities, whether establishments or firms. However, as stated previously, the number of firms within the SBA data is overstated due to the inclusion of residential remodelers. In the same way as for the SBA data, Economic Census data are not reported in ranges that match precisely the SBA small business criteria values.

In using the *Economic Census data*, the data-reporting ranges most closely corresponding to the SBA thresholds are as follows:

- NAICS 236: $10 million (Understates number of small businesses)
- NAICS 237, except 2372: $10 million (Understates number of small businesses)
- NAICS 2372: $5 million (Understates number of small businesses)

Based on the Economic Census establishment-level data, approximately 167,007 C&D establishments, representing approximately 93.4 percent of all establishments in the C&D industry, have revenue below the corresponding SBA thresholds listed above. Given that nearly all C&D industry firms are single-establishment firms, this value, by definition, cannot be substantially different from the number and percentage of small business firms. As reported in *Table 2-23*, this estimate of the number of establishments potentially qualifying as a small business is very likely an underestimate, given the relationship between the Economic Census data reporting ranges and the SBA small business criteria.

In reviewing *Table 2-22* and *Table 2-23*, it is important to note that the subsector definitions differ for the two tables: the SBA-based data are reported in the 1997 NAICS sector framework; the Economic Census data are reported in the 2002 NAICS sector framework. This difference is most evident in the comparison of the total establishment and firm data since residential remodelers are not included within the Economic Census data presented but are included within the SBA data presented. Residential remodelers account for an additional 82,750 establishments. The difference is also evident in the comparison of the establishment and firm data for the NAICS 2372, *Land Subdivision*, where the reported number of firms, 13,860, is greater than the number of establishments, 8,403.

The SBA firm-level data suggests that 99 percent of total C&D industry firms are small firms, while the Economic Census data suggests that small firms make-up 93.4 percent of total establishments. As explained above, EPA considers the SBA data to slightly overestimate the percentage of small entities and the Census data to slightly underestimate the actual percentage. The conclusion that can be made from both estimates is that the C&D industry is dominated by small entities. Small firms, as defined according to SBA criteria, very likely represent more than 95 percent of all firms in the relevant C&D industry subsectors.

Table 2-22: Number of Firms Above and Below SBA Small Business Thresholds

From Small Business Administration Data

NAICS Subsector	SBA Revenue Threshold (million $)	SBA Reporting Range (million $)	Total Firms	Indicated Small Firms	Small Firms as Percent of Total	Under/Over Estimate
Land subdivision and Development	$7.0	$5.0	13,860	13,035	94.0%	Underestimate
Single-family housing Construction	$33.5	$50.0	160,917	160,555	99.8%	Overestimate
Multifamily housing Construction	$33.5	$50.0	9,007	8,907	98.9%	Overestimate
Manufacturing and industrial building construction	$33.5	$50.0	2,342	2,252	96.2%	Overestimate
Commercial and institutional building construction	$33.5	$50.0	38,452	37,676	98.0%	Overestimate
Highway and street construction	$33.5	$50.0	10,507	10,208	97.2%	Overestimate
Bridge and tunnel construction	$33.5	$50.0	792	730	92.2%	Overestimate
Water, sewer, and pipeline construction	$33.5	$50.0	10,520	10,424	99.1%	Overestimate
Power and communication transmission line construction	$33.5	$50.0	4,077	4,013	98.4%	Overestimate
Industrial nonbuilding structure construction	$33.5	$50.0	470	405	86.2%	Overestimate
All other heavy construction	$33.5	$50.0	12,373	12,219	98.8%	Overestimate
Total	**–**	**–**	**263,317**	**260,424**	**98.9%**	**Overestimate**

For two of the C&D NAICS subsectors (236 and 237), the upper bound of the related SBA reporting range is below the SBA small business criterion. For these subsectors, the indicated small firm counts are almost certainly an *overestimate* of the number of small firms. For the subsector (2372), the upper bound of the reporting range is above the SBA small business criterion. For these subsectors, the indicated small firm counts are almost certainly an *underestimate* of the number of small firms. Given that subsectors 236 and 237 (except 2372) represent over 85 percent of the total of firms in the four subsectors, the total of the indicated small firm counts across the four subsectors is more like also an overestimate.

Note: SBA data and assignments by NAICS subsectors are based on the 1997 NAICS sector definition framework.

Figures do not necessarily add to totals due to rounding.

Source: U.S. SBA (2004) and U.S. SBA (2008)

Table 2-23: Number of Establishments Above and Below SBA Small Business Thresholds

From Economic Census Data						
NAICS Subsector	SBA Revenue Threshold (million $)	Census Reporting Range (million $)	Total Estabs.	Indicated Small Estabs.	Small Estabs. as Percent of Total	Under/Over Estimate
236115: New single-family housing construction (except operative builders)	$33.5	$10.0	58,472	57,759	98.80%	Underestimate
236116: New multifamily housing construction (except operative builders)	$33.5	$10.0	4,397	4,050	92.10%	Underestimate
236117: New housing operative builders	$33.5	$10.0	26,043	24,032	92.30%	Underestimate
236210: Industrial building construction	$33.5	$10.0	2,777	2,529	91.10%	Underestimate
236220: Commercial and institutional building construction	$33.5	$10.0	37,208	32,793	88.10%	Underestimate
237110: Water and sewer line and related structures construction	$33.5	$10.0	12,357	11,612	94.00%	Underestimate
237120: Oil and gas pipeline and related structures construction	$33.5	$10.0	1,403	1,211	86.30%	Underestimate
237130: Power and communication line and related structures construction	$33.5	$10.0	6,034	5,586	92.60%	Underestimate
237210: Land subdivision	$7.0	$5.0	8,403	7,851	93.43%	Underestimate
237310: Highway, street, and bridge construction	$33.5	$10.0	11,239	9,425	83.90%	Underestimate
237990: Other heavy and civil engineering construction	$33.5	$10.0	10,502	10,159	96.70%	Underestimate
Total	**–**	**–**	**178,835**	**167,007**	**93.4%**	**Underestimate**

Because the upper bound of the Economic Census reporting range is below the SBA small business criterion for all of the C&D subsectors, the indicated small establishment counts are almost certainly an *underestimate* of the number of small establishments, and the total of these values is therefore also likely an underestimate.

Note: Economic Census data and assignments by NAICS subsectors are based on the 2002 NAICS sector definition framework.

Figures do not necessarily add to totals due to rounding.

Source: U.S. Census Bureau's Economic Census (2005a) and U.S. SBA (2008)

2.5 Industry Dynamics and Forecast

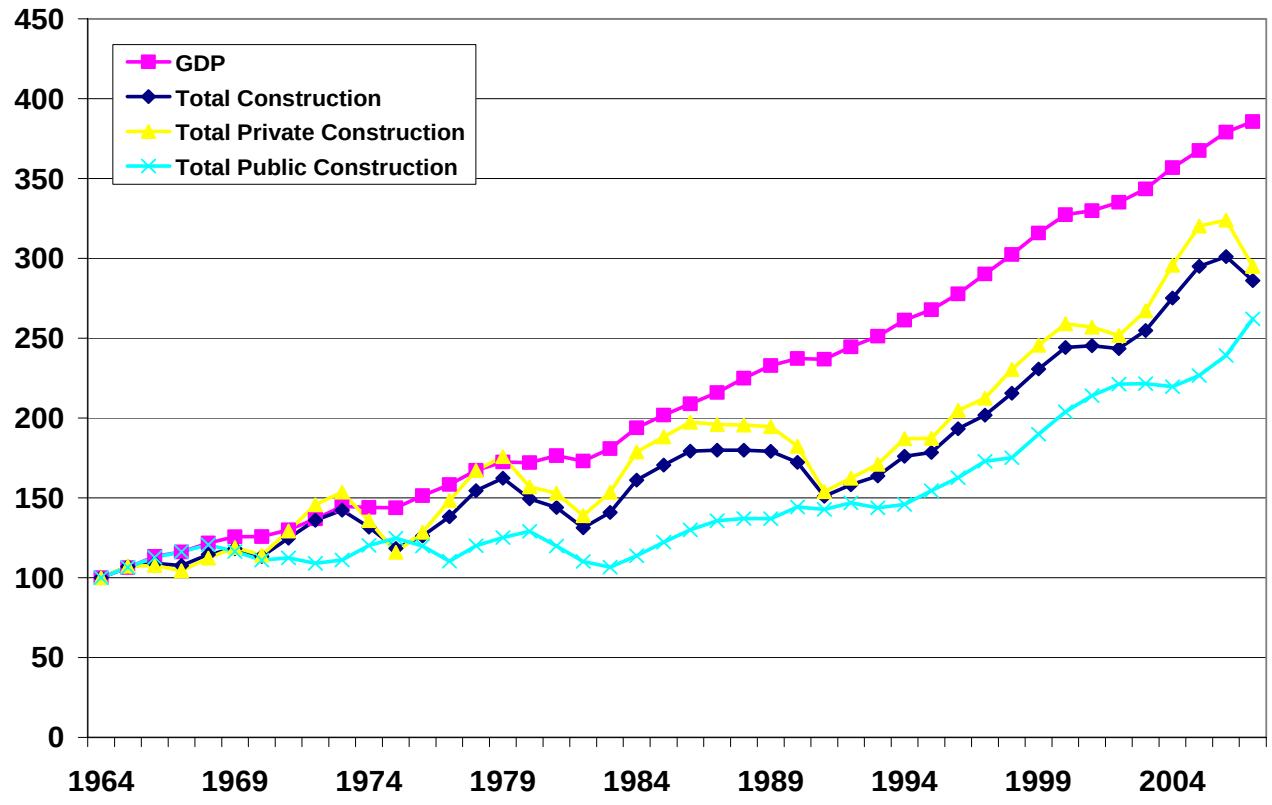
By a number of measures, the C&D industry has historically been a relatively volatile sector, and is subject to wider swings of economic performance than the economy as a whole. Although the industry has been on a fairly continuous growth trend since 1964, there have been a few interruptions within this upward movement. Within the industry, residential construction, as compared to nonresidential and other public construction, has experienced the most volatility of business performance.

From 1991 to 2005, the industry grew fairly continuously. Single-family housing, for example, grew from an annual level of 0.8 million housing starts in 1991 to 1.7 million housing starts in 2005, representing an average annual growth rate of 5.5 percent. During this same period, real GDP grew by an average of 3.2 percent per year (BEA, 2008a). Since 2006, however, the construction industry has experienced a downturn, with the weakness occurring most strongly in the residential sector. To provide insight into the cyclicality of the industry compared to the economy as a whole, this section presents the annual value of total construction, private construction, public construction, and the total number of housing starts indexed to real GDP. The section also highlights housing starts and the value of construction for each sector, including forecast data for the construction industry.

2.5.1 Annual Value of Construction and Housing Starts Indexed to Real GDP

Figure 2-9 (*Total Construction*), *Figure 2-10* (*Private Construction*), and *Figure 2-11* (*Public Construction*) display the annual value of construction, by segment, indexed to 100 in 1964 with GDP for the period 1964-2007 (all underlying values in constant $2006). *Figure 2-12* presents annual housing starts and real GDP, again as index series, over the same analysis period. All of these figures demonstrate the greater variability of the construction industry compared to the entire economy. Slight declines or slow-downs in the general economy, as occurred in 1981/1982, 1991/1992, and 2001/2002, are accompanied by much larger drops in construction industry activity (see *Figure 2-9*, below).

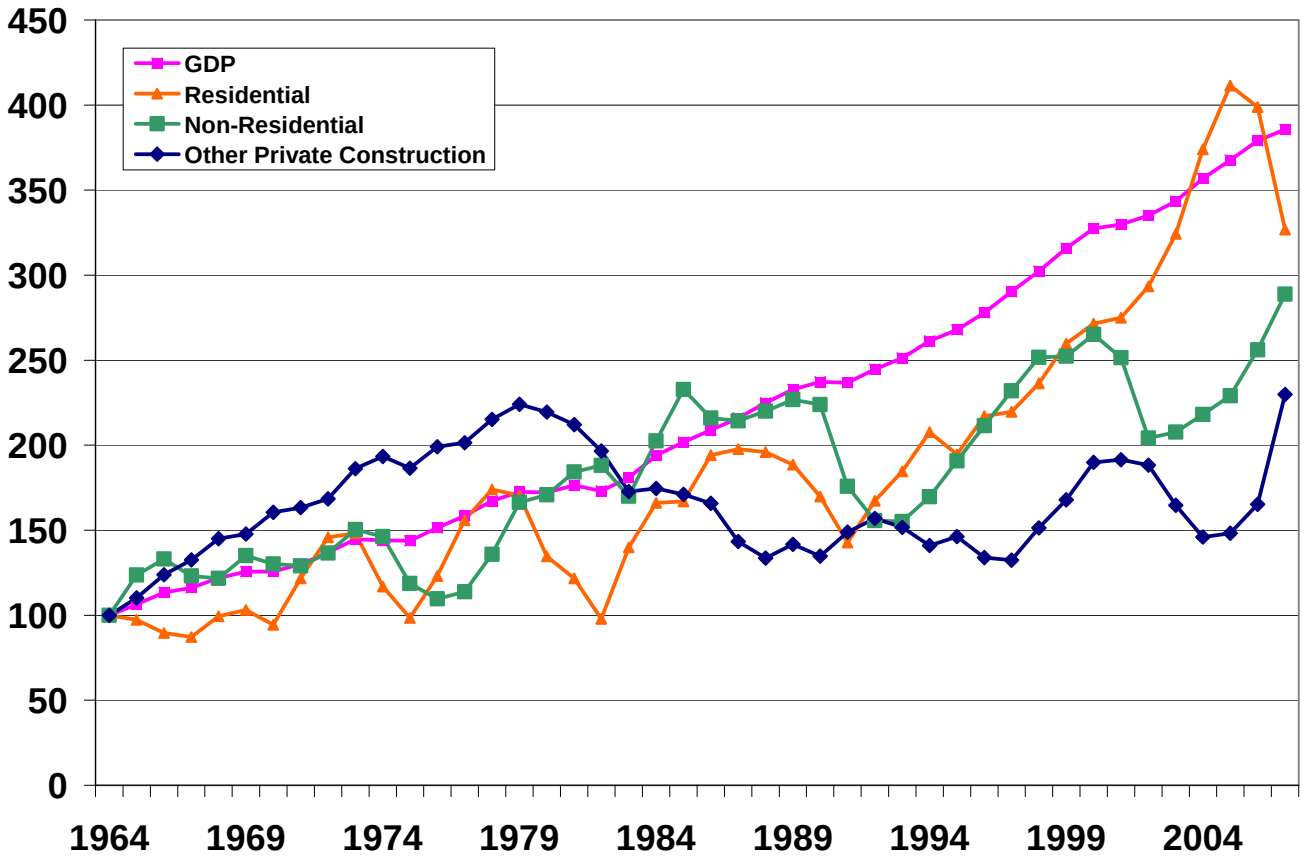
Figure 2-9: Annual Value of Total, Private, and Public Construction and Real GDP, as Index Series



Source: U.S. Census Bureau (2008a) and BEA (2008a)

Private residential construction shows considerably greater volatility than the construction industry as a whole. Before 1991's trough, the annual profile of private residential construction varied substantially. Only after 1991 did private residential construction see a relatively continuous growth trend persisting for a period of more than five years. As shown by the steeper curves in *Figure 2-10*, private residential construction grew more rapidly than the economy, as a whole, from the mid 1990s to 2005. However, as previously discussed, this segment entered a steep downturn in 2006 and 2007, as shown in *Figure 2-10*.

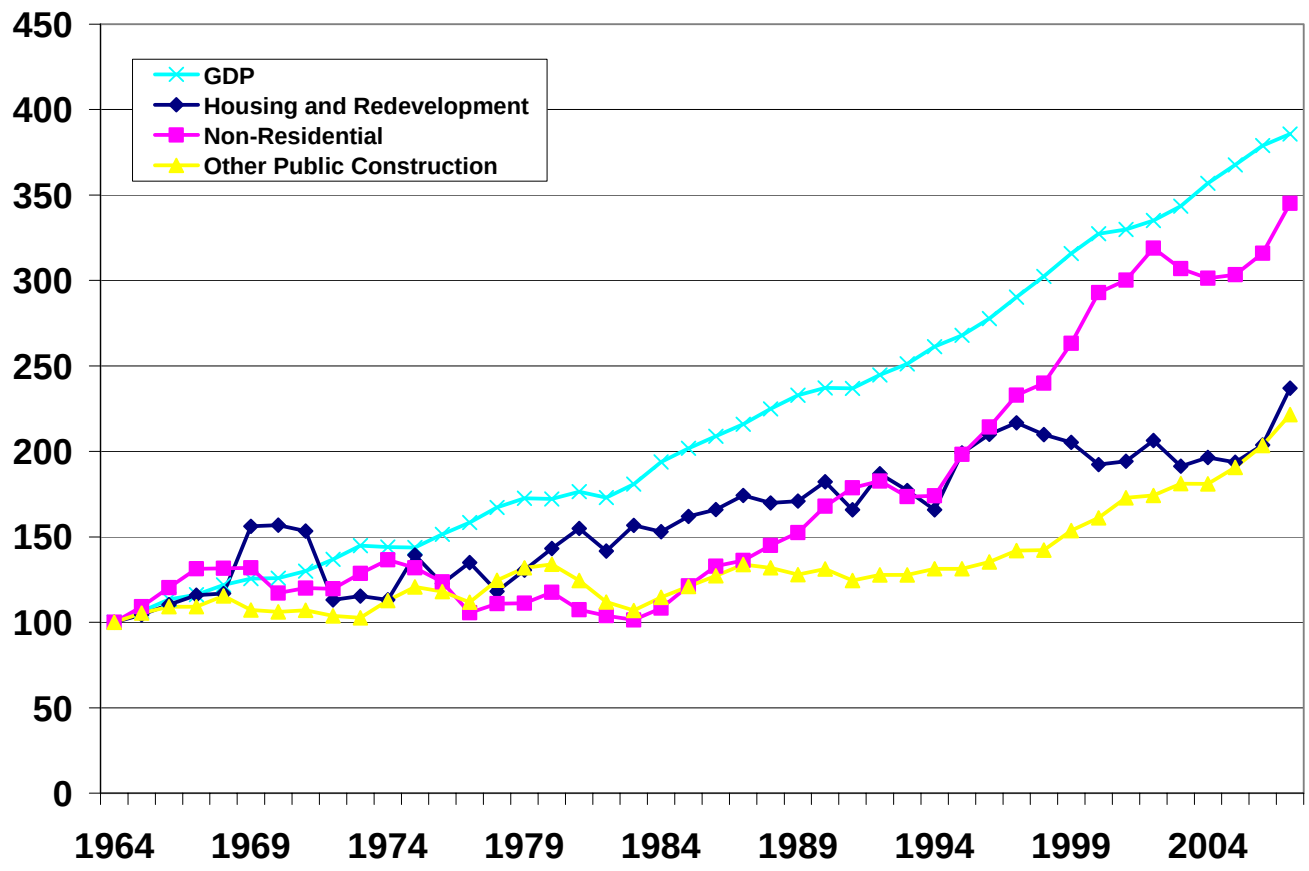
Figure 2-10: Annual Value of Private Construction and Real GDP, as Index Series



Source: U.S. Census Bureau (2008a) and BEA (2008a)

Overall, public construction has generally been less volatile, year-to-year, than private construction. However, the Housing and Redevelopment segment and the Non-Residential segment have shown greater volatility than the Other Public Construction segment and greater volatility than the national economy. All three segments have grown at a lower rate than the overall economy, although the Non-Residential segment grew faster than the general economy from 1993 to 2003.

Figure 2-11: Annual Value of Public Construction and Real GDP, as Index Series

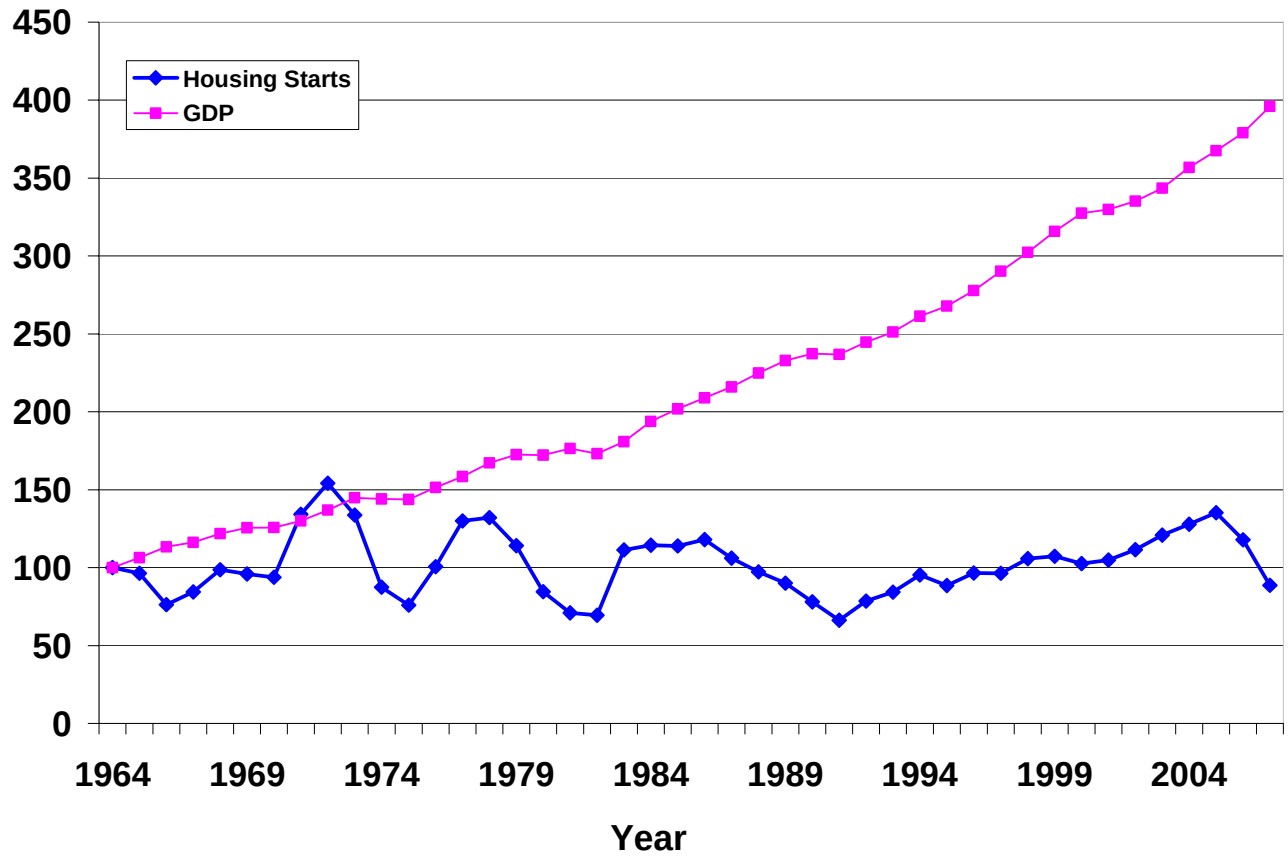


Source: U.S. Census Bureau (2008a) and BEA (2008a)

2.5.2 Housing Starts: Actual and Forecast

Annual housing starts, again as an index and compared with real GDP, also illustrates the higher variability within the residential construction industry compared to the economy as a whole (see *Figure 2-12*). This exhibit also shows the fairly stable growth trend of housing starts over the past 10-15 years and the corresponding drop in housing starts in 2006 and 2007.

Figure 2-12: Annual Housing Starts and Real GDP, as Index Series



Source: U.S. Census Bureau (2008b) and BEA (2008a)

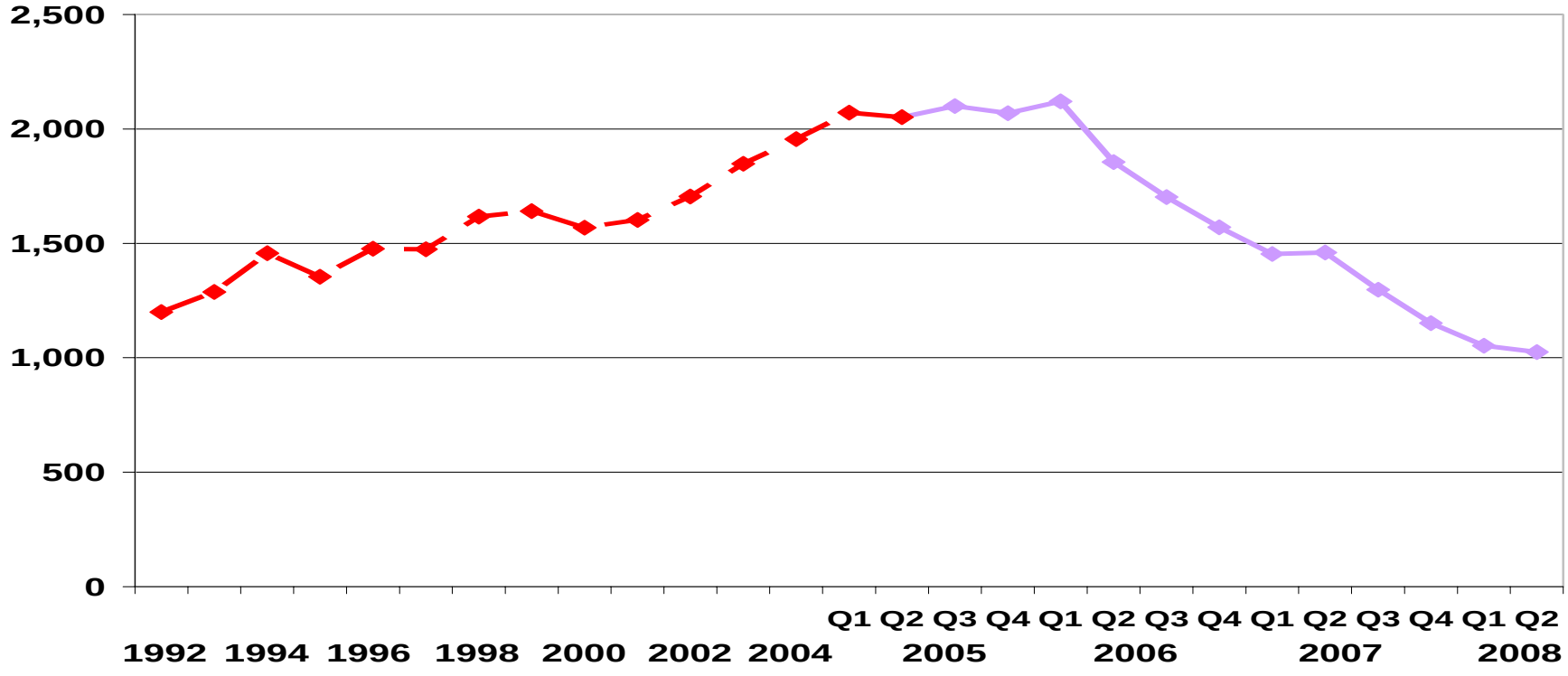
Figure 2-13, page 2-44, reports *annual* housing starts from 1992 to 2004 (in the red, dashed line) and *quarterly* housing starts from 2005 Q1 to 2008 Q2 (in light purple). The quarterly values have been multiplied by four to approximate annual equivalents. The substantial fall-off in housing construction beginning in the second quarter of 2006 and continuing through 2007 is apparent. One of the main reasons 2007 showed such a substantial decline is a speculative run-up in house prices accompanied by a substantial acceleration in new housing supply, which was most widespread within single-family housing (Reed, August 2007). As a result, single-family housing has declined more substantially than multi-family housing. Standard and Poor's Industry Outlook for the housing construction sector provides a similar assessment: since late 2006, the housing market has experienced a downturn after nearly a decade of rising home prices and strong demand. On the other hand, S&P believes that during the current housing downturn, some "homebuilders have strengthened their balance sheets by reducing debt and boosting cash" (S&P, 2008). In general, S&P forecasts residential construction profits will experience further decreases during 2008 before reaching market stability in mid-2009 (S&P, 2008) and achieving supply and demand equilibrium in 2010.

Another construction industry business analysis firm, Global Insight, provides further assessments of the construction industry (Global Insight, January, March, and October 2008). Due to relatively low interest rates and aggressive credit practices, mortgage rates for home purchases remained historically low until recently. However, in 2005, housing affordability began to decline with increasing home prices and mortgage lending rates. In addition, an increasing volume of home sales were accomplished via non-traditional financing arrangements in which interest rates and/or principal payments might be maintained at low levels during the early years of a loan, with the expectation of increasing to more traditional structure levels within a few years of loan issuance. As interest rates were marked to market and payment obligations increased under these non-traditional mortgages, loan payment delinquencies and foreclosures began to increase. These foreclosures added to the excess supply of homes on the market. Beginning in mid-2005, new and existing *home sales* started to fall sharply. However, as demonstrated by *Figure 2-13*, *housing starts* continued to increase well into the first quarter of 2006, adding to the already large inventory of unsold homes. Global Insight assesses that housing starts have farther to fall before prices and sales volume in the segment will stabilize and a recovery begin. Recently, Global Insight forecast that housing starts are expected to drop below the one million mark, bottoming out at 738,000 units by the second quarter of 2009 (Global Insight, October 2008). However, it is not until 2012/2013 that housing starts will reach their forecasted average trend of 1.7 million starts (Global Insight, October 2008).

Although housing starts are expected to return to a positive growth trend during 2009, home prices are not expected to return to a positive growth trend until 2010. Nonetheless, Global Insight believes that regardless of the current housing weakness, falling home prices coupled with continued long-run demand for housing will eventually return the housing market to a sustainable market equilibrium of increased construction and sales of new housing (Global Insight, November 2007). Long-run demand factors – household formation, demand for second homes, and demolitions – will also support recovery in the residential construction segment. According to Harvard University's Joint Center for Housing Studies, the number of new homes demanded will increase due to demographic factors such as increased immigration and the aging of the echo-boom generation and the longer life expectancy of baby-boomers (Joint Center, 2008). Household formation growth is expected to increase to 14.4 million during 2010-2020, compared to 12.6 million during 1995-2005 (Joint Center, 2008). Demolitions are also expected to increase due to the aging housing stock, thus supporting demand for new homes to replace older units.

In a long-term forecast for the housing construction industry published by the National Association of Home Builders (NAHB) in 2006, NAHB forecasted that, on average, annual housing starts in the next ten years will exceed those of the previous decade – despite the current weakness of the housing construction industry. The NAHB publication forecasts that households trading up for larger homes will cause an upturn from 2010 to 2015 (NAHB, 2006).

Figure 2-13: Annual Housing Starts from 1992 to 2004 and Quarterly Housing Starts from Q1 2005 to Q2 2008 (in Thousands of Units)



Note: Quarterly figures were multiplied by four to allow for comparison among annual and quarterly housing starts.
Source: U.S. Census Bureau (2008b)

Table 2-24 reports the number of *actual* housing starts for 2003 through 2007, and *forecasted* starts by Global Insight, Reed Construction, and Mortgage Bankers Association (MBA) for 2008 through 2012 (Reed's projections are only until 2009 and MBA's projections are only until 2010). The 12.9 percent *decrease* from 2005 to 2006 reflects the beginning of the decline in housing starts after the 2005 peak and the 24.8 percent decrease in housing starts from 2006-2007 demonstrates the continued decline. Reed's September forecast, Global Insight's January forecast, and MBA's September forecast show a continuation of this trend through 2008, with housing starts projected to decrease by 25.7 percent (Reed), 23.7 percent (Global Insight), and 28.6 percent (MBA). Housing starts for 2009 were projected to recover after bottoming in 2008 (although possibly still experiencing negative growth rates into the beginning of 2009). Due to the current economic situation, however, Global Insight's October 2008 forecast projects an even greater percentage decline of 29.8% from 2007 to 2008 and expects housing starts to bottom out in *late 2009* at approximately 740,000 units. According to Global Insight's October forecast, the approximately 38 percent increase from 2009 to 2010 will spur the recovery well into 2012/2013 when housing starts are expected to return to their long term trend of approximately 1.7 million starts.

Table 2-24: Housing starts, Actual and Forecasts (in Millions of Starts)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Housing Starts	1.85	1.96	2.07	1.80	1.36	**Reed Forecast**				
						1.01	1.16	-	-	-
						Global Insight Forecast				
						1.03	1.31	1.54	1.71	1.72
						MBA Forecast				
						0.97	0.94	1.13	-	-
Housing Starts, year-to-year Percent Change		5.8%	5.7%	12.9%	-24.8%	**Reed Forecast**				
						-25.7%	14.9%	-	-	-
						Global Insight Forecast				
						-23.7%	27.2%	17.6%	11.0%	0.6%
						MBA Forecast				
						-28.6%	-3.3%	21.3%	-	-

Source: Actuals: U.S. Census (2008b); Forecasts: Reed Construction Data (September 2008b), Global Insight (January 2008), and Mortgage Bankers Association (September 2008)

2.5.3 Value of Construction by C&D Industry Segment: Actual and Forecasts

Residential construction, as illustrated in *Figure 2-13* and *Table 2-24*, has experienced a clear decline in housing starts since early 2006. Moreover, this weakness may remain for several quarters before a recovery (Global Insight, September 2007). Throughout 2006 and 2007, while residential construction was experiencing housing start declines and negative growth, non-residential construction somewhat offset this weakness. *Table 2-25* lists the value of construction in constant 2008 dollars, by sector, for previous years (from the BEA) and for forecasted years (from Global Insight). As shown in the table, residential construction reported a relatively large *decrease* in construction value (-17.5 percent) from 2006 to 2007. At the same time, non-residential construction reported a relatively large *increase* in construction value (12.6 percent) from 2006 to 2007. Looking to the future, for 2009, Global Insight projected (in their January 2008 forecast) a return to growth for the residential segment (5.5 percent) but projects weakness in the non-residential segment (-5.9 percent). Still, within this forecast, Global Insight projects modest growth for the construction industry overall in 2009 (0.5 percent) and, beyond 2009, expects the overall industry to perform more favorably with projected total growth of 5.1 percent in 2010 and 5.7 percent in 2011, before

returning to a more sustainable *real* growth (i.e., in dollar values adjusted for inflation) of 2.5 percent, overall, in 2012 (Global Insight, January 2008). However, these forecasts were projected before the recent economic downturn; therefore, in Global Insight's more recent October 2008 forecast, the industry is expected to witness further declines for both the residential, non-residential, and non-building sectors. Housing starts, a good indicator of the strength of the residential sector, are expected to hit bottom in mid to late 2009 and gradually improve thereafter. Non-residential spending, which often lags behind the pattern in the residential sector, is expected to see declines in private non-residential building through late 2008 into the first quarter of 2010. Furthermore, the non-building sector (i.e., publicly-funded projects), is expected to see further declines due to the flattening or decline in government revenue. In short, though the industry is expected to experience declines over the next couple years, the industry is expected to achieve positive business performance over the longer-term and beginning around 2010/2011.

Table 2-25: Value of Construction, Actual and Forecasts (in 2008 Billions of Dollars)

		Actual				Forecasts					
		2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Nonresidential	Value	$317.3	$321.5	$323.0	$350.1	$394.3	$397.3	$373.7	$376.2	$382.8	$393.9
	Percent Change		1.32%	0.47%	8.40%	12.61%	0.76%	-5.94%	0.66%	1.77%	2.89%
Residential	Value	$653.3	$718.5	$766.1	$729.9	$602.2	$472.3	$498.1	$552.0	$611.1	$627.8
	Percent Change		9.97%	6.63%	-4.72%	-17.49%	-21.58%	5.47%	10.83%	10.70%	2.73%
Government	Value	$272.2	$266.3	$260.6	$265.7	$273.2	$280.2	$283.4	$286.2	$290.0	$294.3
	Percent Change		-2.16%	-2.15%	1.95%	2.85%	2.58%	1.12%	1.01%	1.32%	1.48%
Total	**Value**	**$1,242.9**	**$1,306.3**	**$1,349.7**	**$1,345.7**	**$1,269.7**	**$1,149.8**	**$1,155.2**	**$1,214.5**	**$1,283.9**	**$1,316.0**
	Percent Change		**5.10%**	**3.32%**	**-0.29%**	**-5.64%**	**-9.44%**	**0.46%**	**5.13%**	**5.72%**	**2.50%**

Source: BEA (2008b and 2008c) and Global Insight (January 2008)

Reed Construction, a commercial construction industry data service that collects and reports information on multifamily, commercial/institutional, and industrial construction projects undertaken nationally, projected in their September 2008 forecast that the residential sector will begin recovery in 2009, with some regional markets experiencing increases before others. Overall, Reed Construction projects that residential construction will see an increase in activity of nearly 8 percent from 2008 to 2009 (Reed Construction, September 2008a).

Table 2-26, below, lists year-to-year forecasts (from January 2008) for non-residential construction during the periods 2007/2008 and 2008/2009. Overall, the average consensus among these forecasts was a 0.57 percent *increase* for 2007/2008 and a 1.03 percent *decrease* for 2008/2009, which is somewhat more pessimistic than the January 2008 Global Insight forecast for this segment, as presented above. However, this information does not represent the economic events that have occurred recently; therefore, the forecast below may be optimistic.

Table 2-26: Non-Residential Value of Construction Growth, Compared Forecasts

	McGraw-Hill Construction	Global Insight	Portland Cement Association	Moody's Economy.com	FMI	Reed Business Information	CONSENSUS
Percent Change 2007-2008	-4.6%	-0.8%	-3.0%	1.7%	2.0%	8.0%	**0.57%**
Percent Change 2008-2009	-2.0%	-5.9%	-2.0%	-1.6%	0.4%	4.9%	**-1.03%**

Source: Global Insight (January 2008) and American Institute of Architects (January 2008)

2.5.4 Overall Outlook

Overall, the construction industry is expected to experience continuing weakness until residential markets work through the current inventory of unsold homes, and credit markets and the general economy return to a better condition. Recent forecasts (Global Insight, October 2008) suggest that the industry will experience further declines before returning to better performance.

Currently, the C&D rule is scheduled to be promulgated during 2009. However, EPA anticipates that the rule's requirements will become practically effective over the timeframe of 2009 and 2013, as states incorporate the rule's requirements into their construction general permit as they come up for renewal.[14] Given the above construction industry outlook and the reality that the rule's requirements will not be immediately applicable throughout the country, EPA expects the industry will be on the way to achieving a sufficient recovery during the period when the rule becomes fully implemented, to absorb the rule's requirements without undue adverse effect.

[14] Under the NPDES program, authorized states renew their general permits every five years.

Appendix 2-1: Industry Definition Crosswalks

Table 2-27: Crosswalk between 2002 NAICS and 1997 NAICS Structures

2002 NAICS	Description	Relevant 1997 NAICS codes
236	**Construction of buildings**	
2361	Residential building construction	
236115	New single-family general contractors	233210 Single-family housing construction (general contractors)
236116	New multifamily general contractors	233220 Multifamily housing construction (general contractors)
236117	New housing operative builders	233210 Single-family housing construction (operative builders) 233220 Multifamily housing construction (operative builders)
236118	Residential remodelers	233210 Single-family housing construction (remodeling contractors) 233220 Multifamily housing construction (remodeling contractors)
2362	Nonresidential building construction	
236210	Industrial building construction	233310 Manufacturing and industrial building construction (Other manufacturing and industrial building construction) 234930 Industrial nonbuilding structure construction (Other industrial nonbuilding construction) 234990 All other heavy construction (waste disposal plant)
236220	Commercial and institutional building construction	233220 Multifamily housing construction (barrack and dormitory) 233310 Manufacturing and industrial building construction (grain elevators, dry cleaning plants, and manufacturing and industrial warehouses construction) 233320 Commercial and institutional building construction 235990 All other special trade contractors (indoor swimming pool)
237	**Heavy and civil engineering construction**	
2371	Utility system construction	
237110	Water and sewer line and related structures construction	234910 Water, sewer, and pipeline construction (water and sewer line, mains, and related structures (including pumping stations, etc.) construction 234990 All other heavy construction (sewage and water treatment plants and irrigation systems construction 235810 Water well drilling contractors
237120	Oil and gas pipeline and related structures construction	213112 Support activities for oil and gas operations (partial) 234910 Water, sewer, and pipeline construction (Oil and gas pipelines, mains, and related structures (including oil storage)) 234930 Industrial nonbuilding structure construction
237130	Power and communication line and related structures construction	234920 Power and communication transmission line construction 234930 Industrial nonbuilding structure construction (power generation plants and transformer stations, except hydroelectric)
2372	Land subdivision	233110 Land subdivision
2373	Highway, street, and bridge construction	234110 Highway and street construction 234120 Bridge and tunnel construction (bridge construction) 235210 Painting and wall covering contractors (highway and traffic line painting contractors)
2379	Other heavy and civil engineering Construction	234120 Bridge and tunnel construction (tunnel construction) 234990 All other heavy construction (all other heavy and civil engineering construction 235990 All other special trade contractors (anchored earth retention)
238	**Specialty trade contractors**	
2381	Foundation, structure, and building exterior contractors	
238110	Poured concrete foundation and structure contractors	235710 Concrete contractors (concrete contractors, except paving)
238120	Structural steel and precast concrete contractors	235910 Other structural steel erection contractors (partial)
238130	Framing contractors	235510 Carpentry contractors (framing carpentry)

Table 2-27: Crosswalk between 2002 NAICS and 1997 NAICS Structures

2002 NAICS	Description	Relevant 1997 NAICS codes
238140	Masonry contractors	235410 Masonry and stone contractors 235420 Drywall, plastering, acoustical and insulation contractors (Stucco contractors)
238150	Glass and glazing contractors	235920 Glass and glazing contractors
238160	Roofing contractors	235610 Roofing, siding and sheet metal contractors (roofing)
238170	Siding contractors	235610 Roofing, siding and sheet metal contractors (siding)
238190	Other foundation, structure, and building exterior contractors	235910 Structural steel erection contractors (metal curtain walls and metal furring installation contractors) 235990 All other special trade contractors (forming, ornamental metal work installation, and other foundation, structure, and building exterior contractors)
2382	Building Equipment Contractors	
238210	Electrical Contractors	235110 Plumbing, heating, and air-conditioning contractors (environmental controls installation contractors) 235310 Electrical Contractors
238220	Plumbing and HVAC contractors	235110 Plumbing, heating and air-conditioning contractors (other plumbing, heating, and air-conditioning contractors) 235950 Building equipment and other machinery installation contractors (scrubber, dust collection, and other industrial ventilation installation contractors)
238290	Other building equipment contractors	235950 Building equipment and other machinery installation contractors (partial) 235990 All other special trade contractors (boiler, duct, and pipe insulation and service station equipment, lightning rod, bowling alley, church bell, and tower clock installation contractors)
2383	Building finishing contractors	
238310	Drywall and insulation contractors	235420 Drywall, plastering, acoustical, and insulation contactors (partial)
238320	Painting and wall covering contractors	235210 Painting and wall covering contractors (partial)
238330	Flooring contractors	235520 Flooring contractors
238340	Tile and terrazzo contractors	235430 Tile and terrazzo contractors
238350	Finish carpentry contractors	235510 Carpentry contractors (Finish carpentry contractors)
238390	Other building finishing contractors	235610 Roofing, siding, and sheet metal contractors (sheet metal contractors, except roofing and siding) 235990 All other special trade contractors (trade show exhibits installation and dismantling, spectator seating, modular furniture, window covering fix installation, other building finishing contractors)
2389	Other specialty trade contractors	
238910	Site preparation contractors	213112 Support activities for oil and gas operations 213113 Support activities for coal mining 213114 Support activities for metal mining 213115 Support activities for nonmetallic minerals (except fuels) 234990 All other heavy construction (right-of-way cleaning and line slashing, blasting, trenching, and equipment rental (except cranes) with operator) 235110 Plumbing, heating, and air-conditioning contractors (septic tank, cesspool, and dry well construction contractors) 235930 Excavation contractors 235940 Wrecking and demolition contractors 235990 All other special trade contractors (dewatering contractors, core drilling for construction, and test drilling for construction)
238990	All other specialty trade contractors	234990 All other heavy construction (crane rental with operator) 235710 Concrete contractors (residential and commercial asphalt, brick, and concrete paving contractors) 235990 All other special trade contractors (partial)

Source: U.S. Census Bureau (2007)

Table 2-28: Crosswalk between 1997 NAICS and 1992 SIC Structures

1997 NAICS	Description	Relevant 1992 SIC codes
233	**Building, developing, and general contracting**	
2331	Land subdivision and development	
233110	Land subdivision and development	6552 Land subdividers and developers, except cemeteries
2332	Residential building construction	
233210	Single-family housing construction	1521 General contractors–single-family houses 1531 Operative builders (partial) 8741 Management services (partial)
233220	Multifamily housing construction	1522 General contractors–residential buildings other than single-family (partial) 1531 Operative builders (partial) 8741 Management services (partial)
2333	Nonresidential building construction	
233310	Manufacturing and industrial building Construction	1531 Operative builders (partial) 1541 General contractors–industrial buildings and warehouses (partial) 8741 Management services (partial)
233320	Commercial and institutional building Construction	1522 General contractors–residential buildings, other than single-family (partial) 1531 Operative builders (partial) 1541 General contractors–industrial buildings and warehouses (partial) 1542 General contractors–nonresidential buildings except industrial buildings and warehouses 8741 Management services (partial)
234	**Heavy Construction**	
2341	Highway, street, bridge, and tunnel Construction	
234110	Highway and street construction	1611 Highway and street construction contractors, except elevated highways 8741 Management services (partial)
234120	Bridge and tunnel construction	1622 Bridge, tunnel, and elevated highway construction 8741 Management services (partial)
2349	Other heavy construction	
234910	Water, sewer, and pipeline construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
234920	Power and communication transmission line construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
234930	Industrial nonbuilding structure construction	1629 Heavy construction, n.e.c. (partial) 8741 Management services (partial)
235	**Special trade contractors**	
2351	Plumbing, heating, & air-conditioning contractors	
235110	Plumbing, heating, & air-conditioning contractors	1711 Plumbing, heating, & air-conditioning contractors
2352	Painting and wall covering contractors	
235210	Painting and wall covering contractors	1721 Painting and paper hanging special trade contractors 1799 Special trade contractors (partial)
2353	Electrical contractors	
235310	Electrical contractors	1731 Electrical work special trade contractors
2354	Masonry, drywall, insulation and tile contractors	
235410	Masonry and stone contractors	1741 Masonry, stone setting, and other stone work, special trade contractors
235420	Drywall, plastering, acoustical, and insulation contractors	1742 Plastering, drywall, acoustical, and insulation work, special trade contractors 1743 Terrazzo, tile, marble, and mosaic work, special trade contractors (partial) 1771 Concrete work, special trade contractors (partial)
235430	Tile, marble, terrazzo, and mosaic contractors	1743 Terrazzo, tile, marble, and mosaic work, special trade contractors (partial)

Table 2-28: Crosswalk between 1997 NAICS and 1992 SIC Structures

1997 NAICS	Description	Relevant 1992 SIC codes
2355	Carpentry and floor contractors	
235510	Carpentry contractors	1751 Carpentry work special trade contractors
235520	Floor laying and other floor contractors	1752 Floor laying and other floor work, special trade contractors
2356	Roofing, siding, and sheet metal contractors	
235610	Roofing, siding, and sheet metal contractors	1761 Roofing, siding, and sheet metal work special trade contractors
2357	Concrete contractors	
235710	Concrete contractors	1771 Concrete work special trade contractors
2358	Water well drilling contractors	
235810	Water well drilling contractors	1781 Water well drilling special trade contractors
2359	Other special trade contractors	
235910	Structural steel erection contractors	1791 Structural steel erection special trade contractors
235920	Glass and glazing contractors	1793 Glass and glazing special trade contractors 1799 Special trade contractors (partial)
235930	Excavation contractors	1794 Excavation work special trade contractors
235940	Wrecking and demolition contractors	1795 Wrecking and demolition work special trade contractors
235950	Building equipment and other machinery installation contractors	1796 Install or erection of building equipment, special trade contractors
235990	All other special trade contractors	1799 Special trade contractors (partial)

Source: U.S. Census Bureau (2000)

3 Economic Impact Analysis Methodology

3.1 Overview of the Economic Impact Analysis Methodology

EPA is developing new effluent limitation guidelines applicable to stormwater discharges from new construction and land development activities. Effluent guidelines are technology-based national regulations that control the discharge of pollutants to surface waters and to publicly owned treatment works (POTWs). This chapter presents EPA's methodology for analyzing the economic impacts of the proposed regulatory options covering the C&D industry. EPA has employed a number of different methods for assessing the economic impacts of these options on C&D businesses and consumers of construction industry output at the project-level, firm-level, industry-level, and national-level.

This EA assesses the overall cost and impact of three options for the C&D effluent limitation guidelines regulation:

- *Option 1* would establish minimum sizing criteria for sediment basins used at construction sites with 10 or more disturbed acres draining to one location. Under this option, permittees would be required to install sediment basins that provide *either* 3,600 cubic feet per acre of runoff storage, or be designed to store runoff from the local 2-year, 24-hour storm event, whichever is less expensive. This option also includes requirement for implementing a variety of erosion and sediment controls on all construction sites that are required to obtain a permit (e.g., larger than one acre).
- *Option 2* incorporates the same requirements as Option 1, and in addition, requires construction sites of 30 or more acres to meet a numeric turbidity limit in stormwater discharges from the site. The numeric turbidity standard would be applicable to stormwater discharges for all storm events up to the local 2-year, 24-hour event. The turbidity standard would only apply to construction sites located in areas where the rainfall runoff erosivity factor (R-factor) as defined in the Revised Universal Soil Loss Equation (RUSLE) is greater than or equal to 50 and if the soils on the site contain 10% or more by mass of soil particles smaller than 2 microns in diameter.
- *Option 3* incorporates the same requirements as Option 1, and in addition, requires all sites with 10 or more acres of disturbed land to meet a numeric turbidity standard. Unlike Option 2, the turbidity standard would apply to all sites, regardless of soil types or R-factor. The turbidity standard would apply to all stormwater discharges for all storm events up to the local 2-year, 24-hour event.

This overview section summarizes some of the key underlying concepts and assumptions EPA has used to develop and implement the economic analysis methodology, including the regulatory baseline and the mechanisms by which the proposed rule may affect the C&D industry. The last sub-section in this overview (*3.1.3*) summarizes the various methodologies developed for this EA and how the rest of the chapter is organized.

3.1.1 The Regulatory Baseline

EPA's standard practice in developing regulatory baselines is to assume full compliance with all existing state and federal regulations that affect the entities in the analysis. For the economic analysis, EPA assumes that affected C&D markets have fully implemented the existing Phase I and II stormwater regulations and any state-level requirements. EPA also assumes that industry will be in 100 percent compliance following promulgation of the proposed rule. These criteria define the general regulatory baseline criteria for this economic analysis.

In addition to these general regulatory baseline conditions, EPA has established detailed information that describes the nature, composition, and quantity of baseline industry activity against which the regulation's incremental effects will be measured. The overall baseline specifications are detailed in *Chapter 4 – Developing the Analysis Baseline*, which estimates key baselines metrics describing the C&D industry, model construction firms, and developed acreage that underlie the analysis of the regulatory options. The baseline metrics are developed by using information from the industry profile (*Chapter 2*) and analysis approaches outlined in this chapter. Please refer to *Chapter 4* for the results of the baseline analysis.

3.1.2 Mechanisms by which C&D Markets May be Affected by the Proposed Rule

Some of the mechanisms by which a C&D industry regulation can potentially affect product markets and, as a result, induce impacts of concern in the analysis of a C&D industry regulation include:

1. Regulatory requirements may increase construction costs and lengthen project construction periods, which further increases total project costs. Increased project costs may in turn adversely affect the financial performance of construction projects and the firms that undertake these projects and/or increase the prices paid by consumers of C&D industry output. Increased prices will increase sale prices or rents of completed projects. The extent to which increased construction costs manifest as higher sales prices and rents will depend on supply and demand elasticities in specific construction product markets. These elasticities may vary substantially both over time, across regional markets, and within regional markets according to supply and demand conditions in specific product segments.

2. *Consumers' response to increased project prices can affect the overall bundle of characteristics (e.g., size, technical design and finished product specifications) that determine consumers' value of, and price paid for, the finished real estate product.* Faced with increased construction costs and potential price increases for a finished product, consumers (and project developers as their surrogate) may select lower cost specifications on other aspects of final project design. The flexibility to adjust project design specifications can buffer consumers from the construction cost increase and upward price pressure resulting from regulatory requirements, but may also result in trade-offs of valuable attributes. Such flexibility is particularly important if the potential construction cost and price increases are substantial and consumers faced income-based constraints on the price (or rent) that may be paid for the finished product.

3. *If producers are unable to pass all increased costs along to consumers in the form of higher prices, this could lead to weakened financial performance of, and lower employment among, C&D industry businesses.* Affected businesses may lose business value and could face financial stress, leading potentially to reductions in business activity and, in the worst case, closure of individual businesses. Given the relative fluidity of the C&D industry sectors expected to be affected by this regulation, idled economic resources – i.e., labor and capital – might be redeployed relatively quickly into other existing C&D industry businesses or new industry entrants. Regional and temporal variation in market response to increased construction costs and potential price effects may lead to substantial variation in the extent and character of impacts within the C&D industry.

4. *Increased project costs and associated pressure on project prices for <u>new</u> finished product may spill over into price effects – as increased sales prices or rents, in the present and in the future – for <u>existing</u> finished product or new product not subject to the regulation's requirements.*

5. *Conversely, the presence of existing finished product and new product not impacted by the rule serves as competition for newly constructed finished product and can thus limit the potential for upward pricing pressure on finished product subject to the regulation's requirements.* The presence of existing finished product provides a buffer against price and rent increases to C&D industry product consumers.

6. *Regulatory requirements may change the expected profitability (economic rent) of undeveloped land.* Overall, the change in expected profitability is negative with undeveloped property becoming less valuable because of regulatory requirements. As this reduced value is capitalized into prices for undeveloped property, the reduction in value of undeveloped property can become an offset to an increase in project costs and buffer the project developer/construction firm and/or consumers from the economic/financial effects of regulatory requirements.
7. *These effects will vary by property depending on the compliance requirements that would apply to properties of given physical characteristics.* On a relative basis, some undeveloped properties will become less valuable as a result of a regulation while others could become more valuable. The differential changes in economic rent and value of undeveloped properties may also cause shifts in the ordering and timing of project development. On the margin, the economically desirable time for project development will be delayed for some properties while being accelerated for other properties. For example, in a given local market, *all else equal*, the development of in-scope undeveloped property may be delayed while the development of out-of-scope undeveloped property may be accelerated.
8. *All of these regulatory response effects – increased construction costs from regulation compliance; distribution of compliance costs among owners of undeveloped property, construction businesses, and consumers; changes in the characteristics of C&D industry finished product; and potential effects on the timing and configuration of property development – reflect the internalization of construction-related costs to society that are currently not accounted for in the private transactions of property purchase, development, and sale/rent.* These cost and price effects, and the decision responses by property owners, producers and consumers, are indicative of the correction of production costs and market prices to account for the costs to society that were previously unaccounted for in the various affected transactions.

Of these effect mechanisms, EPA considers items 1, 2, 3, and 7 to be of most importance in causing a material regulatory impact. Of these, items 1, 2, and 3 are able to be addressed in this cost and economic impact analysis.

3.1.3 Summary of Economic Impact Analysis Models and Organization

This section provides a summary of the analysis methodologies developed for the EA and how the rest of the chapter is organized:

- ***Section 3.2 – Analysis of Project-Level Costs and Economic Impacts.*** Assessment of compliance costs and economic impacts for model C&D projects. The purpose of the model building project analysis framework is to develop the incremental compliance cost multipliers that are used to incorporate overhead, debt, and equity cost considerations into the per-acre engineering compliance cost estimates in subsequent analyses outlined in this document.
- ***Section 3.3 – Analysis of Firm- and Industry-Level Economic Impacts.*** Assessment of the cost and economic/financial impact of regulatory requirements on C&D industry firms, and the potential industry-level effects in terms of numbers of firms that may be adversely affected, potential employment at risk, and total costs to the C&D industry for regulation compliance.
- ***Section 3.4 – Analysis of Single-Family Housing Affordability Impacts.*** A MSA-level assessment of housing affordability, where impacts are measured in terms of the expected change in price for median- and lower-quartile priced new single-family homes and the associated number of prospective home buyers that may experience an affordability effect due to the price change.
- ***Section 3.5 – Analysis of Social Cost.*** A state-level assessment of partial equilibrium market effects in the C&D industry building sectors is used to adjust the initial firm-level estimate of total resource cost of compliance to account for the potential reduction in C&D industry output. The analysis also estimates the

overall deadweight welfare loss to society arising from the change in each market's output level. The quantity-effect-adjusted resource cost of compliance and the total deadweight loss comprise two components of the total social cost of the proposed rule.

- ***Section 3.6 – Analysis of Economy-Wide Economic Effects.*** An input-output multiplier analysis that considers total economy effects – in terms of output and employment – based on the total change in demand for society's resources arising from (1) compliance outlays, and (2) the reduction in C&D industry output. The analysis also estimates the *net* change in demand for society's resources arising from these two effect mechanisms.
- ***Section 3.7 – Future Projections of Compliance Cost and Acreage.*** Analysis that projects forward the estimated social cost and quantity of compliance acreage to more accurately reflect the industry's anticipated activity level during 2009, when the rule compliance begins, and out to the year 2025. This analysis accounts for the expected phase-in of compliance cost over the first five years after promulgation as states renew their Construction General Permits (different states renew their permits in different years).
- ***Section 3.8 – Key Sources of Uncertainty and Limitations.*** This section compiles and highlights the key sources of uncertainty and key limitations described throughout the methodology chapter.

3.2 Analysis of Project-Level Costs and Economic Impacts

EPA has analyzed the impacts of the proposed regulatory options on financial models of representative C&D projects. The primary purpose of the model project analysis is to determine, for each C&D sector, a compliance cost "multiplier" that captures the debt and equity cost considerations that firms will incur in performing compliance activities, which are not captured in the engineering estimate of compliance cost per acre. The incremental compliance cost multiplier effect is employed in subsequent sections (*3.4 and 3.5*) of the economic analysis to adjust the incremental compliance cost to a value that more fully reflects the true social resource cost of compliance.

The project models are based on EPA's best available data and assumptions concerning construction project characteristics. They are designed to depict the change in cash flow resulting from compliance with the proposed options for typical projects, representative of the type required to comply with the proposed rule, and the rule's potential impact on project price, given pricing conventions typically employed by the construction industry.

3.2.1 Description of the Project-Level Analysis Model Structure

EPA developed economic models for four types of building development projects that reflect the range of building projects undertaken by the industry and fall within the scope of the proposed rule. For each class of project, EPA developed an economic model that corresponds to a typical 1-acre size project. These projects include:

- A single-family residential development
- A multi-family residential development
- A commercial development
- An industrial development

The model project analysis frameworks account for the timing of outlays and financing for land purchase, development, and construction, as well as the timing for incurring compliance outlays and the ultimate sale of the model construction project. EPA then calculated the discounted present value of project outlays; effectively collapsing the time-explicit framework into a single-period equivalent analysis. The 1-acre model projects are

assumed to be linearly scalable to other acreage sizes as needed to capture the cash flow, present value and return effects of regulatory requirements.

The model project analysis frameworks account for the financing costs associated with project-level outlays using pre-tax costs of debt and equity capital parameters of 7.0% and 13.54%, respectively. These cost of debt and equity parameters were developed using the methodology described in *Section 3.3.2.2*.

The location of each model project is unspecified and, for this reason, EPA used national-level data wherever possible. Also, EPA assumes that model project sites are controlled by a developer-builder (sometimes referred to in the industry as a merchant builder or operative builder). The developer-builder is responsible for all aspects of a project, from land acquisition through permitting, subdivision of the parcel, installation of any stormwater controls and construction and marketing of completed unit(s). EPA recognizes that there are many variations on how a particular site is developed, but believes this model is generally representative of a large number of the projects undertaken each year in the United States.[15] In effect, this assumption focuses the project-level impacts of the action on a single business entity.

EPA assumes that all model projects follow a similar development process, consisting of three phases:

- **Land acquisition –** The developer-builder puts together the necessary financing to purchase the parcel. When lenders are involved, they may require documentation, such as financial statements, tax returns, appraisals, proof of the developer's ability to obtain necessary zoning, evaluations of project location, assessments of the capacity of existing infrastructure, letters of intent from the city/town to install infrastructure, and environmental approvals. To satisfy these factors, the developer might incur costs associated with compiling this data.
- **Land development –** The developer-builder obtains all necessary site approvals and prepares the site for the construction phase of the project. Costs incurred during this phase include so-called "soft" costs for architectural and engineering services, legal work, permits, fees, and testing; and "hard" costs, such as land clearing, installing utilities and roads, and preparing foundations or pads. The result of this phase is a legally subdivided parcel with finished lots ready for construction.
- **Construction –** The developer-builder undertakes the actual construction during this phase. A substantial portion of this work could be subcontracted to specialty subcontractors (e.g., foundation, framing, roofing, plumbing, electrical, and painting subcontractors).

Because the length of each project phase and the timing of an actual sale can vary substantially – both within and across projects that occur in these construction sectors – EPA believes it is reasonable to assume that each model project *could* follow a similar development process in terms of project phases and their timing. EPA's data sources and assumptions regarding the timing of each project phase and the various cost elements incurred during the different phases of development are described in *Section 3.2.2*.

3.2.2 Inputs to the Baseline Model C&D Projects

The baseline financial conditions for the model projects describe the model projects in terms of cash operating events from project start to sale, and in terms of financing structure and financial position, on a pre-tax basis. Model projects are characterized in the baseline by physical and technical parameters (e.g., project total acreage, size and number of construction products associated with the project, acreage disturbed) as well as financial parameters (e.g., types, timing, and magnitude of costs incurred during various phases of the project, and the

[15] Other common scenarios involve the developer selling all or some of the finished lot(s) to builders. The developer will not necessarily retain lot(s) in a development to complete and sell.

sources for these funds in terms of the amounts borrowed versus the amounts provided from the developer-builder's equity).

The general cost categories included during the various stages of each model project – independent of compliance outlays – are summarized in the following table.

Table 3-1: Costs Elements for Model Project Phases

Project Phase	Project Cost Elements
Land Acquisition (Year 1)	Raw land purchase
	Debt cost of land acquisition loan
	Equity cost of capital outlays for land acquisition
Land Development (Year 2)	Land development (e.g., site preparation, site improvement - paving, water and sewer, erosion and sediment - water and electric hook-up)
	Impact fees and analysis
	Other fees (e.g., cost of processing approvals, land dedication or fee in lieu, bonding/escrow fee)
	Land preservation and planting (e.g., tree and wetland preservation and planting; value of land left as green space or park)
	Other costs
	Overhead
	Debt cost of land development loan
	Equity cost of capital outlays for land development
Building Construction (Years 3-4)	Construction cost
	Overhead
	Debt cost of construction loan
	Equity cost of capital outlays for construction
	Real estate and marketing fees

3.2.2.1 Phase 1 – Land Acquisition

The first phase of each model project is land acquisition, which includes the purchase of raw land for the project.

Residential Building Projects

The model single-family residential project is assumed to be an undeveloped parcel zoned for single-family residential housing. The model multi-family residential project is assumed to be an apartment building or complex. The cost of raw land per acre for single- and multi-family development is estimated from the National Association of Home Builder's (NAHB) *2007 National Results - Construction Costs for a Single-Family Unit.* NAHB's annual report includes "average" costs for the development and construction of a single-family housing unit using information compiled from builders in approximately 50 metropolitan markets.

NAHB's 2007 single-family unit cost report indicates a raw lot cost of $45,507, where a new single-family lot as defined by the Census is 16,968 square feet in size. Using this information, EPA estimated the cost of a full acre of raw land is $116,887 (43,560 sq ft. per acre divided by 16,959 sq. ft per lot – or, 2.57 – multiplied by the per-lot land cost of $45,507).

EPA assumed that the land acquisition cost is financed over a time period equal to the total length of the project – from land acquisition through development, construction, and sale. EPA assumes the single-family and multi-family model projects each take four years – that is, revenue from the sale of the housing unit(s) occurs four years after initiation of the land acquisition loan. Part of the land acquisition loan is financed through debt (with debt cost of 7.0%) and part is financed using developer equity (with a 13.54% equity cost) assuming a land acquisition loan-to-value ratio of 65%, which is based on FDIC's Real Estate Lending Rules for land acquisition.

Non-Residential Building Projects

The model commercial building project is assumed to be an enclosed retail shopping or office area. The model industrial building project is assumed to be an industrial park or stand-alone manufacturing facility. As with the residential projects, a single developer-builder is assumed to be responsible for site acquisition, site preparation, construction, and marketing of each project.

The cost of raw land per acre for commercial and industrial development is based on the Urban Land Institute's (ULI) *Market Profiles 2000: North America* report. The median land cost per acre, inflated to 2007 dollars using BEA's GDP deflator, for retail shopping centers as reported in ULI's report is $358,667, and the median land cost per acre for industrial parks is $165,745.

EPA assumed the land acquisition cost is financed over a time period equal to the total length of the projects – from land acquisition through development, construction, and sale. The project timeline for commercial and industrial projects is assumed to be four years from start to finish. Part of the land acquisition loan is financed through debt and part is financed using developer equity assuming a land acquisition loan-to-value ratio of 65%, based on FDIC's Real Estate Lending Rules for land acquisition.

3.2.2.2 Phase 2 – Land Development

Residential Building Projects

NAHB's *2007 National Results - Construction Costs for a Single-Family Unit* is the data source used by EPA to establish the baseline land development costs for the model residential construction projects. NAHB reports specific line item costs for land development, which EPA grouped into five categories:

1. Land development (e.g., site preparation, site improvement – paving, water and sewer, erosion and sediment – water and electric hook-up);
2. Impact fees and analysis;
3. Other fees (e.g., cost of processing approvals, land dedication or fee in lieu, bonding/escrow fee);
4. Land preservation and planting costs (e.g., tree and wetland preservation and planting; value of land left as green space or park); and,
5. Other costs.

NAHB reports each cost element on a per-single-family-lot basis. EPA converted these per-lot costs to a per-acre basis for the multi-family and non-residential model project frameworks using the same assumption – 2.57 single-family lots per acre – used to convert NAHB's raw lot cost to a per-acre basis in the previous section. EPA assumed, based on the NAHB data, that overhead costs are 10% of total baseline land development costs for each residential construction project.

EPA assumed the loan to finance the land development costs is initiated one year following the initiation of the land acquisition loan and continues until the project is completed. Therefore, the land development loans for single- and multi-family model projects have durations of three years. Part of the land development loan is assumed to be financed through debt and part is financed using developer equity assuming a land development loan-to-value ratio of 75%, based on FDIC's Real Estate Lending Rules for land development.

Non-Residential Building Projects

To establish baseline land development costs for the model commercial and industrial projects, EPA used the same per-acre cost elements that are used in the multi-family project framework, which in turn, are originally derived from the single-family framework, as outlined above. EPA similarly maintained the assumption that

overhead costs are 10% of total baseline land development costs for the commercial and industrial construction projects.

EPA assumed the loan to finance the land development costs is initiated one year following the initiation of the land acquisition loan and continues until the project is completed. Therefore, the land development loan for a commercial or industrial model project is three years in duration. Part of the land development loan is assumed to be financed through debt and part is financed using developer equity assuming a land development loan-to-value ratio of 75%, which is based on FDIC's Real Estate Lending Rules for land development.

3.2.2.3 Phase 3 – Building Construction

The third phase of each model project is construction, which includes the physical structures as well as costs for other site infrastructure such as paving and sidewalk construction. Specification of baseline costs during the first two phases of each model project is driven exclusively by the overall size (in acres) of the model project. Costs incurred during the construction phase are driven primarily by the number, size, and orientation (i.e. proximity of units to each other and to street network) of unit(s) – in terms of the number of units per building, floors per building, number of buildings, and ratio of project size to building footprint(s) – constructed on the developed land. For the multi-family and non-residential building construction projects, EPA developed specific characterizations of the number, size, and orientation of unit(s) in a typical 1-acre project based actual project data compiled from Reed Construction. This data improves the project-level construction cost estimates and improves the estimation of the project compliance cost multipliers that are later incorporated into the partial equilibrium analysis framework.

Residential Building Projects

NAHB's *2007 National Results - Construction Costs for a Single-Family Unit* and the U.S. Census *Characteristics of New Housing* are the data sources used by EPA to establish the baseline construction costs for the model single-family residential construction project. The U.S. Census *Characteristics of New Housing* data indicates the 2006 national average lot size for a single-family home is approximately 0.39 acres, and that the average size of a single-family home built on that lot is 2,456 square feet. This implies 2.57 single-family units (or 6,311 square feet of construction) per acre. NAHB reports the total construction cost for an average single-family unit is $65.57/square foot.

Reed Construction project data and R.S. Means are the primary data sources used by EPA to establish the baseline construction costs for the model multi-family residential construction project. Reed Construction indicates that, on average, a 1-acre multi-family construction project consists of approximately 60,000 total square feet of constructed space, distributed – on average – across 2.3 buildings with 4.7 floors and 36 housing units per building.

EPA developed values for multi-family project construction from R.S. Means 2007 National CostWorks data. R.S. Means reports construction cost per square foot for apartment complexes ranging from 1 – 24 stories, and a variety of construction material categories. Based on this data, EPA estimates an average multi-family construction cost per square foot value of $128.73.

EPA has also estimated the total project square footage of roads, driveway, and sidewalk construction area based on ratios of such impervious surfaces to total the total project size as reported in a 2001 study of impervious cover and land use in the Chesapeake Bay watershed (Capiella, 2001). R.S. Means provides values for the average cost of residential paving (e.g., roads, driveway) and sidewalk construction of $1.31 and $4.15 per square foot, respectively.

EPA assumed that overhead costs are 10% of total baseline construction costs for the single- and multi-family construction projects. EPA assumed that the loan to finance the total construction cost is initiated one year following the initiation of the land development loan and continues until the project is completed. The construction loans for single- and multi-family model projects are therefore two years in duration. Part of the construction loan is assumed to be financed through debt and part is financed using developer equity assuming a construction loan-to-value ratio of 80%, which is based on FDIC's Real Estate Lending Rules.

Lastly, EPA developed marketing fee and real estate sales commission values as a percentage of the sale price of each housing unit based on NAHB's single-family housing unit construction cost data. EPA assumed that marketing fees are 2.7% of the cost of each unit constructed in a given project, and the sales commission is 4.6% of the cost of each unit constructed in the project. The marketing fees and sales commission are *not* assumed to carry a financing cost that will affect project price as they are assumed to be incurred late in the construction phase of the project – and hence, relatively close to the period when revenue from sale is realized.

Non-Residential Building Projects

The framework for developing the construction costs for the commercial and industrial building projects is conceptually the same as the multi-family construction cost framework. The frameworks differ primarily in the particular site characterizations developed from Reed Construction and the particular construction cost values developed from R.S. Means.

The Reed Construction data indicate that, on average, a 1-acre commercial and industrial project consists of 21,500 and 25,000 square feet of constructed area, respectively. EPA assumes there is 1 unit (or building) per project for the 1-acre commercial and industrial model projects. In terms of construction cost values, the R.S. Means data indicate average commercial and industrial construction cost per square foot of $131.22 and $84.62, respectively. The commercial construction cost value is based on the average construction cost per square foot, as reported by R.S. Means, for a variety of commercial projects such as banks, day care centers, Laundromats, retail stores, restaurants, supermarkets, and office buildings ranging from 1 to 10 stories. The industrial construction cost is based on the average construction cost per square foot, as reported by R.S. Means, for 1-story factories, 3-story factories, and warehouses. R.S. Means also provides data for the average cost of commercial/industrial paving and sidewalk construction, which are $1.33 and $4.38 per square foot, respectively.

EPA assumed overhead costs are 10% of total baseline construction costs for the commercial and industrial construction projects. EPA assumed the loan to finance the total construction cost is initiated one year following the initiation of the land development loan and continues until the project is completed. The construction loans for commercial and industrial model projects are therefore two years in duration. Part of the construction loan is assumed to be financed through debt and part is financed using developer equity assuming a construction loan-to-value ratio of 80%, based on FDIC's Real Estate Lending Rules.

EPA also assigned marketing and sales fees to commercial and industrial model projects, using the same values of 2.7% and 4.6% of the total sales price, respectively, from the residential project framework. The marketing fees and sales commission are *not* assumed to carry a financing cost as they are assumed to be incurred late in the construction phase of the project – and hence, relatively close to the period when revenue from sale is realized.

3.2.2.4 Summary of Key Model Project Inputs

Table 3-2 presents the key assumptions and data sources used to develop the model single-family construction project described above.

Table 3-2: Key Input Parameters for the Single-Family Construction Model Project

Parameter Description	Value	Source
Project-size variables		
Site-size (acres)	1	*EPA assumption**
Average single-family home size (square feet)	2,456	*U.S. Census Bureau Characteristics of New Housing*
Average lot size (acres)	0.39	*U.S. Census Bureau Characteristics of New Housing*
Lot density (number of lots per acre)	2.57	*Calculated value*
Land acquisition and development variables		
Cost of raw land (per acre)	$116,887	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Land development costs (per lot)	$39,167	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Impact analysis (per lot)	$5,160	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Land preservation and planting (per lot)	$3,115	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Other Fees (per lot)	$5,350	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Other Costs (per lot)	$3,996	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Overhead costs	10%	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Construction cost variables		
Construction cost (per square foot)	$65.57	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Overhead costs	10.0%	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Real estate cost variables		
Marketing fees (% of home sales price)	2.7%	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Real estate sales commission (% of sales price)	4.6%	*NAHB 2007 - Construction Costs for a Single-Family Unit*
Financing terms variables		
Debt cost	7.0%	*Calculated value – see Section 3.3.2*
Equity cost	13.54%	*Calculated value – see Section 3.3.2*
Loan-to-value ratio for land acquisition	65%	*FDIC Real Estate Lending Rules*
Loan-to-value ratio for land development	75%	*FDIC Real Estate Lending Rules*
Loan-to-value ratio for construction	80%	*FDIC Real Estate Lending Rules*
Term of land acquisition loan (years)	4	*EPA assumption*
Term of land development loan (years)	3	*EPA assumption*
Term of construction loan (years)	2	*EPA assumption*

* The model project definition of 1-acre is not intended to imply that all projects subject to regulation are 1-acre in size. This is simply the assumed size of the model project for purposes of estimating the compliance cost unit multiplier value.

As previously noted many of the key parameters employed in the model multi-family and non-residential projects were the same as or derived simply from the single-family model project parameters. Other key parameters used in the multi-family and non-residential model projects were developed independent of the single-family model. These additional key parameters are presented in *Table 3-3*.

Table 3-3: Additional Key Input Parameters for the Multi-Family and Non-Residential Construction Model Projects (1-acre site size)

Parameter Description	Multi-Family	Commercial	Industrial	Source
Constructed building area (sq ft)	59,654	21,468	25,080	*Reed Construction*
Number of buildings per project	2.3	1	1	*Reed/EPA assumption*
Number of units per building	36.2	1	1	*Reed/EPA assumption*
Number of floors per building	4.7	1	1	*Reed/EPA assumption*
Ratio of paved area to site size (%)	26%	36%	35%	*Center for Watershed Protection (2001)*
Ratio of sidewalk area to site size (%)	1%	1%	1%	*Center for Watershed Protection (2001)*
Cost of raw land (per acre)	$116,887	$358,667	$165,745	*Urban Land Institute*
Construction cost (per sq ft)	$128.73	$131.22	$84.62	*R.S. Means CostWorks*
Paving cost (per sq ft)	$1.31	$1.33	$1.33	*R.S. Means CostWorks*
Sidewalk construction cost (per sq ft)	$4.15	$4.38	$4.38	*R.S. Means CostWorks*

3.2.3 Estimating Project-Level Developer and Consumer Impacts

The baseline model project frameworks incorporate the entire set of costs associated with acquiring, developing, and completing construction of housing units or buildings on a given site. Accordingly, EPA has assumed that the

baseline model project costs include the costs of complying with existing Phase I and Phase II NPDES stormwater regulations as they would apply to the site (e.g., 100 percent compliance baseline). An example 1-acre single-family model project (e.g., 2.57 homes) is presented in *Table 3-4* below to show the baseline specification of the model project framework and the resulting incremental changes in land development costs – and ultimately the home price – due to compliance outlays. The single family model project framework is specified using the key input parameters in *Table 3-2*. Recall from previous discussion of the project analysis that model frameworks were developed on a time-explicit basis that accounts for the timing of outlays and financing for land purchase, development, and construction, as well as the timing for incurring compliance outplays and the ultimate sale of the model construction project. EPA then calculated the discounted present value of project outlays; effectively collapsing the time-explicit framework into a single-period equivalent analysis. These collapsed, single-time-period values appear in *Table 3-4*.

Compliance costs for the proposed options are assumed to be incurred at the beginning of the land development phase of the project (i.e., beginning of year 2). The compliance outlays are therefore incorporated into the debt and equity financing for land development – financing which has a 3-year duration. As a result, notice in *Table 3-4* that the costs for land acquisition and construction do not change from baseline to post-compliance conditions, but costs for land development do change. In the example below, the *land development loan* and the *capital outlay for land development* both increase because part of the illustrative $3,500 per acre compliance outlay is financed through debt and part is financed through equity. The sum of the changes in debt and equity outlays ($2,625 + $875) equals the total per-acre compliance outlay value. These outlays then incur a multiplier effect due, respectively, to the 3-year costs of debt and equity financing. The result is that, from baseline to post-compliance conditions, total land development costs increase by more than simply the compliance outlay (e.g., $4,496 land development cost increase vs. $3,500 compliance outlay).

The increased cost for land development due to compliance outlays flows through the framework resulting in an increase in the *total project cost before real estate fees*, *real estate fees*, *sales commission*, and the ultimate *sales price* for each single-family housing unit constructed in the 1-acre project. The sales price per unit is equal to the *final project cost* divided by the number of housing units in the 1-acre project. The example in *Table 3-4* indicates a $1,877 increase in price per unit due to the compliance costs.

Also notice in *Table 3-4* that, since the model project analysis assumed 100% cost-pass-through from developer to consumer, the developer's return on equity does not change from baseline to post-compliance conditions.

Table 3-4: Example Single-Family Construction Model Project Framework (1-Acre Site)

Project Cost Element	Baseline Value	Hypothetical Option	Change Due to Compliance
Land Acquisition			
Raw land cost	$116,887	$116,887	$0
Debt Cost for Land Acquisition			
Land acquisition loan value	$75,977	$75,977	$0
End-of-project acquisition loan balance	$99,590	$99,590	$0
Equity Cost for Land Acquisition			
Capital outlay for land acquisition	$40,910	$40,910	$0
End-of-project capital balance	$67,990	$67,990	$0
Total Land Acquisition Cost	**$167,580**	**$167,580**	**$0**
Land Development			
Development Costs			
Land development	$100,609	$100,609	$0
Impact analysis	$13,255	$13,255	$0
Land preservation and planting	$8,002	$8,002	$0
Other fees	$13,743	$13,743	$0
Other costs	$10,265	$10,265	$0
Overhead costs	$14,587	$14,587	$0
Regulatory Option Compliance Outlay	$ 0	$ 3,500	$ 3,500
Debt Cost for Land Development			
Land development loan value	$120,344	$122,969	$2,625
End-of-project development loan balance	$147,427	$150,643	$3,216
Equity Cost for Land Development			
Capital outlay for land development	$40,115	$40,990	$875
End-of-project capital balance	$58,717	$59,998	$1,281
Total Land Development Cost	**$206,144**	**$210,640**	**$4,496**
Construction			
Construction Costs			
Project construction	$413,687	*$413,687*	$0
Overhead	$41,369	*$41,369*	$0
Debt Cost for Construction			
Construction loan value	$364,044	$364,044	$0
End-of-project construction loan balance	$416,794	$416,794	$0
Equity Cost for Construction			
Capital outlay for construction	$91,011	$91,011	$0
End-of-project capital balance	$117,327	$117,327	$0
Total Construction Cost	**$534,122**	**$534,122**	**$0**
Estimate Sales Price to Consumer			
Total project cost before real estate fees	**$907,846**	**$912,342**	**$4,496**
Price per unit before real estate fees	**$353,424**	**$355,175**	**$1,750**
Marketing fees	$9,380	$9,426	$46
Sales commission	$16,247	$16,327	$80
Final project cost	**$973,693**	**$978,496**	**$4,823**
Final sales price per unit	**$379,051**	**$380,929**	**$1,877**
Estimate Developer's Return on Equity			
Total project cost before real estate fees	$907,846	$912,342	$4,496
Total project outlays	$732,402	$735,902	$3,500
Capital outlays	$172,036	$172,911	$875
Present value of capital outlays	$146,839	$147,609	$771
Debt service cost	$103,446	$104,037	$591
Final equity balance	$244,034	$245,315	$1,281
Return on equity	13.54%	13.54%	0%

3.2.3.1 Incorporating Compliance Costs into the Model Project Frameworks

Using the baseline assumptions and conditions described previously, EPA calculated the sales price for each housing unit (or model commercial or industrial building). The project frameworks then allow EPA to assess the incremental impact of additional requirements imposed under the proposed regulatory options. Each model project incorporates an estimated national average incremental per-acre cost for each proposed option into the

land development phase of the project. As these costs are added to the other costs incurred during that phase, the financing requirements will increase. In turn, the developer's cost for debt and equity financing and overhead associated with that phase of project development will also increase.

3.2.3.2 Estimating Model Project Cost Multipliers

An important purpose of the four model building project frameworks is to develop the incremental compliance cost multipliers that can be used to incorporate overhead, debt, and equity cost considerations into the per-acre compliance cost values used in subsequent analyses outlined in this document (*Section 3.4 & 3.5*). Once incremental compliance costs are incorporated into the model project framework, it produces – assuming 100% cost pass-through – a price differential relative to the baseline price. This price differential is higher than the incremental compliance costs assigned to the project by this implicit cost "multiplier" factor. The project cost multiplier reflects the additional overhead cost as well as the increase in the developer's financing costs since compliance costs are brought into the project analysis framework. The multiplier is calculated by dividing the total change in the *final project cost* from the baseline by the incremental cost of compliance assigned to the project. Referring back to the example in *Table 3-4*, the multiplier is estimated by dividing $4,823 / $3,500.

It is important to emphasize that neither the absolute dollar value of incremental compliance associated with a given project nor the baseline cost of the project determines the value of the cost multiplier. The multiplier represents a mark-up, per dollar of compliance, and is determined by the financing terms specified for the model projects. These include the debt cost, equity cost, loan to value ratios, and the durations of the loans for each phase of development. The multiplier value is therefore option-independent. In addition, since EPA has assumed that the four model projects follow the same development process with respect to these financing terms, the multiplier value is also constant across the model building projects. EPA estimated the project-level compliance cost multiplier to be 1.38, which means each dollar of incremental compliance cost becomes $1.38 of incremental price change for the construction unit due to debt and equity cost considerations.

3.3 Analysis of Firm- and Industry-Level Economic Impacts

3.3.1 Overview of Firm- and Industry-Level Analysis

The firm- and industry-level analysis examines the impact of the rule's compliance costs on firms in the major C&D industry segments that are expected to incur compliance requirements and costs because of the regulation:

- Single-family residential construction
- Multifamily residential construction
- Industrial building construction
- Commercial and institutional building construction
- Non-building construction.

EPA performed a *firm-level* analysis because, in concept, regulatory impacts on an affected industry are appropriately assessed at the level of the affected business entity – i.e., firm – instead of at the level of the individual products of the firm. Assessing impacts at the firm level supports understanding of potential impact in terms of occurrence of firm financial stress and firm closures, and related employment effects. A project-level analysis, for example, would not provide insight into these impact concepts. The firm- and industry-level analysis is based on model firms that represent the baseline (i.e., pre-regulation) financial performance and condition of "typical" businesses in these industry segments. These model firms are used in combination with compliance cost estimates to examine the potential for financial stress, employment effects, and increased barriers to the entrance of new firms to the industry.

The model firms are structured as baseline financial statements for each of the NAICS sectors that align with the C&D industry segments expected to be affected by the regulation, and within NAICS sectors, by revenue size ranges for which data are reported by the Statistics of U.S. Business (SUSB) and the Economic Census (see *Chapter 4: Developing the Analysis Baseline*). The financial statements for the model firms are constructed to capture two business condition cases for the firm-level analysis:

1. A *General Business Conditions* case, which is meant to reflect the financial performance and condition of C&D industry businesses during *normal* – neither excessively strong nor weak – economic conditions for the specific industrial segments. The analyses under the General Business Conditions case examine the potential for adverse impacts on firms over the longer term of general steady state business conditions in the C&D industries.
2. An *Adverse Business Conditions* case, which is meant to reflect the financial performance and condition of C&D industry businesses during weak economic conditions for the specific industrial segments. During these periods, the potential economic/financial impact of the C&D rule may be relatively greater due to weakened financial performance and condition of the affected businesses and lower ability to recover compliance costs from customers. Thus, the analyses under the Adverse Business Conditions case provide a "worse case" assessment of the potential for adverse financial impact on firms as a result of the C&D rule.

The two business condition cases are differentiated by the baseline operating financial circumstances of the model firms as well as other important factors in firm financial performance, including cost of debt and equity capital, and the estimated ability of the model firms to recover compliance costs from customers via price increases.

Impact findings are assessed in terms of occurrence of compliance costs exceeding impact thresholds, increased frequency of weak financial condition and performance, and loss in business value from incurrence of compliance costs. The findings from the analysis of model firms are aggregated by revenue size range and total industry sector to assess the total potential adverse impact in the various sectors. These impact findings are also used in assessing the potential impact of the C&D rule on small entities. The model firm analysis also supports an assessment of potential barriers to entry for new businesses seeking to enter the C&D industry.

The following sections describe the data sources and approach for the firm-level analysis:

- *Section 3.3.2: Establishing Model Firms*
- *Section 3.3.3: Assigning Compliance Costs to Model Firms*
- *Section 3.3.4: Estimating the Change in Model Firm Financial Performance and Condition*
- *Section 3.3.5: Applying the Findings from the Model Firm Analysis to the Total Industry*
- *Section 3.3.6: Assessing Potential Barriers to Entry of New Businesses to the C&D Industry*.

3.3.2 Establishing Model Firms

3.3.2.1 Defining Economic Sectors and Revenue Size Ranges for Model Firms

As described in the preceding *Chapter 2: Economic Profile of the Construction* and Development Industry, EPA identified six principal C&D business segments that are expected to be within the scope of the proposed regulation and for which sufficient data are available to estimate compliance costs and assess potential regulatory effects. As the basis for its firm and industry impact analysis, EPA constructed model firms for the NAICS sectors aligning with each of these business segments:

- New Single-Family Housing Construction (except Operative Builders) (NAICS sector 236115)
- New Multifamily Housing Construction (except Operative Builders) (NAICS sector 236116)
- New Housing Operative Builders (NAICS sector 236117)

- Industrial Building Construction (NAICS sector 236210)
- Commercial and Institutional Building Construction (NAICS sector 236220)
- Highway, Street, and Bridge Construction (NAICS sector 237310).

Within each business segment, EPA further defined model firms according to business size based on seven revenue size categories in which SUSB and Economic Census report data. As described in *Chapter 2*, SUSB reports business data (e.g., number of entities, revenue, and number of employees) by "firm" while Economic Census reports business data by "establishment." Each data source uses slightly different revenue size categories for reporting business data. Because this analysis is focused on "firm-level" impacts, the analysis relied primarily on SUSB as the data source for average size of business, and numbers of businesses and employees within revenue ranges. However, Economic Census data were used to disaggregate some of the SUSB revenue size ranges into smaller size ranges to improve understanding of the differences in baseline financial performance/condition by business size and how economic/financial impacts might vary by business size. The revenue ranges used in the firm-level analysis are:

- Less than $1 million
- $1 - $2.5 million
- $2.5 - $5 million
- $5 - $10 million
- $10 - $50 million
- $50 - $100 million
- $100 million and greater

The SUSB and Economic Census data are important for characterizing average business size, numbers of businesses, and employees within revenue size ranges.

Economic Census and other data on the level of firm activity in terms of potential value and acreage of construction activity are later used to assign compliance costs to firms within these revenue size ranges.

3.3.2.2 Assigning Baseline Financial Information to Model Firms

EPA assigned baseline financial characteristics – balance sheet, income statement, and metrics of financial performance and condition – to each of the model firms as defined by NAICS sector and revenue size range, from financial statement information reported by Risk Management Association (RMA) in its publication, *Annual Statement Studies*. The RMA data are compiled from the financial statements submitted by the borrowers and applicants for lending to financial institutions, and are collected and reported annually. The number of statements represented in the RMA data for a given year varies from several hundred to several thousand in the business sectors analyzed.

The firm-level financial models are defined for both the General Business Conditions case and Adverse Business Conditions case.

- ***General Business Conditions case***: RMA data by sector and revenue range for the 5-year period April 2002 through March 2007 were used to define the General Business Conditions case models. As documented in *Chapter 2*, for all of the affected sectors, this 5-year period encompasses periods of relative weakness and strength.
  - For the residential construction sectors, 2002 through 2005 is a period of growth and generally good financial performance. However, beginning in 2006, this sector has been in a period of weakness.
  - For the non-residential construction sectors, 2000 to 2003 is a period of relative weakness. From 2003 to 2005, these sectors saw relatively flat performance followed by strong growth in from late 2005 into 2007.
- ***Adverse Business Conditions case***: To develop the Adverse Business Conditions case models, RMA data from the *worst* financial performance year in the 5-year period April 2002 through March 2007, *as indicated in the RMA data for each sector*, were used as the basis of the firm-level model financial statements. For the residential construction sectors, 2006 began a period of weakness; data from April

2006 through March 2007 was used for this case.[16] For the non-residential sectors, 2003 began a period of weakness; data from April 2003 through March 2004 was used for this case.[17]

The revenue ranges for which RMA reports data align closely with the revenue size categories derived from SUSB and Economic Census:

Model Firm Revenue Range (from SUSB and Economic Census)	RMA Revenue Range Mapped to SUSB/Economic Census Revenue Range
Less than $1 million	Less than $1 million
$1 - $2.5 million	$1 - $3 million
$2.5 - $5 million	$3 - $5 million
$5 - $10 million	$5 - $10 million
$10 - $50 million	$10 - $25 million
$50 - $100 million	$25 million and greater
$100 million and greater	$25 million and greater

RMA reports balance sheet and income statement information by revenue range for firms in each of the six NAICS sectors for which model firms were developed. The balance sheet and income statement information is reported as percentages for important accounting items for the *average* statement in each business sector and size category:

- Balance sheet – asset percentages are reported for the following items:
  - Cash & Equivalents
  - Trade Receivables (net)
  - Inventory
  - All Other Current Assets
  - Total Current Assets
  - Fixed Assets (net)
  - Intangibles (net)
  - All Other Non-Current Assets
  - Total Assets.
- Balance sheet – capital elements (liabilities and equity) are reported for the following items:
  - Notes Payable-Short Term
  - Current Maturity of Long Term Debt
  - Trade Payables
  - Income Taxes Payable
  - All Other Current Liabilities
  - Total Current Liabilities
  - Long Term Debt
  - Deferred Taxes
  - All Other Non-Current Liabilities
  - Net Worth
  - Total Liabilities & Net Worth.
- Income statement – income statement/operating statement are reported for the following items:
  - Net Sales
  - Gross Profit
  - Operating Expenses
  - Operating Profit
  - All Other Expenses (net)
  - Profit Before Taxes

In addition to reporting average income statement and balance sheet information, RMA also reports values for a large number of metrics of financial structure, performance, and condition by quartile – first quartile, median, and third quartile – as calculated from the statements in the sector and revenue size categories. Key metrics of interest for this analysis include:

- Sales/Total Assets
- Pre-Tax Income/Total Assets
- Earnings before Interest and Taxes (EBIT)/Interest
- Total Liabilities/Tangible Net Worth.

[16] Data are not currently available for the full year of 2007, which would reflect a period of more substantial weakness in the residential construction sectors.

[17] The same data period was used for the non-building sector adverse business conditions case.

These financial metric values by quartile are important for developing baseline financial statements that vary by baseline financial condition and performance. This information is also used to establishing the values of financial performance metrics (for Pre-Tax Income/Total Assets and EBIT/Interest) that are judged indicative of below-standard performance for the business sectors and thus can provide insight into the potential for adverse financial impact of the C&D rule by business sector and size.

Steps in Developing the Baseline Financial Statements

EPA performed the following steps to develop the baseline financial statements for the model firms:

- Use the SUSB-reported average of revenue by sector and revenue range for 2002[18] as the baseline revenue value for firms within each business sector and revenue category. This value applies for each of the three quartiles of baseline financial performance.
- Use RMA-reported value of Sales/Total Assets, by quartile, *and* SUSB-reported average of revenue by sector and revenue range to assign a baseline dollar value of total assets and capital (liabilities and equity) for firm-level balance sheets. This calculation yields a varying baseline total capitalization by baseline financial performance: as expected, more weakly performing firms have lower asset productivity as indicated by the ratio of sales to total assets and thus carry higher capitalizations for the given revenue value.
- Use the RMA-reported values of Pre-Tax Income/Total Assets, EBIT/Interest, Total Liabilities/ Tangible Net Worth, by quartile, to develop baseline *dollar-valued* income statement and balance sheet for each of the three quartiles of baseline performance. These specific RMA-reported values are judged important as the basis for differentiating the baseline financial statements by baseline financial performance – lower quartile performance, median performance, and higher quartile performance – and thus providing insight into the potential impacts of the C&D rule on firms in varying baseline financial circumstances. All else equal, firms with weaker baseline financial circumstances would be at risk of more severe impacts than firms with stronger baseline financial circumstances. The basis for using these specific measures to establish financial statements by quartile is as follows:
  - ***Pre-Tax Income/Total Assets*** is a key measure of the fundamental asset productivity and profit performance of a business, and thus is an important differentiator of financial statements by baseline financial performance and condition. For this analysis, Pre-Tax *and Pre-Interest* Income/Total Assets would have provided stronger insight into basic business financial performance since the income measure would have been before payments to debt capital and thus independent of capital structure. However, RMA does not provide this financial measure.
  - ***Earnings before Interest and Taxes (EBIT)/Interest*** indicates the extent to which pre-interest and pre-tax income exceeds interest obligations and thus is a key measure of the ability of an enterprise to meet its current interest obligations and as well the risk to a borrower for extending additional credit to the enterprise. As such, EPA also judges this measure as an important differentiator of financial statements by baseline financial performance and condition. Businesses with relatively greater debt as a component of total capital and/or with relatively lower basic profitability will have lower EBIT/Interest values.

[18] 2002 is the most recent year for which SUSB and Economic Census data are available for the C&D sectors. While it is likely that the average value of revenue for firms in the various revenue range categories would differ now from the values observed in 2002, it is not possible to know the direction of change and there is no obvious basis – e.g., an index of business revenue change – on which to adjust the average revenue value. Therefore, this analysis uses the average revenue values by NAICS sector and revenue range for 2002 as the basis for the model firms.

- ***Total Liabilities/Tangible Net Worth*** is less closely linked to baseline financial performance and condition and indeed is likely to be a managed element of capital structure. However, the measure is also a direct indicator of the riskiness of a firm's capital structure – and of the risk of the capital structure to providers of both debt and equity capital. Because firms in weaker financial circumstances *may* be more likely to have higher debt as a component of total capital (e.g., as stated in the preceding paragraph, high debt in itself can be a contributor to a low EBIT/Interest value), this measure was also used to differentiate the baseline financial statements by performance/condition quartile.

- In general, the *median quartile* reported values align closely with the values for these measures as calculated from the *average* financial statement information reported in the RMA statements. However, as expected, the RMA-reported values for the lower and upper quartiles of these metrics differ substantially from those indicated by the average financial statements. Accordingly, the lower and upper quartiles for the three financial measures were used to calibrate the baseline balance sheets and income statements to represent lower and upper quartile baseline financial statements for firms by sector and revenue range, as follows:
  - The fraction of total capitalization represented by baseline equity *less intangible assets* was adjusted to yield the reported value of Total Liabilities/Tangible Net Worth. The composition of the resulting residual of total liabilities was structured in terms of the baseline composition of liabilities for the *average* business by sector and revenue range. As a result, the financial statements for the *lower quartile* firm models are assigned a higher debt fraction of total capital than the median and upper quartile firms.
  - Total expenses *before interest and tax expense* and *interest expense* were adjusted to yield the target values of Pre-Tax Income/Total Assets and EBIT/Interest. This calculation yielded a baseline income statement value for interest expense, which is not broken out separately in the RMA-reported income statements (but is implicitly available through the reporting of the EBIT/Interest value), and is needed for the firm-level impact analysis.
- As described more specifically in a later section, the analysis of baseline performance and potential impact of the C&D rule relies in part on an assessment of the change in business value of affected firms. To develop the baseline and post-compliance estimates of business value requires an estimate of after-tax income, which is not reported by RMA in its income statements. To calculate after-tax income, a composite federal/state income tax rate based on (1) the estimated federal rate applicable to pre-tax income for the given model firm and (2) an average of state tax rates of 7.3 percent, was applied to the indicated pre-tax income for the model firms. Where tax rates are unable to be differentiated by pre-tax income level – e.g., in the project analysis – a combined federal/state tax rate of 42.5 percent was used to account for tax effects.

Estimating Baseline Business Value for the Model Firms

The final step in developing the baseline firm financial models by sector, revenue range, and baseline performance quartile was to develop an estimate of the baseline business value of the model firms. As noted in the preceding paragraph, change in business value is one of the impact measures in the firm analysis. Baseline business value is determined as follows:

- Calculate after-tax cash flow from operations available to debt and equity capital, which is the sum of after-tax income and interest payments on a pre-tax basis (total operating cash flow to all capital).[19]

[19] The calculation of after-tax cash flow from operations would also typically involve adding back depreciation, since this a non-cash charge, and subtracting an allowance for ongoing outlays to maintain the existing capital stock and associated baseline production

- Discount total operating cash flow to all capital by the estimated weighted average after-tax cost of capital, which yields going concern value for the business on the basis of total capital – i.e., debt and equity.
- Subtract long-term liabilities from the total capitalization value to yield going concern value to the business' equity owners.
- Add net current assets to the net going concern value to yield total business value to the business' equity owners, including net going concern value and net balance sheet liquidity.

In this calculation, the business is assumed to operate in a "no real growth" steady state – i.e., the firm's cash flow is assumed static, neither increasing nor decreasing, except for the effect of inflation. As a result, a discounted cash flow analysis using the cash flow from a single time period is appropriate for estimating the business value of the firm.

Developing the Cost of Capital Used in Calculating the Business Value of Model Firms

The cost of capital used in the discounted cash flow calculation is based on the model firm's financial structure (debt and equity as fractions of total capital) and further varies according to business size (assumed to affect firms' terms of access to capital markets) and the business conditions case (Copeland, 2000b). Elements of the cost of capital calculation are as follows:

Cost of debt:

- For the General Business Conditions case, based on the reported market yield of 7.0 percent for "Moody's Baa-rated corporate bonds - all industries," over the period 2000-2007 (U.S. Federal Reserve, 2007a).[20] The Baa rating is considered "Medium Grade" debt and is the lowest of the "Investment Grade" debt ratings.[21]
- For the Adverse Business Conditions case, based on the estimated market yield of 12.7 percent for Moody's B-rated debt in the year 2001, the most recent declared recession year in the U.S. economy (NBER, 2003). The B rating is considered "Low Grade (speculative)" and the second highest debt grade within the "Not Investment Grade" debt ratings. This rating and the associated debt cost would be appropriate for firms with appreciably weak financial performance. The estimated 12.7 percent cost for B-rated debt is calculated from reported interest rate spreads for industrial bonds of various ratings against the debt cost for 10-year Treasury Bonds (Bondsonline, 2006).
- To convert the debt cost to an after-tax basis, the debt costs are reduced by the estimated combined federal/state tax rate for each of the firm models, by revenue range, as described above. The resulting after-tax debt costs were applied to firms of all sizes in calculating a cost of capital for use in the firm-level analysis.
- The debt cost from this analysis for the General Business Conditions case is also used in the *Analysis of Project-Level Costs and Economic Impacts*.

Cost of equity:

capability. EPA did not "add back" depreciation in the cash flow calculation because no information was available for estimating an appropriate allowance for ongoing capital outlays. In effect, the value of depreciation recorded in the baseline operating statements is being treated as approximately equal to the ongoing capital outlay value.

[20] Moody's yield on seasoned corporate bonds - all industries, Baa (medium grade, lowest investment grade rating).

[21] Debt ratings definitions from The Bond Market Association.

- The cost of equity is calculated on the basis of the Capital Asset Pricing Model (CAPM) analytic convention, which determines the cost of equity capital as the return on a "riskless" investment plus a risk-adjusted equity market premium. The risk-adjusted equity market premium is based on a firm's or sector's undiversifiable, or systematic, market risk – conventionally defined as the market "beta" for the firm or sector[22] – and the observed equity cost premium to the "riskless" investment – typically a Treasury bond of 10 years or more maturity (Copeland, 2000a).
- The riskless return value is based on the average market yield, 4.7 percent, on 10-Year Treasury Bonds over the period 2000-2007 (U.S Federal Reserve, 2007b).
- The equity market premium varies by business conditions case. The General Business Conditions case uses an equity market premium of 4.9 percent, which is at the lower end of the range of equity market premiums estimated for U.S. equity markets (Damoradan).[23] The Adverse Business Conditions case uses a higher equity market premium of 6.0 percent to reflect the higher degree of investor risk aversion during periods of weak economic performance (Copeland, 2000a).
- The *beta* values applied in the equity cost analysis are based on the average market beta for 41 publicly-traded firms in the Homebuilding Sector[24], as identified by the Value Line Investment Survey (Damoradan).[25] Two *beta* values are used in the analysis. For model firms judged of sufficient size to access public markets for equity capital – $100 million and greater, the highest revenue category in the analysis – a public securities market *beta* of 0.98 is used in the cost of capital analysis. For model firms in the revenue categories below $100 million, which are judged not to be of sufficient size to access public capital markets, a so-called "total market risk" *beta* of 1.32 is used in the analysis. The "total" *beta* reflects the total variance in securities' value for firms in the Value Line Homebuilding Sector and does not set aside the "diversifiable" component of variance. The "total" *beta* concept is judged more appropriate for estimating equity cost for private firms whose owners are likely to have heavily concentrated, less diversified ownership in those firms.
- The resulting after-tax equity costs range from 9.5 percent for large businesses under the General Business Conditions case to 12.6 percent for small businesses under the Adverse Business Conditions case.

The after-tax cost of debt and cost of equity are combined according to the baseline capital structure – debt and equity fractions of total long-term capital – of model firms, by sector, revenue range, and financial performance quartile, to yield the weighted average cost of capital used in the business value analysis for model firms.

The cost of equity developed in this analysis is an after-tax cost of equity, since it reflects the income payable to the firm's equity owners, which by definition, is after taxes. The General Business Conditions case equity cost is also used in the *Project Analysis*, although on a pre-tax basis. The after-tax cost of equity is converted to a pre-tax basis by dividing by one *minus* the estimated combined federal/state tax rate of 42.5 percent.

Table 3-5, below, summarizes cost of capital values used in the firm and industry impact analysis.

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22 The extent of correlation of the firm's or sector's returns with the overall market, which thus cannot be "diversified away" in a portfolio.

23 As recommended in the internet-based financial data portal maintained by Aswath Damoradan, professor of finance at New York University's Stern School of Business.

24 The Homebuilding Sector provides the "best" sector match within the Value Line companies and sectors dataset for identifying the relevant financial characteristics of firms in the construction and development industries.

25 Both *beta* values – the "standard public securities market" *beta*, applicable to publicly traded firms and the "total" *beta*, applicable to private companies – are as reported by Aswath Damoradan.

Table 3-5: Cost of Capital for C&D Industry Effluent Guidelines Analyses

	General Business Conditions Case	Adverse Business Conditions Case
Cost of Debt Capital	7.0%	12.7%
Cost of Equity Capital		
After-tax		
for Public Market Sized Firms	9.5%	10.6%
for Smaller Undiversified Ownership Firms	11.2%	12.6%
Pre-tax		
for Public Market Sized Firms	13.5%	15.1%
for Smaller Undiversified Ownership Firms	16.0%	18.0%

Source: EPA estimates based on underlying data sources

As described at page 3-19, in the single-time-period "business perpetuity" analytic framework, all business operating financial parameters and, as a result, cash flow are assumed to be constant, except for the effect of inflation. Accordingly, the present value of cash flow is determined simply by dividing the constant (*in real terms*) cash flow value by the estimated cost of capital. To account for the effect of inflation in this analysis, the estimated cost of capital is reduced by the assumed constant rate at which cash flow is assumed to grow. This approach is equivalent mathematically to using a *real* discount rate (i.e., setting aside the component of cost of capital which results from inflation) in the discounted cash flow calculation. For this adjustment, EPA used a nominal cash flow growth rate of 3.1 percent, which is the average of year-to-year rates of change of the Engineering News-Record's *Construction Cost Index* over the period 1990-2007 (McGraw Hill, 2008).

As detailed in this section, the firm-level financial models are defined for both the General Business Conditions case and Adverse Business Conditions case. *Table 3-6* summarizes the parameter definitions for these business cases.

Table 3-6: Summary of Key Parameters that Define the *General* and *Adverse* Business Conditions Cases

Sector	General Business Conditions Case	Adverse Business Conditions Case	Data Source	Methodology
Model Firm Rate of Compliance Cost Pass-Through				
NAICS 236115	85.0%	0.0%	*Price elasticity of supply:* Green, Malpezi, and Mayo (2005); and, Benjamin, Jud, and Winkler (1998). *Price elasticity of demand:* HUD, 2006; DiPasquale, 1999; Benjamin, Jud, and Winkler, 1998.	➢ *General Business Conditions Case:* estimates of cost pass-through rates for the residential and non-residential sectors are based on estimates of price elasticity of supply (Es) and demand (Ed). ➢ *Adverse Business Conditions Case*: firms are assumed to absorb all of the compliance outlay within their current operating finances See Section 3.5 of the EA for more detail.
NAICS 236116	85.0%	0.0%		
NAICS 236117	85.0%	0.0%		
NAICS 236210	71.0%	0.0%		
NAICS 236220	71.0%	0.0%		
NAICS 237310	71.0%	0.0%		
Model Firm Cost of Debt Capital				
All Sectors	7.0%	12.7%	Moody's Seasoned data (U.S. Federal Reserve, 2007a).	➢ *General Business Conditions Case*: based on the reported market yield for Moody's Baa-rated corporate bonds (investment grade) over the period 2000-2007. ➢ *Adverse Business Conditions Case*: based on the estimated market yield for Moody's B-rated debt (speculative grade) in the year 2001. See Section 4.3.2.2 of the EA for more detail.
Model Firm Cost of Equity Capital, After-Tax				

Table 3-6: Summary of Key Parameters that Define the *General* and *Adverse* Business Conditions Cases

Sector	General Business Conditions Case	Adverse Business Conditions Case	Data Source	Methodology
All Sectors, for Public Market Sized Firms	9.5%	10.6%	Based on the Capital Asset Pricing Model (CAPM) analytic convention, using data on equity market premiums from Damoradan (2008) and Copeland (2000a).	➢ *General Business Conditions Case*: based on an equity market premium that is at the lower end of the range of equity market premiums estimated for U.S. equity markets. ➢ *Adverse Business Conditions Case*: based on a higher equity market premium to reflect the higher degree of investor risk aversion during periods of weak economic performance. See Section 4.3.2.2 of the EA for more detail. ➢ Also, cost of equity differs by size of firm. The cost of equity for smaller, undiversified ownership firms reflects a larger market risk premium since these firms are not expected to be of sufficient size to access public capital markets.
All Sectors, for Smaller Undiversified Ownership Firms	11.2%	12.6%		
Industry Average Deviation from Trend of Construction Activity During Adverse Performance Years				
NAICS 236115	N/A	-6.88%	U.S. Census, value of construction by sector: 1990 to 2007.	➢ *General Business Conditions Case*: No assumed deviation from trend. ➢ *Adverse Business Conditions Case*: For each general industry sector, EPA assigned each year into categories of *at trend*, *above trend*, or *below trend* based on that's year's deviation in the value of construction activity from the long term trend for the sector. An average deviation from trend during each adverse performance years was estimated for each general industry sector. See Appendix 6-2 of the EA for more detail. ➢ EPA used these percentage values to model a slight contraction in the overall C&D industry during adverse market conditions.
NAICS 236116	N/A	-6.88%		
NAICS 236117	N/A	-6.88%		
NAICS 236210	N/A	-13.89%		
NAICS 236220	N/A	-13.89%		
NAICS 237310	N/A	-4.23%		
Model Firm Baseline Financial Information				
NAICS 236115			EPA estimates based on Risk Management Association (RMA) eStatement Studies. RMA reports financial statement metrics by each NAICS sector and for seven revenue ranges.	➢ *General Business Conditions Case*: Values are based on an average of values over the 5-year period April 2002 through March 2007. ➢ *Adverse Business Conditions Case*: Based on adverse performance years within each sector using Census data on the value of construction activity from 1990 to 2007 (based on the same method as noted above, i.e., the assignment of years into categories of at trend, above trend, and below trend). The adverse performance years used in the analysis are 2007 for the residential sector and 2003 for the non-residential and non-building sector. See Appendix 6-2 of the
Pre-Tax Income/Total Assets	6.4%	5.2%		
EBIT/Interest	6.1	4.7		
Net Income Margin	2.4%	2.3%		
NAICS 236116				
Pre-Tax Income/Total Assets	6.9%	6.7%		
EBIT/Interest	9.1	7.2		
Net Income Margin	1.9%	1.9%		
NAICS 236117				
Pre-Tax Income/Total Assets	5.8%	5.8%		
EBIT/Interest	7.1	5.4		
Net Income Margin	2.3%	2.9%		
NAICS 236210				
Pre-Tax Income/Total Assets	4.8%	3.5%		
EBIT/Interest	8.1	6.2		
Net Income Margin	1.1%	0.9%		

Table 3-6: Summary of Key Parameters that Define the *General* and *Adverse* Business Conditions Cases

Sector	General Business Conditions Case	Adverse Business Conditions Case	Data Source	Methodology
NAICS 236220				EA for more detail. ➢ *Note:* EPA performed the analysis for each of the six NAICS sectors and for the seven revenue ranges within each NAICS code. The values reported here – for illustration – are the averages of the median financial ratios across the seven revenue ranges within each NAICS sector.
Pre-Tax Income/Total Assets	5.4%	3.9%		
EBIT/Interest	9.4	7.9		
Net Income Margin	1.3%	0.9%		
NAICS 237310				
Pre-Tax Income/Total Assets	5.8%	4.1%		
EBIT/Interest	4.6	3.7		
Net Income Margin	1.8%	1.3%		

Source: EPA Analysis

3.3.3 Assigning Compliance Costs to Model Firms

The objective of this part of the firm- and industry-level analysis is to assign compliance costs to model firms to support assessment of the firm- and industry-level financial impacts of the C&D regulation. Compliance costs for a given regulatory option are assigned to the model firms, by sector and revenue range, based on the following considerations:

- Whether the regulatory option is likely to impose costs on the specific sector and thus the model firms that represent that sector. For example, it is possible that a regulatory option will impose direct costs only on the obtainer/holder of the NPDES permit for Stormwater Discharges, and who is likely to be the owner/land developer (e.g., NAICS 236117, New Housing Operative Builders) and not necessarily a general contractor (e.g., NAICS 236115, New Single-Family Housing Construction (except Operative Builders)). Businesses in some sectors may be set aside from the firm-impact analysis based on such considerations.

  For the current analysis, EPA did not set aside from cost assignment any of the sectors identified in *Chapter 2: Economic Profile of the Construction and Development Industry* as likely to be affected by the C&D rule.

- Within a given sector that is expected to be affected by the C&D rule, the extent to which revenue of firms in the sector results from construction activities that will be within the regulation's scope. In a similar concept to the consideration stated above, it is also possible that the revenue of firms within a given sector would be only partially associated with in-scope activities. For example, if it were determined that the primary business activity of firms in the NAICS 236117, New Housing Operative Builders sector would be in-scope *but that other revenue-generating activities* of those firms are not likely to be within the regulation's scope, then a part of the model firm revenue (and business activities) could be set aside from potentially incurring compliance costs. For this determination, EPA relies on the business *specialization* ratio as reported by the Economic Census for businesses in a given sector. The specialization ratio reports the average fraction of businesses' revenues in a sector that arise from the sector's primary business activity. This data allows EPA to exclude the fraction of *firm revenue* that is, on average, associated with *additions or maintenance work*, which is not in-scope of the regulation since this revenue does not come from *new* construction.

Table 3-7: C&D Firm Specialization, by Sector

NAICS	C&D Sector Name	Percent of Revenues from New Construction	Percent of Revenues from Additions, Maintenance, Remodeling
236115	New single-family housing construction	94.4%	5.6%
236116	New multifamily housing construction	92.4%	7.6%
236117	New housing operative builders	99.3%	0.7%
236210	Industrial building construction	54.0%	46.0%
236220	Commercial and institutional building construction	68.2%	31.8%
237310	Highway, street, and bridge construction	56.0%	44.0%

Source: 2002 Economic Census

- The estimated construction project acreage for the various model firms. EPA estimated compliance costs for each regulatory option on a per-acre and state-by-state basis based on project size, type of construction, compliance requirement, and state-specific factors such as presence of overlapping regulatory requirements, varying levels of labor and other compliance input costs, rainfall levels, and soil characteristics. Accordingly, the quantity of acreage developed by a model firm *that could be within the scope of the regulation* is a key determinant of the compliance cost assigned to the firm. As the first step in determining the quantity of in-scope acreage of a given model firm, EPA estimated the *total* construction acreage on which a model firm could initiate (or complete) potentially in-scope projects in a single year. This determination is based on the concept of acreage intensity described in *Chapter **4***. As described in that chapter, acreage intensity is the acreage quantity per dollar of construction project value (which is assumed to translate to business revenue) and was estimated by EPA for the principal construction activities – single-family housing construction, multifamily housing construction, commercial project construction, and industrial project construction – estimated to be within the scope of the C&D rule. For a given model firm defined by sector and revenue range, construction project acreage is calculated as follows:

$$Acreage_{sctr,\,rr} = Acreage\_Intensity_{sctr} * Revenue_{sctr,\,rr} \qquad (1)$$

Where:

$Acreage_{sctr,rr}$	=	Construction Project Acreage for model firms by sector and revenue range
$Acreage\_Intensity_{sctr}$	=	Acres per Dollar of Project Value, derived from Census of Housing and Reed Construction data
$Revenue_{sctr,rr}$	=	Model firm revenue by sector and revenue range

- The fraction of model firms and associated project acreage within a given revenue range that is of sufficient scale to be within the scope of a given regulatory option. In developing regulatory options, EPA considered a number of minimum project size thresholds that would fall within the scope of a given option – e.g., projects of at least one acre in size, projects of at least ten acres in size. EPA also evaluated regulatory options in which regulatory requirements vary by project size – e.g., one level of requirement for projects on sites of at least one acre area but less than ten acres, a second, higher level of requirement for projects on sites of at least ten acres area. Accordingly, it was necessary to identify whether a given model firm could undertake projects that are of sufficient scale to meet one or more of the site size thresholds defined for a given regulatory option. The concept relied on here is the same as that in the preceding step – acreage intensity in conjunction with model firm revenue – but in this case acreage intensity is used to determine the *critical revenue value* that is sufficient to perform projects within the regulatory option's coverage, and based on the critical revenue value, the fraction of model firms and associated project acreage in a given revenue range that are in-scope for a given regulatory option.

The critical revenue value for an option and sector is the revenue that is estimated to be necessary to initiate or bring to completion annually a *single* project of sufficient acreage to be within a regulatory option's coverage. The critical revenue value is calculated as:

$$Revenue\_Critical_{sctr,\,ro} = Acreage\_Min_{ro} / Acreage\_Intensity_{sctr} \quad (2)$$

Where:

$Revenue\_Critical_{sctr,ro}$ = Minimum revenue for performing a *single* project in a given sector for a given regulatory option

$Acreage\_Min_{ro}$ = Minimum site acreage subject to a regulatory option or to specific requirements within a regulatory option

$Acreage\_Intensity_{sctr}$ = Acres per Dollar of Project Value

For example, if *Acreage Intensity* = 0.8 acres per $1 million of value and *Minimum Site Acreage* = 1 acre, then the *Critical Revenue Value = $1.25 million* (1 acre ÷ 0.8 acres per $1 million of value).

Given the critical revenue value for a given regulatory option, the in-scope fractions of model firms and project acreage by regulatory requirement are determined as follows:

- If a revenue range lies entirely below the critical revenue value, then all firms in the revenue range and all project acreage within the revenue range are assumed to be out-of-scope for that regulatory coverage threshold. That is,

$$Fr\_Insc_{sctr,\,rr} = 0 \quad (3)$$

Where:

$Fr\_Insc_{sctr,rr}$ = Estimated fraction of in-scope acreage for a given model firm sector and revenue range

- If a revenue range lies entirely above the critical revenue value, then all firms in that revenue range are assumed to be capable of performing in-scope projects for that regulatory coverage threshold. However, all of the projects performed within that revenue range and the associated revenue will not be in-scope to the extent that firms perform a blend of projects of varying site sizes – some of which exceed the regulatory coverage threshold and some are below the regulatory coverage threshold. To capture this concept, EPA used the estimated fraction of total projects and acreage by site size and developed from the NOI dataset (see *Chapter 4*) to estimate the fraction of total model firm acreage that would be in-scope of a given regulatory option (or the specific requirements step of a regulatory option, for options with stepped requirements by site size).

$$Fr\_Insc_{sctr,\,rr} = Fr\_Insc_{sctr,\,ro} \quad (4)$$

Where:

$Fr\_Insc_{sctr,rr}$ = Estimated fraction of in-scope acreage for a given model firm sector and revenue range

$Fr\_Insc_{sctr,ro}$ = Estimated fraction of total acreage for a given construction sector occurring in projects that exceed the regulatory coverage threshold for a given regulatory option.

- If the critical revenue value lies within a revenue range, the fraction of firms estimated to be capable of performing in-scope activities – and their associated in-scope project acreage – are calculated using the assumption that firms *by revenue* are distributed uniformly over the revenue range.

$$Fr\_Insc_{sctr,\,rr} = Fr\_Insc_{sctr,\,ro} * \left(Rev_{rr,\,high} - Rev\_Critical_{sctr,\,ro}\right) \Big/ \left(Rev_{rr,\,high} - Rev_{rr,\,low}\right) \quad (5)$$

Where:

$Fr\_Insc_{sctr,rr}$	=	Estimated fraction of in-scope acreage for a given model firm sector and revenue range
$Fr\_Insc_{sctr,ro}$	=	Estimated fraction of total acreage for a given construction sector occurring in projects that exceed the regulatory coverage threshold for a given regulatory option.
$Rev_{rr,high}$	=	Upper bound of revenue range
$Rev\_Critical_{sctr,ro}$	=	Minimum revenue for performing a *single* project in a given sector for a given regulatory option
$Rev_{rr,low}$	=	Lower bound of revenue range

For any given combination of *Minimum Site Acreage* for a regulatory option and *Acreage Intensity*, these calculations probably overstate, perhaps substantially, the fraction of firms that can perform in-scope activities because (1) all of the firm's activity and annual revenue is *assumed to be derived from a single project* and (2) for all but the lowest revenue range, firms *by revenue* are not likely to be distributed uniformly within the revenue range, but instead their mass is likely to be concentrated at the lower end of the range.

- The resulting in-scope project revenue and acreage by model firm. For each model firm defined by sector and revenue range, multiplying the total possible acreage by the estimated fraction of in-scope acreage yields the total in-scope acreage for the model firm. Other ways of interpreting this concept are that the estimated fraction of in-scope acreage is equivalent to the fraction of *firms* and/or fraction of model firm revenue within the revenue range that is associated with construction activities within the scope of a regulatory option.
- The estimated compliance cost for each model firm. Based on the estimated in-scope acreage by model firm, compliance costs for the model firm are calculated by multiplying the estimated compliance cost per acre for the given regulatory option by the number of in-scope acres for the model firm. For regulatory options with only one set of regulatory requirements *or* for firms that are capable of performing only projects that fit within the first regulatory requirement of a multi-stepped option, this calculation is straightforward: in-scope acreage *times* compliance cost per acre yields model firm compliance costs. For regulatory options with more than one set of regulatory requirements that vary by site size *and* for firms that are capable of performing projects in the higher site size range, the compliance cost per acre used in the calculation is a weighted average of compliance costs based on the estimated fractions of projects by site size undertaken by the model firm in each of the site size ranges for the regulatory option.

EPA performed the estimation and assignment of compliance costs to model firms *on a state-by-state basis* for each regulatory option. EPA estimates that the incidence of compliance requirements and compliance costs per acre of construction activity will vary from state to state. The variation over states results from three factors:

1. The presence of state requirements that, in some instances, capture elements of the compliance requirements of a given regulatory option. For those states in which all or part of the requirements of a given C&D rule regulatory option are already required by the states, EPA adjusted the compliance costs per acre to reflect only the *incremental* requirement, if any, for the regulatory option in estimating costs for the state.

2. For some regulatory options, variation by state in soil characteristics and rainfall levels, which may affect the extent and character of compliance response required for a regulatory option.
3. Variation in compliance activity costs by state resulting from differences in labor and other compliance input costs by state.

As a result of these factors, for certain regulatory options, some states have no or substantially lower compliance costs per acre of construction activity than other states. As a result, the assessments of aggregate sector and industry level impacts described in later sections of this chapter are based on the model firm analyses *performed on a state-by-state basis.* The state-by-state findings are then aggregated to the national level to yield national cost and impact results.

3.3.4 Estimating the Change in Model Firm Financial Performance and Condition

The firm-level compliance cost estimates are assigned to the model firms to support assessment of the potential financial impact of the C&D regulation. The impact assessments at the level of the model firms are used in *Section 3.3.5: Applying the Findings from the Model Firm Analysis to the Total Industry* to assess industry level effects, accounting for the numbers of firms by affected sector and revenue range that are expected to be within the scope of the C&D regulation.

3.3.4.1 Impact Concepts for the Analysis

Three concepts of economic/financial impact are used in the firm- and industry-level impact analysis:

1. A "screening level" impact measure based on comparison of annual compliance costs to revenue. EPA generally judges compliance costs that are less than one percent of revenue as not imposing a material economic/financial burden on affected businesses. Costs exceeding three percent of revenue are judged as potentially imposing a material economic/financial burden, while the findings for costs between one and three percent of revenue are generally viewed as inconclusive in terms of economic/financial burden. This assessment, which examines the frequency with which compliance costs exceed one and three percent of revenue, is also important for the small entity impact analysis. This impact measure is also used in the Regulatory Flexibility Act analysis of impact on small entities.
2. Changes in two key measures of firm financial performance and condition, based on application of compliance costs to the model firm financial statements:
   - Pre-Tax Income/Total Assets, a key measure of the fundamental asset productivity and profit performance of a business. Businesses with weak return on assets will be unable to provide competitive returns to investors and will have difficulty attracting capital to support the ongoing business as well as business expansion.
   - Earnings before Interest and Taxes/Interest, which indicates the extent to which pre-interest and pre-tax income exceeds interest obligations and thus is a key measure of the ability of an enterprise to meet its current interest obligations and as well the risk to a borrower for extending additional credit to the enterprise.[26]

   The assessment for these two financial measures estimates the fraction of firms in the various sector and revenue ranges for which the financial measures decline – because of compliance outlays – to levels indicative of material financial weakness. The analysis uses the lower quartile of these financial measures

[26] These are two of the financial measures reported by RMA for median, lower and upper quartiles by sector and business size that were used in constructing the baseline financial statements for the model firms.

as developed from the RMA statements *for a given sector for the General Business Conditions case*[27] as the threshold value of financial weakness.

3. Change in business value, based on application of compliance costs to the model firm financial statements, and the fraction of firms whose net business value becomes negative because of compliance outlays. This impact measure is used as an indicator of potential closures due to the regulation. EPA also estimated and reports the employment in firms that are potential closures. This employment is at risk from the potential closure of these facilities. In *Section 3.5.3.2: Estimating the Loss in C&D Output*, page 3-50, EPA describes estimation of a potential employment effect resulting from an estimated contraction in C&D industry output due to the regulation. These potential employment effects are different in concept. The employment effect from *firm closures* results from some firms being marginal financial performers that may cease business because of regulatory requirements. These potential job losses, if they do occur, are not necessarily *permanent* losses in the C&D industry but may be better thought of as *dislocations* as some firms cease operations but other, financially more healthy, firms increase activity and restore part or all of these losses. On the other hand, the employment losses from potential *contraction* of C&D industry output, as described in *Section 3.5.3.2*, may be understood as permanent losses.

These assessments of impact for these measures are performed for two analysis cases:

- Primary Impact Analysis Case: This case reflects EPA's best estimates of the likely impact of the C&D rule under *general* business conditions and is presented as the primary impact assessment in *Chapter 5: Economic Impact Analysis Results*. For this case, firms are assumed to pass on part of the compliance outlay to other parties. The extent of pass-through varies by sector and is determined from the market level analysis outlined in *Section 3.5: Analysis of Social Cost*. In addition, this case reflects the *General Business Conditions case* of baseline firm financial performance and condition.
- Adverse Impact Analysis Case: This case reflects more adverse, *not business as usual*, business conditions and is presented as an assessment of how the regulation might affect businesses during adverse business conditions. For this case, firms are assumed to absorb all of the compliance outlay within their current operating finances – i.e., unable to pass on any of the compliance outlay to customers or to the sellers of the land on which development occurs. In addition, this case reflects the *Adverse Business Conditions case* of baseline firm financial performance and condition. The findings from this analysis are presented in an appendix to *Chapter 5: Economic Impact Analysis Results*.

A third case – 100% cost pass-through – in which all compliance outlays are assumed to be passed on to other parties, is also possible. However, this case is not directly addressed in the firm-level impact analysis, since businesses experience no adverse financial impact under this cost pass-through case. This case *is assessed* in terms of potential regulation impacts on consumers (*Section 3.4: Analysis of Single-Family Housing Affordability Impacts*, page 3-33).

3.3.4.2 Incorporating Compliance Cost Estimates into Baseline Financial Statements

Model-firm compliance cost estimates from *Section 3.3.3* are incorporated into the baseline income statement and balance sheet for each model firm to assess how compliance costs change the key financial ratios and business value for the representative construction firms.

For the firm-level analysis, model firms are assumed to be in a steady state of operations in which a constant level of activity – project starts and project completions – subject to regulation occurs year-to-year. The financial

[27] That is, the threshold values that are used for assessing adverse financial impact are based on the General Business Conditions case estimates regardless of whether the analysis is being performed for the *General Business Conditions* case or the *Adverse Business Conditions* case.

impact of compliance outlays can be assessed as a one-time change to this steady state condition, based on the level of activity subject to regulation that is initiated in a given year. Key assumptions in this analysis include:

- Model firms are assumed to finance compliance outlays 80 percent from debt and 20 percent from equity capital.
- In the *no cost pass-through analysis*, the compliance outlay affects the income statement as follows:
  - Cost of revenue is increased by the amount of the compliance outlay, in turn reducing business gross profit.
  - Interest expense is increased by the one-period cost for interest on the debt for financing the outlay. Interest is charged according to the business conditions case being analyzed.
  - Pre-tax income is reduced by the amount of the compliance outlay and interest expense.
  - After-tax income is reduced by the amount of the compliance outlay and interest expense *times* the model firm's tax rate, which is determined from a schedule of combined federal/state corporate tax rates varying by pre-tax income level.
- In the no cost pass-through analysis, the compliance outlay affects the balance sheet as follows:
  - The total compliance outlay, including interest cost on debt financing is assumed to be recorded as an increase in non-current assets.
  - Debt is increased by the debt fraction of the total compliance outlay; equity is increased by the equity fraction of the outlay.
- In the *partial cost pass-through analysis*, the analysis differs in that the compliance outlay is assumed to be partially recovered through an increase in revenue, which in turn results in a lower reduction in net income on the income statement, and an increase in current assets, and a lower increase in non-current assets on the balance sheet.

The changes in income statement and balance sheet translate into changes in the financial impact measures and also affect the business value analysis by reducing after-tax cash flow and increasing the liabilities that are subtracted away in calculating business net worth.

3.3.4.3 Assessing the Effect of Compliance Outlays on the Impact Measures

As described above, three impact concepts are accounted for in the firm impact analysis:

1. Occurrence of compliance costs exceeding one and three percent of revenue – a screening-level measure of financial impact.
2. Deterioration in measures of financial performance and condition to levels that would indicate financial stress to the enterprise.
3. Decline to a negative net worth business value, which is assumed to point to a risk of business closure.

Occurrence of Compliance costs Exceeding One and Three Percent of Revenue

The "screening level" cost-to-revenue measure is assessed as whether the total compliance outlay, including financing cost, exceeds thresholds of one and three percent of revenue.

This analysis is performed at the model firm revenue level within each revenue range and using the distribution of acreage intensity (see *Chapter 4*) to assess the potential for compliance costs to exceed the one and three percent thresholds. Specifically, for each model firm by sector and revenue range, the calculation first determines the

levels of compliance cost that would exceed one and three percent of revenue – *critical compliance cost* levels. The analysis then calculates the acreage intensity that would yield the critical compliance cost, given the relationships for determining compliance cost by model firm as outlined in *Section 3.3.3*, above. Finally, the analysis looks to the distributions of acreage intensity by sector to estimate the percentage of firms within the revenue range for which compliance cost would exceed the indicated critical compliance cost values.

This calculation is performed in two ways:

1. Using the unadjusted compliance cost. This metric indicates the potential burden of compliance costs in relation to revenue, without accounting for the likelihood that some of the compliance cost will be offset by increase revenue.
2. Using the compliance cost adjusted by the increase in revenue that is estimated to occur from passing on a part of the compliance cost increase to customers as a price increase. This measure may provide a more meaningful measure of potential compliance cost burden. In this calculation, the total compliance cost is simply reduced by the increase in revenue resulting from cost pass-through. The resulting comparison is of *net compliance cost burden* (i.e., after offsetting revenue increase) to baseline revenue.

Deterioration in Measures of Financial Performance

In the financial measures analysis, baseline and post-compliance values of the measures are calculated for the median, lower quartile, and upper quartile model firm financial statements within each sector and revenue range. Impact findings are assessed in terms of the estimated fraction of firms by sector and revenue range whose financial performance value declines below financial weakness thresholds as a result of compliance outlays. This analysis involves the following steps:

- For each financial performance measure, the baseline and post-compliance values of the *median, lower quartile and upper quartile* values are used to construct baseline and post-compliance linear-segmented cumulative distributions. These distributions are developed separately on a baseline and post-compliance basis, by revenue range within each sector.
- The baseline first quartile value for each financial measure *over the entire sector (i.e., all revenue size categories) and for the General Business Conditions case* is used as the *Critical Threshold Value* for assessing material financial weakness for a given sector.
- The baseline distribution is used to determine the fraction of firms, by revenue range and sector, falling below the critical threshold value for each financial performance measure in the baseline – i.e., *before application of compliance costs*. In reaching this determination, EPA assumed that firms are uniformly distributed within the linear segments of the cumulative distribution of financial performance measure values. Because the analysis uses a critical threshold value that is determined at the sector level and does not vary by revenue range within the sector, the *baseline* percentage of firms falling below the threshold value varies by revenue range within the sector. Typically, a fraction larger than 25 percent of firms in the smaller revenue ranges fall below the impact threshold value, while less than 25 percent of firms in the higher revenue ranges fall below the threshold value.
- The post-compliance distribution is developed from the financial performance values for the median, lower quartile, and upper quartile model firms, based on application of compliance costs to the model firms, as described in previous sections. In effect, the post-compliance distribution is a *shifted* version of the baseline distribution with the newly calculated median, lower quartile, and upper quartile values being lower than the values at these same percentile points on the baseline distribution.
- The post-compliance distribution is then used to determine the fraction of firms, by revenue range and sector, falling below the critical threshold value for each financial performance measure. The *difference*

between the post-compliance and baseline percentages indicates the percentage of model firms in a given sector and revenue range that move below the critical threshold value because of the incurrence of compliance costs from a given regulatory option.

Key elements of these calculations are summarized in *Table 3-8*, below.

Table 3-8: Summary of Concepts in Developing Distributions of Financial Performance Measures and Calculating Performance Relative to Impact Thresholds

Percentile Value	Baseline Distribution and Values	Post-Compliance Distribution and Values
0^{th} Percentile	Determined by linear extrapolation from 25^{th} percentile value based on *slope* between 25^{th} and median percentile values	Determined by linear extrapolation from 25^{th} percentile value based on *slope* between 25^{th} and median percentile values
Threshold Value lies between 0^{th} and 25th percentile	The baseline percentile of the critical threshold value is determined by linear interpolation between the 0^{th} and 25^{th} percentile measure values from the baseline distribution	The post-compliance percentile of the critical threshold value is determined by linear interpolation between the 0^{th} and 25^{th} percentile measure values from the post-compliance distribution
First Quartile (25^{th} percentile)	$Metric_{Q1}$ *assigned to baseline financial statement from RMA data, for firms by revenue range and sector*	$Metric_{Q1,post\text{-}compliance}$ *calculated after application of compliance costs*
Threshold Value lies between 25^{th} percentile and median	The baseline percentile of the critical threshold value is determined by linear interpolation between the 25^{th} percentile and median measure values from the baseline distribution	The post-compliance percentile of the critical threshold value is determined by linear interpolation between the 25^{th} percentile and median measure values from the post-compliance distribution
Median (50^{th} percentile)	$Metric_{Median}$ *assigned to baseline financial statement from RMA data, for firms by revenue range and sector*	$Metric_{Median,post\text{-}compliance}$ *calculated after application of compliance costs*
Threshold Value lies between median and 75^{th} percentile	The baseline percentile of the critical threshold value is determined by linear interpolation between the median and the 75^{th} percentile measure values from the baseline distribution	The post-compliance percentile of the critical threshold value is determined by linear interpolation between the median and the 75^{th} percentile measure values from the post-compliance distribution
Third Quartile (75^{th} percentile)	$Metric_{Q3}$ *assigned to baseline financial statement from RMA data, for firms by revenue range and sector*	$Metric_{Q3,post\text{-}compliance}$ *calculated after application of compliance costs*
Threshold Value lies between 75^{th} and 100^{th} percentile	The baseline percentile of the critical threshold value is determined by linear interpolation between the 75^{th} and 100^{th} percentile measure values from the baseline distribution	The post-compliance percentile of the critical threshold value is determined by linear interpolation between the 75^{th} and 100^{th} percentile measure values from the post-compliance distribution
100^{th} Percentile	If needed in analysis, determined by linear extrapolation from 75^{th} percentile value based on *slope* between median and 75^{th} percentile values	If needed in analysis, determined by linear extrapolation from 75^{th} percentile value based on *slope* between median and 75^{th} percentile values

Source: U.S. Environmental Protection Agency

As described above, the estimated *increase* in percentage of firms falling below a given threshold value is the measure of impact, by sector, for each financial measure. EPA used the *greater* of the impact percentages for each financial measure, by revenue range and sector, as a composite indicator of financial stress, by revenue range and sector. These firms are assessed as potentially incurring material financial weakness as a result of regulatory requirements.

Occurrence of Negative Business Value

The analysis of change in business value is comparable in structure to the financial measures analysis, with baseline and post-compliance business value being calculated at median, lower quartile, and upper quartile model firm financial statements within each sector and revenue range. These quartile values are again used to construct linear-segmented cumulative distributions of business value by sector and revenue range. As described above, the baseline distribution of business value shifts as a result of compliance costs, leading to an increased fraction of firms, by sector and revenue range, whose business value is assessed as negative, and thus at risk of closure. Impact findings are assessed in terms of the fraction and resulting number of firms whose net business value falls below zero as a result of compliance.

As described above, EPA interprets this impact measure as an indicator of potential closures due to the regulation.

3.3.5 Applying the Findings from the Model Firm Analysis to the Total Industry

EPA used the findings from the model firm analyses by sector and revenue range to estimate the industry-level cost and impact of each regulatory option.

3.3.5.1 Estimating Industry Level Occurrence of Economic/Financial Impacts

Industry-level impacts are estimated by extending the findings from the model firm analysis to the specific revenue ranges and sectors that are represented by the model firms. The percentage of firms estimated to incur an adverse financial impact finding – cost exceeding one or three percent of revenue; incurring financial stress due to regulatory requirements; or encountering negative business value due to regulatory requirements – by sector and revenue range, are multiplied by the number of firms in the relevant combinations of sector and revenue range to estimate the total number of firms expected to incur the indicated financial impact. Estimation of the numbers of firms by sector, revenue range *and state*, is described in the regulatory analysis baseline (see *Chapter 4*). As described in *Section 3.3.3*, EPA performed the firm and industry level analyses on a state-by-state basis and aggregated the findings over states to yield national level estimates. These calculations provide estimates of the number of firms (and percentage within all firms in a given sector) that are estimated to incur the various impact measures. In addition, for firms estimated to incur the various financial impacts, EPA assessed total potential employment at risk based on the employment totals reported in the SUSB/Economic Census data by sector and revenue range.

Firms expected to experience financial stress may need to change their business operations, including potentially down-sizing or closing operations. However, the actual likelihood of these outcomes may be quite low given that these analyses are conditioned only on the so-called "less than full cost pass-through" cases. Furthermore, these business effects may not be noticeable within the ordinary course of business changes in the C&D industry, where year-to-year fluctuations in the level of business activity can be quite substantial as a result of changing macroeconomic conditions (e.g., interest rates, overall strength of the national economy) and/or changing local economic conditions (e.g., strength of local industries). Finally, the C&D industry is a relatively fluid industry, as documented in the industry profile, with low barriers to entry and considerable entry and exit activity from year to year. As a result, the potential employment losses or capital-idling effects of weakness in a specific firm are likely to be offset by changing levels of activity in other existing firms or entry of new firms into the local market.

3.3.5.2 Estimating Total Cost of Compliance and Total Acreage Incurring Compliance Costs

The estimate of total industry level effects also yields an estimate of total annual compliance outlays and related project acreage by sector and revenue range, and in aggregate, over all sectors and revenue ranges, for a given regulatory option. This calculation is performed by simply aggregating the estimated compliance costs and acreage over revenue ranges, sectors, and states for a given regulatory option.

In developing the baseline estimates of total construction activity acreage that underlie the firm- and industry-level analysis, EPA needed to reconcile the estimates of construction activity derived from the "bottom-up" model firm analysis to the "top-down" construction activity estimates (based on the National Land Coverage Database) by adjusting the acreage intensity values underlying the model firm analysis. A similar adjustment was performed for each of the regulatory options to align the total compliance cost estimates from the "bottom-up" analysis with the "top-down" analysis. For some regulatory options considered, this adjustment required an increase in the activity estimates underlying the firm- and industry-level analysis. In other cases, the adjustment required a decrease in the activity estimates underlying the firm- and industry-level analysis. The effect of these adjustments is to increase or decrease the total cost, compliance acreage and related estimates of firm- and industry-level

economic/financial impacts. *Chapter 4* provides a more complete description of the approach EPA used to reconcile estimates of construction activity from the engineering cost to the model firm analysis.

3.3.6 Assessing Potential Barriers to Entry of New Businesses to the C&D Industry

EPA also examined the potential for the C&D regulatory options to pose a barrier to entry for new businesses seeking to enter the C&D industry. This analysis, which is presented in *Chapter 5*, looked specifically at the extent to which the regulation would increase the capital required by firms of various revenue sizes to participate in the industry. A substantial increase in capital requirements could mean that some firms might not be able to assemble the capital necessary to participate in the industry.

For this assessment, EPA made the following assumptions:

- For any given revenue level, the capital required for entry to the industry is no different than the capital required by existing businesses for their continued participation in the industry.
- The total estimated compliance outlay would need to be financed by both existing businesses and new entrants to the industry.
- For any given revenue level, the total estimated compliance outlay would be the same for existing businesses and new entrants.

To assess the potential entry barrier effect, EPA compared the estimated financing requirement associated with compliance outlays to baseline total assets for each of the model firms, by industry sector and revenue range, as described in *Chapter 4: Developing the Analysis Baseline*. The comparison of financing requirement to the model firm's assets assumes that the compliance outlay would be financed and recorded on the model firm's balance sheet. To the extent that the compliance outlay is financed and recorded *not on the firm's baseline sheet but as part of a separate project-based financing for each individual project*, this comparison is likely to overstate, perhaps substantially, the incremental burden of financing in relation to the going concern asset base of the model firms.

In estimating the additional financing requirement for each model firm, EPA assumed, as outlined in the model project discussion (*Section 3.2: Analysis of Project-Level Costs and Economic Impacts*), that construction projects require, on average, four years to complete, and that the compliance outlay and hence the additional financing requirement occurs at the beginning of the second project year. As a result, the additional financing requirement for a individual project is assumed to be carried on the firm's baseline sheet for three years (i.e., until project completion) and the *steady state* increase in financing requirements is thus approximately three *times* the single project outlay – assuming a steady state operating condition of constant project and revenue activity by year as outlined in *Section 3.3.4.2: Incorporating Compliance Cost Estimates into Baseline Financial Statements.*

If the resulting additional financing requirement is substantial in relation to baseline assets, then the additional requirement could pose a material entry barrier.

3.4 Analysis of Single-Family Housing Affordability Impacts

Because the C&D rule may increase the cost of housing construction and, as a result, the price (or rent) of housing, the regulation has the potential to adversely affect consumers of newly constructed housing. Given this potential effect, EPA performed a regional-level analysis (i.e., level of Metropolitan Statistical Areas (MSA)) that estimates the number and fraction of potential single-family home buyers whose purchasing decisions may be affected by the potential increase in the price of newly constructed, single-family housing. The results of the

analysis are then reported (in *Chapter 5*) at the national-level by aggregating the number of potentially affected households across the MSAs in each state.

An MSA-level affordability analysis is more robust than a regional- or national-level analysis because it is able to capture the high variability in housing market prices and household incomes across and within states. For this analysis, EPA used MSA-level single-family new home prices and household income distributions to determine the number of *prospective home-purchasing* households that are at or above the income level estimated to be necessary to qualify for the financing of a newly constructed single-family home. This analysis involved the following steps:

- Calculating *critical income values* for the *median- and lower-quartile-priced* new home in each MSA, based on standard home-loan underwriting criteria and estimates of the total monthly housing payment, including mortgage loan, property tax, and property insurance. Property tax and property insurance are estimated by MSA. The critical income value is the value at which a household could just afford the median- or lower-quartile-priced home.
- Calculating the increase in home prices *due to the compliance costs* of the proposed regulatory options and the new critical income values for the median- and lower-quartile-priced home, by MSA. To provide a worst case assessment, the increase in new home price assumes that 100 percent of compliance costs will be passed through in housing prices.[28] Although this housing price effect may occur in "tight" markets, this extent of housing price effect is not likely to persist over the long-term. And, in periods of housing market weakness, such as currently occurring in U.S. housing markets, the assumption of 100 percent compliance cost pass-through may overstate substantially the price effect, and therefore critical income value effect, from the regulatory options.[29]
- Calculating the numbers of *prospective home-purchasing* households, for the median- and lower-quartile-priced home, by MSA, whose purchasing decision is potentially affected by the increase in housing price. The number of affected households is calculated from the MSA-based household income distributions by first determining the number of prospective home-purchasing households that *just* qualify to purchase the median- and lower-quartile-priced home, by MSA, at the baseline price, and then subtracting from these values, the number of households that just qualify to purchase at the higher, post-compliance-based prices.

  In performing these calculations, EPA recognized that, at any given time, the number of households that are actually "in the market" for purchasing a home is *significantly less* than the number of households in an MSA. EPA further recognized that the number of these households whose purchasing decision might be *practically* affected – i.e., seek to purchase a new single-family house whose price is affected by a given regulatory option – is smaller again than the number of households seeking to purchase a home. Accordingly, in developing the estimates of potentially affected households, EPA reduced the numbers of households by income range in the total MSA household income distribution to account for these considerations.

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[28] For each regulatory option, the price change per single-family housing unit was applied as a direct add-on to the median- and lower-quartile new home prices.

[29] It is important to note that the assumption of *full cost pass-through* for the affordability analysis effectively contradicts the analysis assumptions of *partial* and *no cost pass-through* used in the assessment of potential firm and industry level impacts. That is, for there to be material effects in the firm and industry impact analysis, costs must not be fully passed through to consumers and some cost and economic impact burden must remain at the level of the industry's business participants. And, conversely, for there to be material effects in the affordability analysis, costs must be passed through to consumers. Accordingly, both sets of analysis assumptions, and as a result, the potential impact findings, cannot occur at the same time in a given market: that is, adverse effects on the industry's business participants will mean less potential for advserse affordability effects, and adverse affordability effects will mean less potential for adverse effects on the industry's business participants.

The overall objective of this analysis is to account for the possibility that an increase in the price of a new, in-scope single-family home may increase the income necessary to qualify for a mortgage to purchase the home and, therefore, potentially influence the purchasing decision of likely home buyers. However, a finding of a marginal affordability effect for likely home buyers does not mean that these households would be unable to afford a home. Rather, the analysis indicates that some households *may* need to adjust the *preferential dimensions* of their housing purchase, or the *timing* of the purchase, to accommodate the higher price estimated potentially to result from the C&D industry regulation. For example, to purchase a new, in-scope single-family home, the housing purchaser might offset the increase in the monthly mortgage payment by changing some housing attribute in order to offset the increase in price from regulation compliance, or by increasing their initial down payment. Alternatively, the prospective home purchaser might decide to purchase a home whose price is not affected by regulation's compliance requirements. These interpretive considerations are discussed in more detail in *Chapter 5* along with the analysis results.

3.4.1 Estimating Critical Income Values for Single-Family Home Purchases

The critical income value is the income at which a household can *just* afford the median- or lower-quartile-priced home. The first step in estimating this baseline income value is to establish the price for the median- and lower-quartile new single-family home price, by MSA.

Median- and lower-quartile home prices from the Census Bureau's *2006 American Community Survey* (ACS) serve as the baseline home prices (2006 was chosen because it is the most recent year for which the required MSA-level data are available from the Census). The ACS provides the median *new* home price (homes built in 2005 or later) as well as the median- and lower-quartile home price for *all existing* homes. Since the lower quartile *new* home price is not available, EPA estimated the lower-quartile price of a *new* home by adjusting the median *new* home prices. This adjustment was based on the proportional relationship between the median- and lower-quartile prices *for existing homes*. Since the *2006 ACS* is a household survey, self-reporting bias may be present in the home price data. For example, the National Association of Home Builders (NAHB) has noted that studies have found that owners may overestimate the values of their homes in government surveys by *as much as eight percent* (Kiel and Zable, 1999).[30] However, the degree of over- or under-statement is likely to be small given that we are using values for *new* homes sold from 2005 - 2006. Since homeowners were reporting the value of a home they purchased within the previous year, it is not likely that homeowners would substantially err in estimating the value of their home. Other sources of new, single-family home price data are available from the Census; however, EPA identified the ACS data as the highest quality source given the relatively large sample size of approximately three million housing units and the additional benefit of being available for nearly 550 MSAs across the country.[31] As noted above, obtaining MSA-level home price data significantly improves the analysis because it allows EPA to account for the very high variability in housing prices across and within states.[32]

Table 3-9 reports the distribution – 5th percentile, 95th percentile – of newly constructed, single-family home prices from the set of median- and lower-quartile MSA prices used in the analysis. This table further illustrates the high variability in housing market prices – and therefore, critical income values – across and within states, and

[30] It should be noted that the study by Kiel and Zable (1999) examined data from the Census-HUD American Housing Survey for years 1978 – 1991. It is not clear whether and to what extent the observations of Kiel and Zable (1999) are also present in the American Community Survey.

[31] For example, the Census' monthly Survey of Construction is an alternate source; however, this data are available only at the national level and by Census region. In addition, these data are based on a small sample, relative to ACS, of approximately 5,000 respondents representing 28,000 buildings.

[32] For example, among the 543 MSAs included in the analysis, median home prices in individual MSAs range from about $39,000 to just over $1,000,000.

highlights the desirability of performing this analysis at the MSA-level (as opposed to state or national-level analysis that ignores this variability).

Table 3-9: Baseline New Single-Family Home Prices (2006$)

	5th Percentile	95th Percentile
Median Baseline New Home Price	$110,300	$560,400
Lower Quartile Baseline New Home Price	$66,486	$403,593

Source: U.S. Census Bureau. 2006 American Community Survey.

The second step in estimating the baseline critical income values is to establish the monthly housing payment for the median- and lower-quartile priced new single-family home in each MSA. The baseline monthly housing payments are based on standard home-loan underwriting criteria and include the mortgage loan, property tax, and property insurance:

- Estimate the monthly loan payment for purchase of new housing assuming that buyers finance approximately 80% of the home purchase price using a 30-year conventional fixed rate mortgage with an interest rate of 7.39%. The 80% loan to value ratio is derived from the Federal Housing Finance Board's *Terms on Conventional Single Family Mortgages, Fixed-Rate 30-Year and 15-Year Non-jumbo Loans* average percentage (since 1990) of the financing amount to the total home purchase (FHFB, 2006). The 7.39% interest rate is derived from Freddie Mac's *Primary Mortgage Market Survey: Conventional, Conforming 30-Year Fixed-Rate Mortgage Series Since 1971* average interest rate since 1990 (Freddie Mac, 2008).
- Estimate monthly property taxes by determining the percent of the monthly property tax payment to the median and lower quartile new home value for each MSA. The 2006 ACS provides the median annual property tax payment for each MSA. The monthly value was compared to the median home value for each MSA to derive monthly property taxes as a percentage of the median home value. This same percentage was used to develop the monthly property tax payment for the lower quartile home price analysis.
- Estimate the monthly insurance payment by determining the percent of the monthly insurance premium to the median and lower quartile new home value for each state. The Insurance Information Institute (III, 2007) provides the average annual insurance premium for each state. The monthly premium was compared to the median home value for each state to derive the percent of the monthly insurance premium compared to the median home value. This same percentage was used to develop the monthly insurance premium for the lower quartile home price analysis.

Private Mortgage Insurance is not included in the monthly payment calculation since this analysis assumes a loan to value ratio of 80%, which means that the loan would not require mortgage insurance.

Using the above parameters, the monthly mortgage payment is calculated as follows:

$$PI = \frac{FP(r/12)}{1*(1-(r/12)*360} \quad (6)$$

$$T = tP \quad (7)$$

$$I = sP \quad (8)$$

$$PITI = PI + T + I \quad (9)$$

Where:

PI	=	Monthly Principal and Interest
P	=	Home Purchase Price
F	=	Proportion of New Home Cost that is financed
r	=	Annual Mortgage Interest Rate
T	=	Monthly Tax Payment
t	=	Monthly Tax Rate as a Percentage of the Home Purchase Price
I	=	Monthly Insurance Premium
s	=	Monthly Insurance Rate as a Percentage of the Home Purchase Price
PITI	=	Principal, Interest, Taxes, and Insurance

Based on the FHA's underwriting guidance that a homeowner's total housing purchase payment should not exceed 29% of income (FHA, 2008), the calculation of total housing payment, as outlined above, supports the calculation of the annual income necessary to purchase a home at the median- and lower-quartile price for each MSA. *Table 3-10* summarizes the key input parameters used in this part of the analysis.

Table 3-10: Terms for 30-Year Conventional Fixed-Rate Mortgage

Duration of mortgage (years)	30
Payments per year	12
Percent of home value financed	79.9%
Annual interest rate	7.39%
Private Mortgage Insurance	N/A
Share of gross income available for housing	29%

3.4.2 Estimating the Change in New Single-Family Home Prices due to the Regulation

The estimate of potential affordability effects – i.e., the change from baseline conditions due to the regulation – begins by calculating the increase in home prices *due to the compliance costs* of the proposed regulatory options and the new critical income values for the median- and lower-quartile-priced home, by MSA. For each regulatory option, the estimated price effect for each housing unit due to the rule's compliance costs was applied as a direct add-on to the median- and lower-quartile new home price.

The price change per single-family unit is calculated by first assigning state-specific compliance cost per acre values to each MSA. In approximately fifty instances, an MSA overlaps more than one state. In these cases, EPA allocated the households within the MSA to the separate states using county-level housing data from the U.S. Census. The Census provides the county names within each MSA (U.S. Census, 2007b) and, for approximately half of the counties, provides the number of households within the county. However, the Census did not report the number of households for counties with populations less than 65,000. Therefore, EPA used the 2006 Population Estimates for each county to estimate the number of households within these counties for which household counts were not available. For example, the Parkersburg-Marietta-Vienna, WV-OH MSA is spread among four counties, one in Ohio and three in West Virginia. Because these are relatively small counties, the Census only reported the number of households for one county in West Virginia. EPA estimated the number of households for each county by apportioning the total number of households in the MSA to the counties based on the proportion of the total MSA population in each county. This enables the total number of households in the MSA to be reasonably apportioned, in this example, between Ohio and West Virginia.

The number of households within MSAs for each state was summed and compared to the total reported number of households for each state. In some instances – i.e. for those states in which all counties fall within an MSA – the number of households within the MSAs for each state *equaled* the total number of households for each state. However, in most instances, the number of households within the MSAs for each state was *less than* the total number of households for each state. For three states in which MSAs include more than one state and for which

EPA estimated the number of households for each state, the sum of households within the MSAs exceeded the reported total of households for the state. In these cases, the actual number of households by county (in lieu of the population proportions) was used to estimate the state-level number of households. Making this adjustment provides a better estimate of the number of households by state. Ultimately, EPA compared the total number of U.S. households found *within MSAs* to the *total reported number of households by state*, and found that 87% of *all* households fall within MSAs.

Once all MSA households are appropriately assigned to states, EPA then assigned each MSA the state's compliance cost per acre for each regulatory option. For regulatory options involving two sets of costs for in-scope residential projects based, for example, on soil or rainfall characteristics, EPA calculated the weighted average of the two types of costs per-acre, by state, based on the number of residential acres estimated subject to regulation in each of the cost categories. Equation (10) shows this calculation.

$$WC = \frac{(LC_1 * LA_1) + (LC_2 * LA_2)}{LA_1 + LA_2} \quad (10)$$

Where:

WC	=	Weighted Cost per Acre
LC_1	=	Large Residential Cost per Acre, Cost Set 1
LA_1	=	Large Residential Number of Acres, Cost Set 1
LC_2	=	Large Residential Cost per Acre, Cost Set 2
LA_2	=	Large Residential Number of Acres, Cost Set 2

EPA then converted the cost per acre by state, either the weighted average cost per acre or the standard residential cost per-acre, depending on the option, into a price effect per single-family home. The conversion is performed by dividing the cost per acre by the national *median* number of single-family units per acre – to estimate cost per unit – and then multiplying that cost per unit by the single-family project cost multiplier derived from the project-level analysis (*Section 3.2.3.2*). Multiplying the cost by the previously estimated cost multiplier accounts for the possibility that cost increases at a single-family residential housing project can translate into an increase in the asking price of a new home by more than the direct compliance cost increase (see *Section 3.2: Analysis of Project-Level Costs and Economic Impacts*). From the Census Bureau's *2006 Characteristics of New Housing*, the 2006 median number of units per acre (for both attached and detached single-family units) is 5.05. For the lower-quartile home price analysis, EPA also performed an alternative analysis where the cost per unit is based on the median number of units per acre for *only attached* single-family homes, which is approximately 14 units per acre. EPA performed this alternative analysis to account for the fact that lower-priced homes are more likely to be attached single-family homes and more likely to sit on lot sizes below the median of all single-family homes. In addition, Census data indicate that lot size generally declines as sales price declines and therefore the denser configuration of *attached* single-family homes may better represent a typical lot size for the lower priced homes (as opposed to the median lot size of both attached and detached homes). The results of this alternative analysis are discussed in *Chapter 5*.

In using the lot size data from the Census Bureau's *Characteristics of New Housing*, EPA recognized that these data sources do not account for road development associated with a building's construction. As a result, the reported lot size values from these datasets would understate actual area subject to the regulation for any given housing unit. To address this omission, EPA applied a 13% multiplier to scale-up the lot size values to account for the typical road development "overhead" associated with new construction activity. EPA derived this multiplier from information in the Center for Watershed Protection's *Impervious Cover and Land Use in the Chesapeake Bay Watershed* (Capiella, 2001).

3.4.3 Estimating the Number of Potentially Affected Single-Family Home Buyers

After the median- and lower-quartile housing prices are adjusted to reflect the incremental compliance cost of the regulatory options, EPA then calculated the numbers of *prospective home-purchasing* households, for the median- and lower-quartile-priced home, by MSA, whose purchasing decision is potentially affected by the increase in housing price.

To estimate the number of potentially affected households – i.e., those whose income is now below the new, post-compliance critical income value for either the median- or lower-quartile priced home – EPA used household income distribution data from the American Community Survey's *2006 Statistics of Household Income.* The ACS reports the number of households falling in ten income ranges: $0-$10,000, $10,000-$14,999, $15,000-$24,999, $25,000-$34,999, $35,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000-$149,999, $150,000-$199,999, and $200,000 or more.

Households in the income ranges *below* the range that contains the estimated critical income value are already considered to be unable to afford the home (e.g., median- or lower-quartile priced) in that MSA and therefore cannot experience an affordability effect for that particular home. The number of households present in the distribution *below* the range containing the critical income value is estimated as follows:

$$N\ Households_{inc} = N\ Households_{ir^*, inc} + \sum_{ir=1}^{ir^*-1} N\ Households_{ir} \qquad (11)$$

Where:

N Households $_{inc}$	=	Number of households over all income ranges with income below critical income value (*inc*)
N Households $_{ir^*, inc}$	=	Number of households in Income Range *ir** with income below critical income value (*inc*), where Income Range *ir** contains the critical income value *inc*
N Households $_{ir}$	=	Number of households in Income Ranges *ir* below Income Range *ir**

The Census does not provide information on how household income is distributed *within* the Census-reported income ranges. In all likelihood, the critical income value necessary to qualify for mortgage will fall *within*, and not at the edge of, a Census income range. Accordingly, it is necessary to estimate the fraction of households *within* a Census income range that fall below the critical income value. For this analysis, EPA assumed that households are uniformly distributed *over the income values* within an income range. As a result, the fractional point at which the critical income value lies within an income range is also the fraction of households within that income range that fall below the critical income value.

The *uniform-distribution-of-households-within-range* assumption inevitably involves error and could overstate or understate the fraction of households within an income range that fall below a critical income value, depending on the change in slope of the density distribution over the income range. Nevertheless, EPA considers the assumption of a uniform distribution with an income range to be a reasonable approach. The numbers of households that fall *within* the range containing the critical income value are estimated as shown within Equation (12).

$$N\ Households_{ir^*, inc} = \frac{(Inc_{criticalincome} - Inc_{ir^*, mn})}{(Inc_{ir^*, mx} - Inc_{ir^*, mn})} \times N\ Households_{ir^*} \qquad (12)$$

Where:

$N\ Households_{ir^*, inc}$	=	Number of households in Income Range *ir* *with income below the critical income value (*inc*), where Income Range *ir** contains the critical income value *inc*
$Inc_{critical\ income}$	=	Critical income value
$Inc_{ir^*, mn}$	=	Minimum value of Income Range *ir**
$Inc_{ir^*, mx}$	=	Maximum value of Income Range *ir**
$N\ Households_{ir}$	=	Total number of households in Income Range *ir**

The above steps produce an estimate of (1) the change in household income needed to qualify for financing to purchase the now-higher-priced housing unit and (2) the corresponding reduction in the number of households with income sufficient to be able to *just* purchase either the median- or lower-quartile housing unit in each MSA.

In performing these calculations, EPA recognized that, at any given time, the number of households that are actually "in the market" for purchasing a home is significantly less than the number of households in an MSA. EPA further recognized that the number of these households whose purchasing decision might be *practically* affected – i.e., seek to purchase a new single-family house whose price is affected by a given regulatory option – is smaller again than the number of households seeking to purchase a home. Accordingly, in developing the estimates of potentially affected households, EPA reduced the numbers of households by income range in the total MSA household income distribution to account for these considerations.

The only households that could *practically* experience an affordability effect from the regulation are those that are *in the market* for a newly, single-family home that would incur compliance costs under the regulation. To estimate the number of affected households, EPA first assumed that the potential market demand for new-construction single-family homes is essentially comprised of existing households who already own a single-family home. This reduced set of households *potentially in the market* actually understates the number of potential home buyers in any given year because it excludes non-homeowners (e.g., first-time home buyers). According to the 2006 American Community Survey, approximately 65.5 million households live in owner-occupied single-family households. EPA then compared the number of owner-occupied single-family households with data describing the annual sales of new single-family homes to estimate the number of new, single-family home sales per owner-occupied single-family household. The National Association of Realtors and the Census Bureau's *2006 Characteristics of New Housing* reported approximately 6.7 million sales of new and existing single-family homes during 2006. Therefore, based on EPA's assumption about households that comprise market demand for single-family homes, about 10 percent of all single-family homeowners were assumed to be in the market for a new or existing home during 2006. In addition, only about 15 percent (978,000) of the 6.7 million sales were sales of *new* single-family homes, implying a measure of about 0.015 new single-family home sales per owner-occupied single-family household (i.e., 978,000 new home sales/65,500,000 households).

The final step in this analysis is to further adjust the numerator in the above ratio to account for the fact that not all new single-family homes will be in-scope of the regulation and incur costs. To determine the number of new single family home sales that are expected to incur compliance costs, EPA estimated the percentage, for each regulatory option, of in-scope residential construction acreage to total residential construction acreage from the firm-level analysis (i.e., for businesses in NAICS sectors 236115, 236116, and 236117). These percentages were applied to the number of new single family home sales (978,000 in 2006) to estimate approximately the number of new, single-family homes likely to incur compliance costs under each regulatory option. From this calculation, the number of new, single-family homes that are in-scope and incur cost is estimated to be approximately 205,000 for Option 1, 513,000 for Option 2, and 879,000 for Option 3.

EPA then used these option-specific estimates of the numerator value – the number of in-scope single-family home sales estimated to be affected by the regulatory option – to determine the fraction of total households whose

purchasing decision could be practically affected by a regulatory option.[33] *Table 3-11* summarizes the calculation of the option-specific, in-scope multipliers. As shown in *Table 3-11*, the fraction of total households, by regulatory option, whose purchasing decisions and capability could be practically affected by the regulatory options is quite small – reflecting the considerations of likelihood (1) that the household would be in the market to purchase a home and (2) that the home purchased would be a new home that would incur costs (and price effect) under the C&D rule options.

Table 3-11: Multipliers for Determining the Number of Households with an Affordability Impact

Single Family Home Sales	6,700,000
New Single Family Home Sales	978,000
In-Scope New Single Family Home Sales	
Option 1	203,883
Option 2	453,715
Option 3	883,532
Owner-Occupied Single Family Households	65,500,000
Multiplier: In-Scope New Single-Family Home Sales per Single-Family Owner-Occupied Household	
Option 1	0.0031
Option 2	0.0069
Option 3	0.0135

In the analysis for each regulatory option, EPA used these fractions to calculate the number of potentially affected households by applying these option-specific multipliers to the estimated change – from baseline to post-compliance – in the number of households whose income is sufficient to purchase the median- and lower-quartile new single-family home.[34] *Chapter 5* reports the findings from that analysis by regulatory option.

3.5 Analysis of Social Cost

Markets vary in the level of activity, structure of the industry, and ultimately cost pass-through potential, from state to state and region to region. The modeling approach described in this section captures such regional variation in the impacts of the proposed regulatory options by estimating *partial equilibrium* (PE) models at the state level for each building construction sector (single-family, multi-family, commercial, and industrial).

EPA applied the PE models using national-level estimates of the elasticity of market supply and demand to estimate the impact of incremental costs on the supply curve and, thus, on prices and quantities of construction products under post-compliance conditions. In this framework, part of the increased costs may raise the price of new housing, with the balance of increased costs being absorbed by the builder, depending on the relative elasticities of supply and demand. A PE analysis assumes that the proposed regulation will only *directly* affect a single industry; in this case, the construction and development industry. Holding other industries "constant" in this way is generally appropriate since the compliance costs of the proposed regulatory options are expected to result in only marginal changes in prices and quantities and the Rule does not *directly* affect the other industries (HUD, 2006).

Economic impacts in the *directly* affected industry can trigger further output and employment effects in the broader U.S. economy via inter-industry linkages. For the industries *indirectly* affected by the proposed rule, a multi-sector input-output or general equilibrium modeling approach is more appropriate (HUD, 2006). A

[33] Ideally, this analysis would include the number of new home sales and owner-occupied units for both the single-family and multi-family residential sectors. However, the number of new home sales is only available for the single family residential sector. Since the data is not available to adjust the both the numerator and denominator, EPA opted to only include single-family residential sector data in the metric estimates.

[34] The multipliers are also applied to the figures in *Appendix 6-2,* which presents the results for the top 15 MSA's affected for each option.

traditional approach for assessing such cross-industry effects is the input-output (I/O) modeling concept. For its analysis of the C&D regulation, EPA used input-output-based multipliers to estimate the indirect impacts on economic output and employment in the broader U.S. economy. The PE analysis of state- and national-level economic impacts includes five broad steps:

1. Establish the baseline market equilibrium for each construction sector at the state-level
2. Establish the post-compliance market equilibrium for each construction sector at the state-level after accounting for compliance costs of the proposed regulatory options; this produces an estimate of the change in the quantity of C&D market output.
3. Estimate the total resource cost of the proposed regulatory options and the value of lost C&D output, after adjusting for the quantity effect of the proposed options, for each state.
4. Aggregate the resource cost (an increase in demand for society's resources) and lost economic output (a reduction in demand for society's resources) across states to obtain a national-level estimate of direct economic impacts; and,
5. Apply national-level *total requirements* multipliers, derived from national input-output tables, to the resource cost of the regulation and the direct change in C&D output to estimate the total inter-industry economic value and employment effects of the proposed options.

The remainder of this section is organized as follows:

- *Section 3.5.1* presents the methodology for estimating each PE market model;
- *Section 3.5.2* describes the data inputs employed;
- *Section 3.5.3* presents the methodology for estimating the resource cost of compliance, the value of lost C&D output, and the dead weight loss for each regulatory option; and

3.5.1 Description of the Partial Equilibrium C&D Market Models

This section describes the methodology for estimating the partial equilibrium market model; that is, the pre- and post-compliance market equilibrium for a given C&D sector. This methodology is applied separately to each building construction sector and estimated for each state within the four sector-specific models. Inputs to the partial equilibrium framework vary across construction sectors, and are discussed in *Section 3.5.2*.

3.5.1.1 Estimating the Baseline Construction Market Equilibrium

EPA assumes a linear partial equilibrium market model. The assumption that compliance costs of the proposed regulatory options will result in only small marginal changes in prices and quantities provides the basis for assuming that the supply and demand curves are linear in the relevant range of market effect. The data inputs required to estimate the baseline market equilibrium for each model include the baseline construction unit price (e.g., the price of a single-family home), the baseline quantity of construction activity (e.g., the number of new single-family housing units constructed), and the assumed elasticities of supply and demand for the construction sector being analyzed. The intersection of the baseline quantity and baseline price serves as the baseline market equilibrium.

The baseline supply curve for a given construction market in a given state can be approximated by:

$$Q^s = \alpha + \beta \mathrm{P} \qquad (13)$$

Where:

Q^s	=	Annual number of new construction unit permits issued
P	=	Price of a new construction unit
α	=	Intercept calibrated from the baseline equilibrium price and quantity $\left[= Q_0 - \beta P_0\right]$
β	=	Supply coefficient on price $\left[= E_s * \left(\frac{Q_0}{P_0}\right)\right]$
E_s	=	Supply elasticity of new construction units (> 0)

Similarly, the state-level baseline demand curve is given by:

$$Q^d = \sigma + \gamma P \tag{14}$$

Where:

Q^d	=	Annual number of new construction unit permits issued
σ	=	Intercept calibrated from the baseline equilibrium price and quantity $\left[= Q_0 - \gamma P_0\right]$
γ	=	Demand coefficient on price $\left[= E_d * \left(\frac{Q_0}{P_0}\right)\right]$
E_d	=	Demand elasticity of new construction units (> 0)

EPA assumes that the baseline condition for each market being analyzed is in equilibrium, and so, the initial *supply* and *demand* quantity values (Q^s and Q^d) in these two equations are equal.

3.5.1.2 Estimating the Post-Compliance Construction Market Equilibrium

The incremental unit cost of compliance to comply with the proposed regulatory options increases builders' costs and causes an upward shift the supply curve (and creating a new, "shocked" supply intercept). This shift drives changes in prices, which increase, and quantities, which decrease. A key assumption in the model is that the changes in production cost on the supply side are not enough to change the price elasticities or substitution on the demand side. In effect, the supply curve shifts by the amount of the per unit incremental compliance costs – including adjustments for debt cost and equity cost - without any change in the demand curve.

The post-compliance supply intercept (α_s) is given by:

$$\alpha_s = Q_0 - \beta(P_0 + ESC) \tag{15}$$

Where, ESC is the per unit incremental cost of compliance (marked-up by the project-level compliance cost multiplier to account for debt cost and equity cost considerations).

The new construction market price (P_N) is then given by:

$$P_N = \frac{\alpha_s - \sigma}{\gamma - \beta} \quad (16)$$

And the post-compliance equilibrium quantity is then recalculated using the new price:

$$Q_N^d = \sigma + \gamma P_N \quad (17)$$

The cost pass-through rate is the ratio of the elasticity of supply divided by the difference in the elasticity of supply and the elasticity of demand ($E_s/(E_s - E_d)$). The cost pass-through rate can also be calculated by dividing the change in the price of a construction unit in the market by the adjusted per unit incremental cost of compliance ($(P_N – P_0)/ESC$).

3.5.2 Inputs to the Partial Equilibrium C&D Market Models

EPA estimated the above partial equilibrium model for four building construction sectors: single-family residential, multi-family residential, commercial, and industrial construction. The data sources for each model are discussed in the sub-sections below.

3.5.2.1 Construction Market Quantity

Residential

The quantity of new residential construction in the single and multi-family construction sectors is measured by the number of new units authorized. The U.S. Census reports the number of new single and multi-family units authorized by permits on an annual basis at the state level. EPA used each state's average annual number of new single and multi-family housing units authorized for the years 2002 – 2007 as the measure of baseline quantity.

Non-Residential

Since the Census Bureau discontinued collection of non-residential building permit information in 1994, EPA sought an alternative measure of new non-residential construction activity to serve as the quantity metric for the PE models. In the absence of other information, EPA has opted to use the baseline average annual quantity of commercial and industrial acreage developed according to the NLCD data described in detail in *Chapter 4*. Referred to as the "top-down" estimate of developed acreage, the NLCD data indicate that approximately 590,000 acres of land are newly developed annually across all construction sectors (U.S. EPA, 2008). EPA interprets these data as representing the total quantity of acreage developed annually on sites of at least one acre and therefore potentially within the scope of the regulatory options that were considered in developing the C&D propose rule.

EPA used Notice of Intent (NOI) data for permits under the Stormwater Regulation to disaggregate the NLCD acreage among sectors and states (U.S. EPA, 2008). EPA spread the 590,000 total acres among three construction activity categories: (1) residential building, approximately 287,000 acres; (2) non-residential building, 248,000 acres, and (3) transportation, 55,000 acres. The NOI data were also used to estimate acreage, for the residential and non-residential building sectors, in two size categories that were important in defining and estimating the impact of regulatory options: (1) small projects – 1 to 10 acres; and (2) large projects – 10 or more acres. Additionally, state level breakouts were provided according to the NOI data.

To use the NLCD acreage estimates in this PE analysis required further disaggregating the state-level non-residential acreage values into the commercial and industrial sector. EPA based this *sector-level* disaggregation on information from the Census Bureau's 2006 *Characteristics of New Housing* and from Reed Construction Data.

The detailed methodology for establishing the baseline acreage for the commercial and industrial sectors is detailed in *Chapter 4*.

3.5.2.2 Construction Market Price

Residential

The state-level median price of new single-family homes serves as the baseline price in the single-family market model. The U.S. Census *American Community Survey 2006* reports the median price, at the state-level, for owner-occupied units constructed since 2005.

Separate price series for multi-family housing units are not reported by the Census. EPA instead calculated the ratio of multi-family housing unit prices to single-family housing unit prices using data available from the National Association of Realtors (NAR). The NAR's *Metropolitan Area Existing-Home Prices* data series includes data for existing single-family home sales as well as sales prices for condos by metro market. EPA calculated a weighted-average value of the ratio of multi-family unit prices to single-family unit prices of approximately 68%. This ratio was used to adjust the state-level median single-family home price series published by the Census to approximate 2006 multi-family unit prices for each state.

Commercial

Rental rates, in dollars per square foot per year, are closely watched indicators of demand for commercial space and serve as the price for the commercial market model.

Grubb & Ellis reports rental rates for Class A and Class B office space for 75 metropolitan areas in the United States (Grubb & Ellis, 2007). Rental rate data refer to asking rents for space that is available on the market at the end of the third quarter of 2007. Rates are per square foot, quoted on an annual basis. Rates for each available suite are weighted by the size of the building in which the suite is located. Grubb & Ellis adheres to the BOMA[35] guidelines for office building classifications. Class A properties are the most prestigious buildings competing for premier office users with rents above average for the area, Class B properties compete for a wide range of users with rents in the average range for the area, and Class C buildings (not reported) compete for tenants requiring functional space at rents below the area average.

Grubb & Ellis also reports rental rates for retail market space in 51 metropolitan areas in the United States (Grubb & Ellis, 2007). Rental rate data refer to in-line shop space in a grocery-anchored center, 3,000-square-foot national credit tenant, newly developing suburban trade area, first generation space, white-box build-out. Rates are per square foot, quoted on an annual basis.

EPA estimated the average commercial space rental rate in each state as the average of Class A, Class B, and retail rates across all of the metropolitan areas reported for each state. EPA used the average rental rate for other states in the same Census division for states for which no metropolitan areas are reported. There are 15 states with no reported data: Alaska, Arkansas, Hawaii, Iowa, Kentucky, Louisiana, Maine, Mississippi, North Dakota, Rhode Island, South Dakota, Utah, Vermont, West Virginia, and Wyoming.

In order to use this data describing the average "annual rental rate per square foot per year" as the metric of the price of commercial space in the PE model, EPA had to convert this rate into units of "annual rental rate per acre per year." This is required because EPA is using the quantity of commercial acreage developed per year as the quantity metric. To convert the "per square foot" value for commercial space into a "per acre" value, EPA used the Reed Construction database to estimate the average quantity of commercial square footage constructed on any

[35] BOMA was formerly known as Building Owners and Managers Association (http://www.boma.org)

given acre land developed for commercial purposes. This value, estimated to be approximately 14,200 square feet per acre, is multiplied by the Grubb & Ellis rental rate to estimate an annual commercial rental price per acre per year for each state.

Industrial

Rental rates, in dollars per square foot per year, are closely watched indicators of demand for industrial space and serve as the price for the industrial market model.

Grubb & Ellis reports rental rates for industrial space classified as "warehouse-distribution" or "R&D-flex" in 69 and 66 metropolitan areas in the United States, respectively (Grubb & Ellis, 2007). Rental rate data refer to space that is available on the market at the end of the third quarter 2007. Rates for available space are expressed in dollars per square foot per year in most parts of the country and dollars per square foot per month in areas of California and selected other markets. EPA is working to identify the specific markets in which the data are reported on a monthly basis so that we can convert the values to an annual basis.

EPA estimated the average industrial space rental rate in each state as the average of the two data series across all of the metropolitan areas reported for each state. EPA used the average rental rate for other states in the same Census division for states for which no metropolitan areas are reported. There are 17 states with no reported data: Alaska, Arkansas, Connecticut, Hawaii, Iowa, Kentucky, Louisiana, Maine, Mississippi, New Hampshire, North Dakota, Rhode Island, South Dakota, Utah, Vermont, West Virginia, and Wyoming.

As with the commercial rental price data, in order to use this data describing the average "annual rental rate per square foot per year" as the metric of the price of industrial space in the PE model, EPA had to convert this rate into units of "annual rental rate per acre per year." This is required because EPA is using the quantity of industrial acreage developed per year as the quantity metric. To convert the "per square foot" value for industrial space into a "per acre" value, EPA used the Reed Construction database to estimate the average quantity of industrial square footage constructed on any given acre land developed for industrial purposes. This value, estimated to be approximately 12,700 square feet per acre, is multiplied by the Grubb & Ellis rental rate to estimate an annual industrial rental price per acre per year for each state.

3.5.2.3 Incremental Compliance Cost Effect per Construction Unit

Each state-level construction market is shocked with the estimated compliance costs associated with the proposed regulatory options. The residential PE market models require compliance costs on a per-construction-unit basis in order to be consistent with the measures of price and quantity in the market models. In addition, the incremental compliance costs per construction unit must be adjusted to account for the additional costs beyond the direct compliance outlay (e.g., cost of financing) associated with each unit of construction. Consequently, the final magnitude of the shift in the supply curve for each construction market will be greater than simply the incremental compliance costs for a given residential unit or non-residential acre. The non-residential PE market models require compliance costs in terms of a per-acre annual rent-recovery value since the price metric is rent per acre and the quantity metric is acres of non-residential development. These compliance cost concepts are detailed below.

Residential

The total state-level dollar value of price effect per housing unit (i.e., the magnitude of supply curve shift) in the single and multi-family market models is measured by the adjusted incremental compliance cost per unit of single or multi-family housing. The price effect for each state is given by:

$$ESC = \left(\frac{IC_{acre}}{Units_{acre}} \right) * COST_x \quad (18)$$

Where:

IC_{acre} = State-specific incremental compliance cost per acre for the specified construction sector and regulatory option

$Units_{acre}$ = Estimated number of housing units per acre, as determined in the project-level analysis for single and multi-family construction sectors

$COST_x$ = Indirect project cost multiplier from the project-level analysis framework, which indicates the dollar change in the price of a housing unit for each dollar of incremental compliance cost, after accounting for overhead, debt cost, and equity cost considerations.

Non-Residential

The total state-level dollar value of price effect (i.e., magnitude of supply curve shift) in the commercial and industrial market models needs to be a measure of the incremental increase in the annual rental price for an acre's-worth of new commercial and/or industrial space, given the price and quantity metrics previously outlined. EPA therefore converts the non-residential incremental compliance cost per acre for each state and regulatory option into an annualized value to be recovered through rent over the useful life of the commercial or industrial property. This approach is appropriate because the developer of new commercial or industrial space will not attempt to recover the entirety of the incremental compliance cost *every* year, nor will the developer attempt to recover the cost though a *single* year's rental fee since that could presumably increase the rental price to such an extent that the property is less attractive relative to other available properties for potential renters.

EPA calculates the annual compliance cost recovery value for each state and option by amortizing the incremental per-acre cost assuming a 20-year recovery period, a 7% cost of debt, 13.54% cost of equity, and 75% loan-to-value ratio (i.e., 75% of the cost is financed through debt, 25% using developer equity). Such expenditures on non-residential property development would be depreciated over a 39-year useful life; however, EPA has alternatively assumed a more aggressive 20-year recovery period to be conservative in the analysis.

3.5.2.4 Elasticity of Supply

A review of the literature indicates that, in contrast to demand elasticity research, less is known about the behavior of supply (HUD, 2006). There are three key empirical difficulties identified in the housing supply elasticity literature. First, estimated housing supply elasticities vary widely. Second, price does not seem to be a sufficient statistic, and other market indicators are quite important in explaining supply (e.g., land availability, land-use and other regulatory restrictions, and demographic characteristics). Third, construction levels seem to respond quite sluggishly to construction costs and output prices (DiPasquale, 1999; Hwang and Quigley, 2006; Green, Malpezzi and Mayo, 2005).

EPA's review of the literature indicates that the supply of residential and non-residential construction space is generally elastic, although there can be significant variability across specific markets or regions. For example, an MSA-level analysis of residential supply elasticity found statistically significant elasticity values ranging from 1.43 – 21.6 (Green, Malpezzi and Mayo, 2005). Green, Malpezzi and Mayo (2005) estimate separate supply elasticities for individual U.S. Metropolitan Statistical Areas (MSAs) using annual data for 45 MSAs and over 18 years (1979-1996). Their analysis developed 45 first-stage regressions to recover supply elasticities for the MSAs, where the dependent variable in each regression is the number of housing units for which building permits were issued, multiplied by an average household size of 2.5, divided by population (e.g., %DQ) and the independent

variable is the lagged first difference in the natural logs of the Fannie Mae repeat-sales index of house prices for the MSA. The resulting estimated supply elasticities were found to be statistically significant and greater than zero in 22 of 45 cases. Based on the results in Green, Malpezzi and Mayo (2005), EPA assumed that 4.01 is a reasonable assumption for the price elasticity of residential supply.

For non-residential construction, EPA has referred to the analysis of Benjamin, Jud, and Winkler (1998), which similarly analyzed price elasticity at the MSA-level. Their analysis employed data for 19 MSAs covering years 1986 – 1995. Based on the statistically significant results of Benjamin, Jud and Winkler (1998), EPA has assumed a non-residential price elasticity value of 0.49.

3.5.2.5 Elasticity of Demand

Estimates of the price elasticity of demand for both residential and non-residential construction are more consistent within the literature relative to estimates of the price elasticity of supply. A key factor that determines demand elasticity in a given market is the availability of close substitutes. If a homebuyer has the option of substituting existing housing, rental housing, other new housing, or manufactured housing, demand will be relatively more elastic. On the other hand, housing is a necessity, which tends to make demand inelastic (HUD, 2006). A review of the literature indicates a somewhat inelastic demand for new housing and non-residential space (HUD, 2006; DiPasquale, 1999; Benjamin, Jud and Winkler, 1998), ranging nationally from about -0.1 to -1.0. Based on the literature, EPA has assumed a residential price elasticity of demand of -0.7, and a price elasticity of non-residential demand of -0.2.

3.5.3 Estimating the Resource Cost, Deadweight Loss, and Output Loss Due to the Proposed Rule

Section 3.3 – Analysis of Firm- and Industry-Level Economic Impacts described EPA's estimation of the *first order* resource cost of compliance within each C&D industry sector and for each of the proposed regulatory options. This estimate of resource cost produced in the firm-level analysis, however, does not account for the potential affect of the proposed options on the quantity of construction activity/units performed in the various C&D markets. The PE analysis considers the potential for the proposed regulatory options to shift the supply curve up in each market (i.e., via increased production costs), resulting in a higher price per unit and, depending on market response, a lower quantity of output. A primary output of the PE analysis is to estimate the change in market quantity expected on average in each market. EPA estimated this quantity-effect using the methodology outlined above for calculating the pre- and post-compliance market equilibrium. The estimated change in quantity is then used not only to adjust the firm-level resource cost for the quantity-effect of the regulation, but also to compute the direct output (revenue) changes in the construction industry sectors themselves. The resource cost and output loss, in turn, have ripple effects in the rest of the economy, which are measured using input-output multipliers developed by the Bureau of Economic Analysis in *Section 3.6*.

3.5.3.1 Estimating Resource Cost and Deadweight Loss

Adjusting the firm-level estimation of resource cost for the anticipated C&D market-effect of the proposed regulatory options is relatively simple. EPA reduces the state-level estimate of resource cost from the firm analysis by the anticipated percentage change in the quantity of output with each state estimated by the PE market model.

$$RC_{Adj} = \%\Delta Q * RC_{Un-adj} \quad (19)$$

Where:

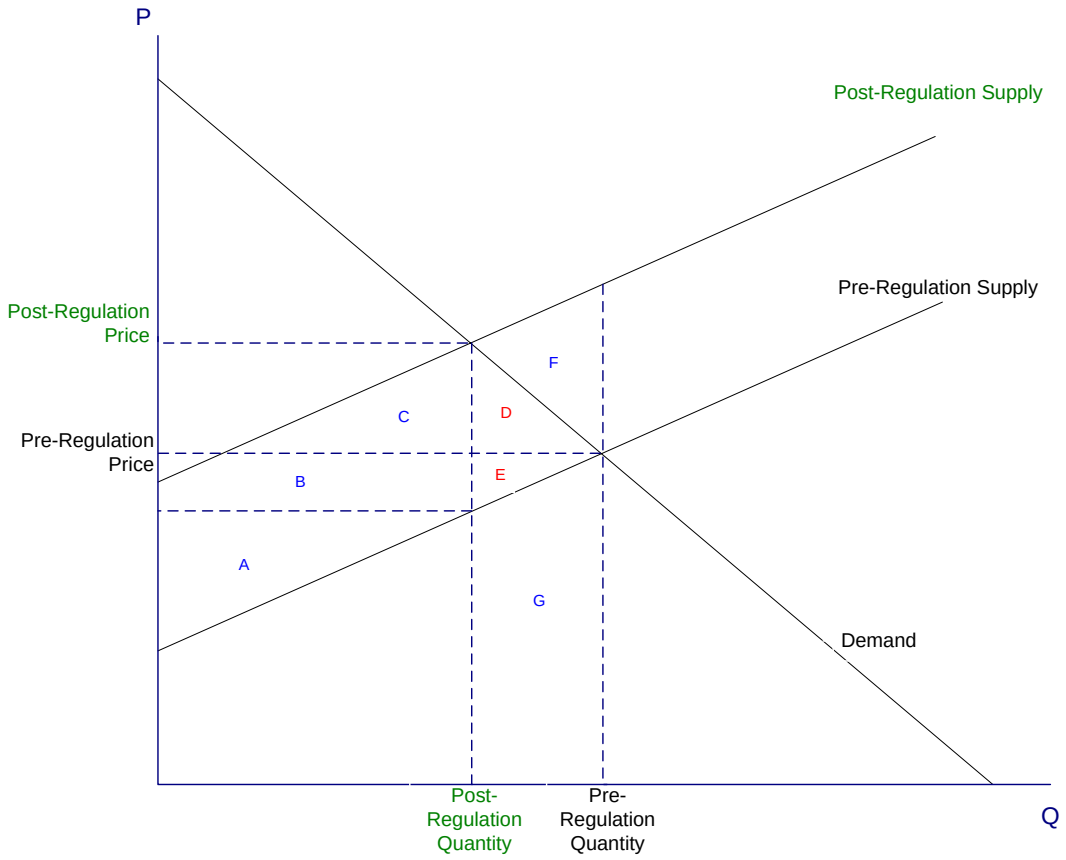
RC_{Adj}	=	Market-effect adjusted measure of resource cost in each state and market
$RC_{Un\text{-}adj}$	=	Unadjusted, firm-level measure of resource cost in each state and market
$\%\Delta Q$	=	Percentage change in state-level quantity of construction from baseline to post-compliance from the PE analysis

The diagram below (which exaggerates the magnitude of the market impact for purposes of illustration) shows conceptually these alternate measures of resource cost. The firm-level analysis previously outlined is essentially estimating a measure of resource cost equal to the sum of area A, B, C, D, E, and F in the diagram; it is a measure of resource cost that assumed the quantity of C&D industry output does not change as a result of the cost of the proposed rule. However, the PE analysis indicates that, given the relationship between supply and demand, the upward shift in the supply curve in a given C&D market will result in a post-compliance market equilibrium with a lower quantity of production, and each unit of production has a higher price. Therefore, the true resource cost of compliance, accounting for this quantity-effect, is the sum of areas A, B, and C. The difference between the un-adjusted and adjusted measure of resource cost is captured by the sum of areas D, E, and F. Areas D and E represent the deadweight loss (DWL) of the proposed rule for a given C&D sector, which is simply one-half of the sum of areas D, E, and F since EPA has assumed linear supply and demand curves in the PE model.

The PE model has a number of implications for the welfare of society. When the supply curve shifts as a result of incremental compliance costs, consumers lose some of their benefits from the product in absorbing those compliance costs. The result is a change in consumer surplus, part of which eventually makes its way to the entities whose services are purchased to implement the requirements of the rule, and part of which becomes the consumer contribution to the dead weight loss of the proposed rule. There is also a change in producer surplus. Some producer surplus is similarly transferred to other producers whose services are purchased to implement the regulation due the partial absorption of compliance costs, and another portion of producer surplus is contributes the dead weight loss of the rule.

EPA estimates the adjusted resource cost and DWL for each C&D building sector, state, and proposed regulatory option. EPA assumes inelastic demand in the C&D non-building sector, and therefore assumes no quantity effect or DWL and uses the firm-level analysis measure of resource cost for the non-building sector. The sum of resource cost and DWL across all states and C&D markets is the total social cost of the regulation[36].

[36] Traditionally the social cost would also include government administrative and monitoring costs; however EPA does not expect any additional administrative or monitoring costs associated with the proposed rule.



3.5.3.2 Estimating the Loss in C&D Output

EPA estimates the state-level change in C&D industry revenues for each of the four C&D building sectors by multiplying the baseline construction unit price by the difference between the pre- and post-compliance quantity of construction units:

$$R_{loss} = \Delta Q * P_0 \quad (20)$$

Where:

R_{loss}	=	Decline in revenue for the C&D sector in a given state
ΔQ	=	Change in state-level quantity of construction from baseline to post-compliance ($Q_N - Q_0$)
P_0	=	Baseline state-level construction unit price

The sum of the C&D output loss across all states and C&D markets is the total value of output loss associated with each regulatory option.

3.5.3.3 Price-Effect in C&D Markets

As noted above and illustrated in the above figure, the PE analysis indicates that, given the relationship between supply and demand, the upward shift in the supply curve in a given C&D market will result in a post-compliance market equilibrium with a *lower quantity of production*, and a *higher price per unit* of production. It is important to note, however, that the expected increase in market price is actually *less than* the magnitude of the vertical shift in the supply curve. The supply curve shifts upward by the amount of the per unit compliance cost, but – as seen

the figure above – the supply and demand elasticity responses to this compliance cost result in a quantity-reduction that causes the price to ultimately rise by less than the amount of compliance cost.

In the following section, the aggregate measures of C&D output loss and total resource cost are separately analyzed in an input-output framework to estimate the total (e.g., direct and indirect) economic impacts of the proposed regulatory options.

3.6 Analysis of Economy-Wide Economic Effects

There are also economy-wide effects that arise from both the resource cost of compliance outlays and the direct decrease in C&D industry output loss estimated for each regulatory option. The resource cost outlays to comply with the proposed rule will require the production of services from those sectors that provide the services needed for compliance. Those sectors, in turn, require inputs from a myriad of other sectors to produce any given unit of output. The increased economic activity derived from the outlays required for compliance should be thought of as the total increase in the demand for society's resources necessary for compliance to occur, where, the value-added component of all the increased activity is equal to the resource cost of compliance. Although this value is a positive number, it is not a "benefit" of the rule, but rather, a measure of the sum of inter-industry transfers that arise from the compliance outlays required by the regulation.

The loss in C&D industry output also produces inter-industry economic effects. In this case, the reduction in C&D output means fewer materials and services are required from sectors in the economy that typically provide inputs to the C&D sector. Those sectors, in turn, require fewer inputs from the sectors that supply them. It is important to emphasize that neither set of inter-industry economic effects (i.e., resource cost-*related* or output loss-*related* impacts) is the social cost of the regulation. Rather, these effects are manifestations of social cost.

3.6.1 Economy-Wide Economic Effects Arising from Resource Cost of Compliance Outlays

3.6.1.1 Resource Cost Impacts on Economic Output

The resource cost of compliance represents the dollar value of goods and services that will be purchased from sectors that make or install the environmental controls or provide other services related to regulatory compliance. EPA estimates that approximately 45% of these services will be provided by engineering service firms, 40% will be provided by firms related to the production or rental of water treatment equipment, and about 15% of the resource cost will be used to purchase chemicals for treatment.

As the first step in estimating the inter-industry output impacts of each option, EPA allocated the total estimated resource cost for each option to these three key industries. EPA next used total requirements I-O multipliers from BEA for these three key industry sectors to estimate the total economy effects of the purchases of goods and services required for regulatory compliance.[37] BEA's total requirements multipliers show the dollar value of inputs required by each of these three industries from 66 other industries in the national economy to produce a dollar of output. Multiplying the vector of I-O multipliers for each key industry sector by its assigned proportion of resource cost yields the total value of economic activity associated with providing the services necessary for compliance with the option being analyzed. The sum of the multiplier effects across the three key industry sectors is the aggregate, national inter-industry economic output effect due to the resource cost of the regulation. Since

[37] EPA "mapped" these three key industry sectors to BEA's industry definitions by selecting the Professional, Scientific, and Technical services industry to represent the engineering service firms, the Chemical Production industry to represent the chemical purchases, and the Machinery Manufacturing industry to represent the water treatment machinery required by the proposed options.

the regulatory options *require* outlays and additional economic activity from society, this is a positive number (but not a benefit).

3.6.1.2 Resource Cost Impacts on Employment

EPA also estimated the potential number of jobs that might be associated with the additional economic activity required to produce the services for regulatory compliance. To estimate the potential employment effects, EPA required two sets of data for the three key industry sectors:

- BEA direct requirements I-O multipliers for employee compensation, which indicate the dollar value of employee compensation required from industries that provide inputs to the three key industry sectors in order for the key industry sector to produce a dollar of output.
- Economic Census data for all industries indicating the number of employees in the industry for every dollar of employee compensation.

To estimate the number of jobs potentially affected by each option, EPA first converted the economic output multiplier effect in each industry into an equivalent employee compensation value using the direct requirements multipliers. Next, EPA converted the dollar value of employee compensation into a quantity of jobs using the Economic Census data multipliers. These economy-wide employment effects that stem from the resource cost of regulatory compliance should not be interpreted as a benefit of the regulation. These employment effects are simply another way of representing the cost of the rule. That is, the employment effects reflect the labor requirements – both in the directly affected industries and economically linked industries – of supplying the goods and services that are needed for regulatory compliance.

3.6.2 Economy-Wide Economic Effects Arising from the Direct Loss in C&D Industry Output

The compliance-induced reduction in C&D output means that the C&D industry purchases fewer inputs from other economic sectors compared to the pre-compliance level of activity. The value of this reduction in purchases from other sectors is represented by the direct change in C&D output calculated above in *3.5.3.2*. When the C&D industry reduces the value of purchases from other sectors, those sectors, in turn, require fewer inputs from the sectors that supply them.

EPA estimated the national, inter-industry economic output and potential employment impacts associated with the direct reduction of output in the C&D industry using the same methodology as *3.6.1*, except that this analysis uses multipliers for the C&D industry itself. The resulting measures of inter-industry economic activity and number of jobs are *negative* numbers since they are associated with a reduction in economic activity. This total economy effect represents the total *reduction* in demand for society's economic resources resulting from the estimated contraction in C&D industry output.

3.7 Future Projections of Compliance Cost and Acreage

As previously documented in this chapter and *Chapter 2 – Economic Profile of the Construction and Development Industry*, EPA's primary economic analysis is performed for a single industry snap-shot year, 2002. As a result, the magnitude of compliance cost and acreage developed from the economic analysis described thus far in this chapter reflect the level of activity in the C&D industry during 2002. The purpose of this section is to outline EPA's approach for projecting forward the estimated quantity of compliance acreage – and therefore, cost – to more accurately reflect the industry's anticipated activity level during 2010, when the rule begins, and beyond. In so doing, EPA also takes into consideration the expected "phase-in" of compliance across over the first five years after promulgation as states renew their Construction General Permits (CGP) over the five years

following rule promulgation (i.e., not all states will renew their CGP during 2010; compliance will therefore phase in from 2010 through 2014).

Overall, the construction industry is expected to experience continuing weakness until residential markets work through the current inventory of unsold homes and credit markets and the general economy returns to a better condition. Nevertheless, as previously summarized in the profile chapter, recent forecasts suggest that the industry will return to better performance during 2010 – 2011 timeframe.

3.7.1 Projecting Aggregate C&D Industry Activity into the Future

To project forward the expected compliance acreage and cost from the year 2002 to 2010 and beyond, EPA began with the time series of the total value of construction (in constant 2008 dollars) developed in the profile chapter. This time series is based on data from the BEA up to the year 2006 and industry forecast data from Global Insight for years 2007 through 2012 (BEA 2008b and 2008c and Global Insight January 2008). The other key required parameter for this projection is the total quantity of developed acreage in the base year, 2002, which is estimated from NLCD data to be approximately 590,000 acres (see *Chapter **4*** for additional detail on how this baseline acreage value was developed).

Using the aggregate industry data for 2002 (e.g., total value of construction and quantity of acreage), EPA estimated an acreage intensity value for 2002 by dividing the quantity of developed acreage by the total value of construction. Acreage intensity is interpreted as the quantity of acreage developed per dollar of construction value. As the next step in developing the projection of industry activity, EPA estimated the time series of developed acreage that aligns with the time series of the value of construction from 2002 to 2012. EPA estimated the quantity of acreage developed in each year from 2002 to 2012 by multiplying the base-year acreage intensity value by the total value of construction. This calculation assumes acreage intensity is constant over the time period 2002 to 2012. Next, EPA extended this time series of aggregate industry construction value and compliance acreage to the year 2025. EPA extended the time series by assuming a uniform annual growth rate in aggregate construction value from 2012 to 2025 of 2.7% per year. This value is based on the industry's long-term average annual growth rate of construction value from Census' value of construction data for the period 1964 to 2007. After projecting construction value to 2025, EPA then estimated the quantity of developed acreage in each year continuing to assume constant acreage intensity (i.e., construction value times acreage intensity equals acreage).

The resulting time series of aggregate industry activity is presented in *Table 3-12*.

Table 3-12: Total Value of Construction and Quantity of Acreage by Year, 2002 – 2025* (millions of $2008)

Year	Total Value of Construction	Year-to-year Percent Change	Total Estimated Acreage	Year-to-year Percent Change
2002	$1,203,139	--%	589,922	--%
2003	$1,242,853	3.3%	609,394	3.3%
2004	$1,306,287	5.1%	640,497	5.1%
2005	$1,349,660	3.3%	661,764	3.3%
2006	$1,345,681	-0.3%	659,813	-0.3%
2007	$1,269,728	-5.6%	622,572	-5.6%
2008	$1,149,807	-9.4%	563,772	-9.4%
2009	$1,155,151	0.5%	566,393	0.5%
2010	$1,214,460	5.1%	595,473	5.1%
2011	$1,283,936	5.7%	629,538	5.7%
2012	$1,316,002	2.5%	645,261	2.5%
2013	*$1,351,038*	*2.7%*	*662,440*	*2.7%*
2014	*$1,387,007*	*2.7%*	*680,076*	*2.7%*
2015	*$1,423,934*	*2.7%*	*698,182*	*2.7%*
2016	*$1,461,844*	*2.7%*	*716,770*	*2.7%*
2017	*$1,500,764*	*2.7%*	*735,853*	*2.7%*
2018	*$1,540,719*	*2.7%*	*755,444*	*2.7%*
2019	*$1,581,738*	*2.7%*	*775,556*	*2.7%*
2020	*$1,623,850*	*2.7%*	*796,204*	*2.7%*
2021	*$1,667,082*	*2.7%*	*817,402*	*2.7%*
2022	*$1,711,466*	*2.7%*	*839,164*	*2.7%*
2023	*$1,757,031*	*2.7%*	*861,506*	*2.7%*
2024	*$1,803,809*	*2.7%*	*884,442*	*2.7%*
2025	*$1,851,833*	*2.7%*	*907,989*	*2.7%*

* Data for 2002 – 2006 are from U.S. BEA, 2007 – 2012 are projections from Global Insight, and 2013 – 2025 are EPA projections.
Source: EPA Analysis

3.7.2 Projecting Total Social Cost and Compliance Acreage into the Future

EPA used the above data along with the estimated total social cost and compliance acreage estimates based on the 2002 industry snap-shot for each regulatory option to estimate social cost and compliance acreage from 2010 to 2025.

The first step in the cost projection analysis for each option is to estimate the total social cost and compliance acreage for each year from 2010 through 2014 *based on the 2002 snap-shot of industry activity*. These estimates of social cost and acreage are produced using the same firm-level, and subsequently, social cost analysis methodologies described in *Sections 3.3 and 3.5.* EPA used the firm-level and social cost analysis methodologies along with specific information about which states come into compliance during each year from 2010 to 2014 to produce these annual estimates of cost and acreage – again, based on 2002 industry activity.[38]

The next step in the analysis is to scale up the estimated social cost and acreage in 2010 to 2014 to account for the anticipated change in industry activity between 2002 and those future years. These values were estimated by multiplying the 2002-based social cost and compliance acreage – for each year 2010 – 2014 – by the percentage change in total construction value and developed acreage from 2002 to each projection year. EPA essentially scaled the social cost and compliance acreage in any given year in proportion to the total *value of construction* and *developed* acreage in that year. For example, social cost in 2010 *adjusted for the expected level of industry activity in 2010*, is calculated as follows:

[38] EPA expects that costs will "phase in" over the first five years after promulgation as states renew their CGPs over the five years following rule promulgation (i.e., not all states will renew their CGP during 2009; compliance will therefore phase-in from 2009 through 2013).

$$SC2009_{2009} = SC2009_{2002} * \left(\frac{CV_{2009}}{CV_{2002}} \right) \quad (21)$$

Where:

$SC2010_{2010}$	=	Projected social cost in 2010, reflecting 2010 industry snap-shot
$SC2009_{2002}$	=	Projected social cost in 2010, reflecting 2002 industry snap-shot
CV_{2010}	=	Projected total construction value in 2009
CV_{2002}	=	Total construction value in 2002

EPA used this approach to adjust the 2010 – 2014 social cost and acreage estimates to adjust for the expected change in industry activity from 2002 to each of those five respective years. This process resulted in estimates of total social cost and compliance acreage for 2010 – 2014 that properly reflect the anticipated phase-in of states – where 2014 is the first year of 100% compliance – and changes in aggregate C&D industry activity.

Using estimated social cost and acreage for 2014 as a starting point, EPA then projected social and acreage out to the year 2025 using the same general approach. That is, scaling cost and acreage in any given year in proportion to the percentage change in the value of construction and developed acreage from 2014 to that year.

Lastly, EPA estimated the annualized value of social cost over the period 2010 – 2025 using both 3% and 7% discounting rates.

3.8 Key Sources of Uncertainty and Limitations

This section highlights the primary sources of uncertainty and limitations in the cost and economic impact analysis approaches presented in this chapter. The review of these uncertainties and limitations is organized according to the analysis concept to which they refer. This section is not intended to be an exhaustive re-iteration of all assumptions and potential sources of error introduced into the analysis, but rather, to highlight those that EPA judges to be of most consequence.

3.8.1 Analysis of Project-Level Costs and Economic Impacts

- ***Determinants of the Compliance Cost Multiplier*.** The parameters that determine the project-level compliance cost multiplier is substantially uncertain (see *Section 3.2.3.2*). The multiplier represents a mark-up, per dollar of compliance, and is determined by the financing terms specified for the model projects, including:
  - Debt cost
  - Equity cost
  - Loan to value ratios, and
  - Durations of each phase of development and the associated financing for these phases.

  To the extent that these parameters vary from the model parameter values for actual in-scope construction projects, EPA may be overstating or understating the cost multiplier.

3.8.2 Analysis of Firm- and Industry-Level Economic Impacts

EPA has addressed some of the key uncertainties present in the firm and industry level analysis economic analysis for the proposed rule by performing this analysis under two plausible alternative assumptions of business

conditions for C&D firms and the overall industry: the *primary analysis case* and the *adverse analysis case* (see *Section 3.3.4.1*).

However, *within both of these overall analysis configurations*, additional key sources of uncertainty and limitations remain. EPA is continuing to acquire data and develop analysis approaches to address the remaining uncertainties to the extent possible. These uncertainties and considerations are summarized below with reference to the more detailed discussions in previous sections of this chapter for more information:

- ***Determination of In-Scope Model Firm Revenue and Construction Activity.*** Four key sources of uncertainty affect EPA's determination of the fraction of firm revenue and construction activity estimated to be in-scope of the regulation:
  - ***The Likelihood that Firms' Activities Would Incur Direct Compliance Costs.*** There is uncertainty with respect to the business configurations for performance of construction projects in which the rule will impose *direct costs* on C&D firms. Large construction projects, in particular, can be performed by multiple firms and those firms can be organized in multiple business configurations for any given project. For example, a single developer can sell "pieces" of a project to other independent firms. Under this configuration, the single developer would incur the *direct* costs of the regulation (the subsequent lot purchases may then incur *indirect* costs via cost pass through from the developer). Or, a configuration could exist where several firms undertake a project as a partnership, where all of the firms "share" the *direct* cost of the regulation in some way. Lacking information on the distribution of business configurations for projects undertaken by firms in the various C&D sectors and revenue ranges, it is inherently difficult to account for these scenarios. As a result, EPA may be overestimating or underestimating the *baseline fraction of model firms' activity and revenue that could incur direct costs* under the regulation (see *Section 3.3.3*).
  - ***The Type of Construction Activity Performed by C&D Firms***. There is uncertainty with respect to the fraction of C&D firm revenue that is generated from potentially in-scope activities (i.e. *new* construction) versus revenue generated from activities that are not potentially in-scope (i.e. *additions or remodeling work*). When the Economic Census assigns C&D firms to NAICS industry sectors, they are assigned into the sector from which the majority of their revenue is generated, and therefore, not all firm revenue is necessarily associated with activity in their assigned sector. For example, a firm assigned to NAICS 236115 generates at least 51% of its revenue from *New Single-Family Residential Construction*, but *as much as* 49% of the firm's revenue could come from construction activities, such as remodeling, that would not be in-scope. EPA currently accounts for this concept using the C&D sector specialization data available from the 2002 Economic Census. There is uncertainty in the specialization data because it is only an average representation of the fraction of new construction activity undertaken by firm in a given sector. Some firms within a sector perform a higher fraction of new construction activity, while some firms likely perform a lower fraction. This uncertainty could be partially mitigated by obtaining data from the Census that characterize the average/typical "specialization" of firm activities within each NAICS sector *and by revenue range* (see *Section 3.3.3*).
  - ***The Number of Projects Typically Completed Annually by C&D Firms***. EPA determined whether C&D firms, by sector and revenue range, are of sufficient size to perform an in-scope project (using the *critical revenue value* method described in *Section 3.3.3*) based on the assumption that *all* of a model firm's revenue would be associated with only *one project* in a given year. This assumption was made because EPA currently lacks information on the distribution of projects, by site size, undertaken annually by firms in each revenue range and sector. EPA may therefore be overstating the fraction of firms, by sector and revenue range, that are capable of performing in-scope activities to the extent that firms typically engage in more than one construction project per year. This assumption effectively

minimizes the number of in-scope firms needed to achieve the aggregate estimates of in-scope construction acreage and associated compliance cost, and simultaneously maximizes the impact per firm. This uncertainty could be mitigated by obtaining data on the distribution of projects, by number and value, which firms engage in annually by sector and revenue range. EPA could then assess cases in which compliance costs and acreage are spread across a larger number of firms and where the impact per firm is reduced relative to the current analysis configuration.

- ***The Distribution of Firms within Revenue Ranges.*** In instances where the critical revenue value lies within a revenue range, the fraction of firms estimated to be capable of performing in-scope activities – and their associated in-scope project acreage – are calculated using the assumption that *firms by revenue are distributed uniformly over the revenue range*. This assumption is likely to overstate the fraction of firms within a given revenue range that can perform in-scope activities because for all but the lowest revenue range, firms are *not* likely to be distributed uniformly within the revenue range, but instead their mass is likely to be concentrated at the lower end of the range.

- ***Determination and Interpretation of Firm Financial Stress and Potential Closure.*** EPA's analyses of the occurrence of financial stress and potential closures are based on movement of firms below specified thresholds of concern – below first quartile values of the financial stress measures and below a zero business value for the potential closure measure. Because of data limitations, in particular, these analyses involve considerable simplifications both in determining the baseline and post-compliance financial performance/condition measures and in assessing the occurrence of the adverse impact conditions. A more rigorous financial analysis, based on detailed understandings of the financial status of affected firms might yield different impact findings. For example, the analysis of business value is based on a static, single time period, model of firm financial performance and condition. A more rigorous analysis would consider the change in financial performance and condition over time. For firms with a history and expectations of substantial growth, the simplified, static assessment would tend to understate, perhaps considerably, business value. Similarly, the use of the first quartile values of *Pre-Tax Income/Total Assets* and *Earnings before Interest and Taxes/Interest* for use in the financial stress analysis is also subject to considerable uncertainty. Although the first quartile values are, by definition, in the lower range of observed financial performance for the subject industries, the first quartile values are not necessarily strong differentiators between adequate and weak financial performance. EPA sought to ameliorate this concern by using the average of first quartile values observed over the full data analysis period (see *Section 3.3.5.1*).

- ***Determination of Barriers to Entry.*** There is uncertainty with respect to the model firm's mechanism for absorbing compliance outlays. The comparison of the rule's financing requirement to the model firm's assets assumes that the compliance outlay would be financed and recorded on the model firm's balance sheet. To the extent that the compliance outlay is financed and recorded *not on the firm's baseline sheet but as part of a separate project-based financing for each individual project*, this comparison is likely to overstate, perhaps substantially, the incremental burden of financing in relation to the going concern asset base of the model firms (see *Section 3.3.6*).

3.8.3 Analysis of Single-Family Housing Affordability Impacts

The single-family housing affordability analysis likely overstates the practical impact on home buyers prospectively purchasing an in-scope home because purchasers have a number of avenues through which any price increase due to the regulation might be mitigated:

- ***Price negotiation.*** The home buyer may be able to offset the price increase through negotiation of the sales price.

- ***Attribute substitution.*** The home buyer may be able to mitigate the effect of the price increase through substitution (e.g., purchasing a new home with marginally different attributes, or effectively the same new home in a marginally different location).
- ***Purchase deferment.*** The home buyer may be able to mitigate the effect of the regulation by increasing the down payment so that the there is no change in what would have otherwise been the monthly payment. If the home buyer lacks the financial resources to increase the down payment *at the preferred time of purchase*, the increase in the down payment might be achieved by delaying the purchase and saving from current income to reach the needed down payment value.
- ***Purchase an out-of-scope home.*** Each of the preceding adjustments involves changes to purchase the desired new, in-scope home. However, the prospective home buyer may be able to mitigate the effect of the price increase, entirely, by purchasing a new or existing home whose price does not increase as a result of the regulation.

EPA cannot say with certainty whether and to what extent these mechanisms will be effectively employed by likely single-family home buyers. But, to the extent that otherwise affected home buyers *do* mitigate the regulation's impact via these mechanisms, EPA is likely overstating the severity of single-family housing affordability effects.

In addition, other qualification and uncertainties in this analysis are critical for properly understanding the practical implications of whether and to what extent households will be affected by the regulation:

- ***Cost-Pass Through Potential Varies with Prevailing Market Conditions.*** To provide a worst case assessment, the increase in new home price assumes 100 percent pass-through of compliance costs, a market condition. This extent of housing price effect is not likely to persist over the long-term due to several factors, including (1) the availability of substitutes for any given home, and (2) the determination that proposed rule is only expected to affect the equivalent of about 7% of the total number of single-family home sales.[39] And, in periods of housing market weakness, such as currently occurring in U.S. housing markets, the assumption of 100 percent compliance cost pass-through may overstate substantially the price effect, and therefore critical income value effect, from the regulatory options (see *Section 3.4*).
- ***Compliance Cost and Any Related Potential Price Increase are Likely to Decline as with the Baseline Sales Price of the Affected Property.*** An important factor to be accounted for in the analysis for the lower-quartile price home is that the compliance cost burden and potential home price increase will typically be less for the lower-quartile price home than for the median price home. As a result, simply carrying forward the same price effect as used for the median price analysis will overstate the typical impact. This occurs because, as indicated by Census data, lot size typically declines with price for new single-family homes, thereby reducing the compliance cost burden, which is directly associated with lot size, and the resulting price impact per home (see *Section 3.4.2*).
- ***Low/Moderate-Income Home Buyers are Less Likely to Purchase Newly Constructed Single-Family Homes than Higher Income Home Buyers.*** The practical impact of the regulation on low/moderate-income (and first-time home buyers, to the extent these home buyers are more likely of low/moderate income) is also probably overstated in the analysis because these households are less likely to purchase newly constructed housing than higher income home buyers. As reported in the 2005 American Housing Survey (HUD, 2006a), in any given income range, the fraction of home purchases that are new generally increases with income (see *Figure 5-2*). This information indicates that, in general, households with higher incomes are more likely to purchase a new home than households with lower income.

[39] Based on 2006 home sales data, EPA estimates that approximately 500,000 new, single-family home sales would be expected to incur cost under Option 2 out of a total of approximately 6.7 million single-family home sales.

- ***Market Participation Varies Across Income Ranges.*** EPA's analysis recognizes that, at any given time, the number of households that are actually *in the market* for purchasing a home is significantly less than the number of households in an MSA. EPA therefore calculated impacts in terms of the numbers of prospective home-purchasing households whose purchasing decision is potentially affected by the increase in housing price. However, the current analysis identifies these households along the household income distribution using a concept whereby the household income distribution is reduced *uniformly* across income ranges based on an *average* measure of market participation. *To the extent that the income range containing the critical income value for a given home purchase is found to have a market participation rate below the current average participation rate, the affordability impacts are overstated.* This assumption of a uniform, average market participation rate could be improved with data that indicates the number and character of single-family home purchases *by income range* (see *Section 3.4.3*).
- ***Assumption of a Uniform Distribution of Households within Income Ranges.*** For this analysis, EPA assumes that households are uniformly distributed *over the income values* within an income range. The *uniform-distribution-of-households-within-range* assumption inevitably involves error and could overstate or understate the fraction of households within an income range that fall below a critical income value, depending on the change in slope of the density distribution over the income range (see *Section 3.4.3*).
- ***Price and Character of In-Scope Homes is Unknown.*** EPA has no basis for determining which homes along the home price distribution for any given state will actually incur costs, and therefore a potential price effect, under the regulation. The regulatory options specify the number and character of *in-scope projects***,** but the kind and price of homes that are most likely to be built *within* in-scope projects is unknown. Therefore, EPA *may* be overstating affordability effects for either or both of the home price affordability analyses.

3.8.4 Analysis of Social Cost and Economy-Wide Economic Effects

- ***Elasticities of Supply and Demand Vary Across Regional Markets.*** EPA estimated the state-level partial equilibrium models using *national-level* estimates of the elasticity of market supply and demand. These elasticity values are used to estimate the impact of incremental costs on the supply curve and, thus, on prices and quantities of construction products under post-compliance conditions. However, the extent to which increased construction costs manifest as higher sales prices and rents – and changes in market quantity – depend on supply and demand elasticities *in specific construction product markets*. Elasticities may vary substantially both over time, across regional markets, and within regional markets according to supply and demand conditions in specific product segments and other important market indicators (e.g., land availability, land-use and other regulatory restrictions, and demographic characteristics). To the extent that EPA's national-level elasticity values vary across the states, EPA may be over- or under-estimating the potential market effect on the prices and quantities of C&D market output (see *Sections 3.5.2.4 and 3.5.2.5*).
- ***Impacts on Markets for Existing Construction Are Not Evaluated.*** There is uncertainty with respect to the effect of existing construction on prices for new construction subject to the regulation, and vice versa.
  - Increased project costs and associated pressure on project prices for <u>new</u> finished product may spill over into price effects – as increased sales prices or rents, in the present and in the future – for <u>existing</u> finished product not subject to the regulation's requirements.
  - Conversely, the presence of existing finished product and new product not impacted by the rule serves as competition for newly constructed finished product and can thus limit the potential for upward pricing pressure on both existing finished product and new finished product subject to the

regulation's requirements. The presence of existing finished product provides a buffer against price and rent increases to C&D industry product consumers.

Given that the new construction expected to be subject to the regulation represents a very small fraction of all available construction product (both existing and new), EPA believes that the latter effect is, in general, likely to prevail. Therefore, price effects on new residential and non-residential construction product may be overstated. In this case, over the longer term, the cost and economic impact of the regulation may more likely be borne by owners of undeveloped land as property developers adjust construction cost estimates to reflect regulatory requirements and correspondingly adjust the prices to be paid for the land on which project development will occur. This effect would be particularly important in those instances in which otherwise similar undeveloped properties in the same market have different compliance requirements due, for example, to differences in soil and run-off characteristics, or property size.

- ***Assumption of Uniform Impact on the Supply of C&D Output.*** The partial equilibrium market analysis considers the potential for the proposed regulatory options to shift the supply curve upward in each market (i.e., via increased production costs), resulting in a higher price per unit and, depending on market response, a lower quantity of output. As described in *Section 3.5.3*, EPA assumes that in-scope C&D output is *distributed uniformly* across the pre-regulation supply curve, resulting in a uniform shift of the supply curve. However, EPA has no basis for knowing with certainty exactly which segments of the C&D supply curve in any given market will actually be in-scope, and more importantly, where in-scope segments sit relative to the pre-regulation market equilibrium. *To the extent that the marginal – and hence price-determining – supply of C&D output for a given market segment does not incur costs because of the regulation*, the increase in production cost for other, infra-marginal, segments of the supply schedule may have no or little effect on the market price. As a result, EPA may be overstating the change in market equilibrium point due to the regulation. This consideration is the same in concept as the last uncertainty described in *Section 3.8.3*.

3.8.5 Future Projections of Compliance Cost and Acreage

- ***Future Projections of Industry Activity are Inevitably Uncertain.*** EPA's analysis to estimate compliance costs and acreage out to the year 2025 inevitably embeds an unknown, and potentially significant, amount of uncertainty because it is based on a projection of aggregate C&D industry activity. The actual nature and quantity of C&D industry in any year in the future will be determined by overall economic and industry conditions, which can vary widely and unpredictably over time. Therefore, it should be emphasized that EPA's estimates of future cost and acreage are highly uncertain and may be over- or under-stated, in particular for any given year of the projection.

- ***Assumption of Constant Acreage Intensity over Time.*** EPA based the projected estimates of developed acreage on an assumption that acreage intensity (e.g., acres developed per million dollars of project value) is constant over time. EPA believes, contrary to this assumption, that acreage intensity is more likely to decline over time due to several factors, including changes in productivity, the mix and cost of construction inputs, the mix of construction activity, and the unavoidable decline in the availability of raw, undeveloped land (and hence the tendency to use land more parsimoniously in construction projects of a given development value over time). These factors point towards an expectation of declining acreage intensity over time. EPA has been able to establish this declining trend for residential construction and is in the evaluating these trends for the non-residential C&D sectors. However, EPA *currently* assumes a constant acreage intensity value in the projection analysis. As a result, EPA's current projections of acreage, and therefore cost, may be overstated to the extent that acreage intensity does decline over time.

In addition, the compliance cost burden relative to total project value would be expected to decline over time as a result of this trend.

- ***Future Compliance Cost and Acreage may not be Proportional to Total C&D Output and Acreage.*** EPA currently estimates future compliance cost and acreage, based on projections of total C&D output and acreage, assuming the compliance costs/acreage change in proportion to total C&D output/acreage. This assumption may lead to over- or under-statement of compliance costs and acreage depending on how the mix of construction activity in the C&D changes over time in terms of in-scope versus out-of-scope activity. For instance, due to the increasing scarcity of new land over time, it is likely that the proportion of construction value produced from developing *new land* will decline over the long term. In addition, it is likely that, with the passage of time and increased experience by the C&D industry in complying with regulatory requirements, that the industry will become more efficient in deploying economic resources – technology, labor, treatment chemicals – to meet the regulation's performance standards. As a result, the estimated *unit costs* of compliance – i.e., cost per acre – may be expected to decline over time, on an inflation-adjusted basis, relative to the estimates underlying this cost and economic impact analysis. This factor would further reduce the compliance cost burden of the regulation.

4 Developing the Analysis Baseline

This chapter estimates key baseline metrics describing the construction industry, model construction firms, and developed acreage that underlie the analysis of the regulatory options. The baseline metrics are developed using information from the industry profile (*Chapter 2*) and approaches outlined in the regulatory analysis methodology (*Chapter 3*):

- *Section 4.1* summarizes development of the industry baseline for the establishments and firms within the C&D industry that are expected to be affected by this regulation and that were accounted for in the firm- and industry-level analyses of regulatory options. The section includes a summary of the model financial baseline that was developed using the approach for characterizing model firms as described in *Chapter 3*.
- *Sections 4.2* and *4.3* present the estimated quantity of acreage and project development associated with the construction industry baseline. This development baseline underlies the analysis of costs and impact of compliance with regulatory options for the C&D rule.
- *Section 4.4* highlights the primary sources of uncertainty and limitations in the analysis baseline.

4.1 Construction and Development Industry

As described in *Chapter 2*, the Construction and Development industry encompasses business operating in a range of construction industry segments. This section outlines those industry segments that are likely to perform activities within the scope of the regulation and that are the focus of this regulatory analysis.

4.1.1 Identifying Industry Segments and Establishments Likely to Be Affected by the C&D Regulation

Table 4-1 shows the 2002 universe of establishments in the entire C&D industry, as reported in the 2002 NAICS framework. As described in *Chapter 2*, 2002 is the most recent year for which SUSB and Economic Census data are available. And, as documented in *Chapter 2*, EPA judges this year to reflect a period in which the individual construction industry segments were in neither exceptionally strong nor weak business condition. Accordingly, EPA views this year as an appropriate year for building the industrial "snapshot" for this regulatory analysis.

In the remainder of this section, tables and information are presented at the firm level, which is the focus of the industry impact analysis. In addition, the following section summarizes the exclusion of industry segments that are not applicable to this regulatory analysis.

Table 4-1: All Establishments within the C&D Industry (2002 data)

2002 NAICS	Description	Establishments
236115	New single-family housing construction (except operative builders)	58,472
236116	New multifamily housing construction (except operative builders)	4,397
236117	New housing operative builders	26,043
236118	Residential remodelers	82,750
236210	Industrial building construction	2,776
236220	Commercial and institutional building construction	37,209
237110	Water and sewer line and related structures construction	12,356
237120	Oil and gas pipeline and related structures construction	1,403
237130	Power and communication line and related structures construction	6,034
237210	Land subdivision	8,403
237310	Highway, street, and bridge construction	11,240
237990	Other heavy and civil engineering construction	10,501

Table 4-1: All Establishments within the C&D Industry (2002 data)

2002 NAICS	Description	Establishments
238110	Poured concrete foundation and structure contractors	27,151
238120	Structural steel and precast concrete contractors	4,321
238130	Framing contractors	14,455
238140	Masonry contractors	25,720
238150	Glass and glazing contractors	5,294
238160	Roofing contractors	23,192
238170	Siding contractors	6,632
238190	Other foundation, structure, and building exterior contractors	2,786
238210	Electrical Contractors	62,586
238220	Plumbing, heating, and air-conditioning contractors	87,501
238290	Other building equipment contractors	6,086
238310	Drywall and insulation contractors	19,598
238320	Painting and wall covering contractors	38,943
238330	Flooring contractors	12,865
238340	Tile and terrazzo contractors	8,950
238350	Finish carpentry contractors	35,087
238390	Other building finishing contractors	3,729
238910	Site preparation contractors	30,498
238990	All other specialty trade contractors	33,453
	Total	**710,431**

Source: U.S. Census Bureau's Economic Census (2005a)

The majority of business that fall within the industry definitions outlined in *Table 4-1* will not be affected by the C&D Regulation. The regulation will apply to only those businesses engaged in activities that disturb land and whose individual projects reach a scale that will be subject to regulatory requirements. A substantial number of businesses will be exempt from regulatory coverage because they are primarily engaged in subcontracted parts of a building project, such as flooring contracts, or they are involved in remodeling activities that will not disturb land. In this section, EPA identifies and sets aside from further analysis those industry segments that are *not* likely to perform activities that would be within the scope of the regulation. The estimates for the remaining segments are brought together to derive final estimates of the number of establishments expected to be covered by a C&D regulation.

4.1.1.1 Excluding Segments and Establishments That Are Not Involved in Land Disturbance

The C&D regulation will apply only to those activities that disturb land and that are of sufficient scale to be within the regulation's scope. Therefore, most business within the *Special Trade Contractors* (NAICS 238) sector will not be affected and are excluded from this analysis. The only *Special Trade Contractors* segment whose activities have the potential to result in land disturbance are those entities within NAICS 238910, *Site Preparation Contractors*. The primary groups of entities within this NAICS are *Excavation Contractors, Wrecking and Demolition Contractors,* and *All Other Heavy Construction.*

The other sector within the C&D industry that is not likely to perform activities that result in land disturbance is NAICS 236118, *Residential Remodelers.* Based on the Economic Census definitions of the specific sectors within NAICS 238 and all of the entities within NAICS 236118, EPA excluded these segments from this analysis.

4.1.1.2 Excluding Segments and Establishments That Are Not NPDES Permittees

As stated above, EPA included certain categories within NAICS 238 in the analysis – 1997 NAICS 235930 (*Excavation Contractors*), 235940 (*Wrecking and Demolition Contractors*), and 234990 (*All Other Heavy Construction),* all within 2002 NAICS 238910 – because these establishments engage in land disturbing activities. Most often, however, establishments in 2002 NAICS 238910 act as subcontractors on C&D projects and are hired by developers or general contractors to perform specific tasks. EPA believes that these establishments will not generally appear as NPDES permittees or co-permittees.

4.1.1.3 Adjustments and Exclusions Based on Data Limitations

EPA expects that businesses in NAICS 237210 (*Land Subdivision*) will undertake activities that are within the scope of the C&D rule. However, data for characterizing the profile of projects performed by NAICS 237210 and assigning compliance costs to businesses in this segment are not available and/or are not distinguishable from the activities performed by the primary construction sectors – NAICS 236115, 236116, 236210, and 236220 – that are expected to be principally affected by the regulation. For this reason, EPA allocated the businesses and economic activity reported for NAICS 237210 *among these four primary focus sectors*. Thus, EPA accounted for the impact of the C&D rule on the NAICS 237210 sector in this regulatory analysis, but with those impacts being estimated and accounted for in the analysis for the four principal impact sectors: NAICS 236115, 236116, 236210, and 236220.

EPA also anticipates that some businesses and activities in the *Heavy Construction* sector (NAICS 237) will be affected by the C&D rule. However, with the exception of NAICS 237310 (*Highway, street, and bridge construction*), data are not available to support an assessment of the number and character of projects performed by NAICS 237 sector businesses that would be subject to compliance requirements and incur compliance costs. For this reason, of the sectors in NAICS 237, only NAICS 237310 (*Highway, street, and bridge construction*) is considered in the cost and impact analysis for the C&D rule.

4.1.1.4 Total Number of Potentially Affected Establishments

To summarize, EPA took several steps to adjust the number of affected entities to account for regulatory coverage and data availability. A total of 710,431establishments are within the C&D industry, as broadly defined. However, as stated in the two previous sections, a large number of businesses are not expected to perform activities within the scope of this regulation and were therefore excluded from this regulatory analysis. As a result of these exclusions, only about one-fourth of the total C&D industry establishments are expected to be affected by the regulation and are covered in this analysis. The specific steps leading to the estimate of potentially affected establishments are detailed within *Table 4-2*.

Table 4-2: Sectors and Establishments in the C&D Industry Included in this Analysis (2002 data)

2002 NAICS	Description	All Sectors in C&D Industry	Sectors Involved in Land Disturbance		
				Sectors that are NPDES Permitees	
			All	All	Sectors With Sufficient Data for Analysis[a]
236115	New single-family housing construction (except operative builders)	58,472	58,472	58,472	58,472
236116	New multifamily housing construction (except operative builders)	4,397	4,397	4,397	4,397
236117	New housing operative builders	26,043	26,043	26,043	26,043
236118	Residential remodelers	82,750	-	-	-
236210	Industrial building construction	2,776	2,776	2,776	2,776
236220	Commercial and institutional building construction	37,209	37,209	37,209	37,209
237110	Water and sewer line and related structures construction	12,356	12,356	12,356	-
237120	Oil and gas pipeline and related structures construction	1,403	1,403	1,403	-
237130	Power and communication line and related structures construction	6,034	6,034	6,034	-
237210	Land subdivision	8,403	8,403	8,403	8,403
237310	Highway, street, and bridge construction	11,240	11,240	11,240	11,240
237990	Other heavy and civil engineering construction	10,501	10,501	10,501	-
238110	Poured concrete foundation and structure contractors	27,151	-	-	-
238120	Structural steel and precast concrete contractors	4,321	-	-	-
238130	Framing contractors	14,455	-	-	-
238140	Masonry contractors	25,720	-	-	-
238150	Glass and glazing contractors	5,294	-	-	-
238160	Roofing contractors	23,192	-	-	-
238170	Siding contractors	6,632	-	-	-

Table 4-2: Sectors and Establishments in the C&D Industry Included in this Analysis (2002 data)

2002 NAICS	Description	All Sectors in C&D Industry	Sectors Involved in Land Disturbance		
			All	Sectors that are NPDES Permitees	
				All	Sectors With Sufficient Data for Analysis[a]
238190	Other foundation, structure, and building exterior contractors	2,786	-	-	-
238210	Electrical Contractors	62,586	-	-	-
238220	Plumbing, heating, and air-conditioning contractors	87,501	-	-	-
238290	Other building equipment contractors	6,086	-	-	-
238310	Drywall and insulation contractors	19,598	-	-	-
238320	Painting and wall covering contractors	38,943	-	-	-
238330	Flooring contractors	12,865	-	-	-
238340	Tile and terrazzo contractors	8,950	-	-	-
238350	Finish carpentry contractors	35,087	-	-	-
238390	Other building finishing contractors	3,729	-	-	-
238910	Site preparation contractors	30,498	30,498	-	-
238990	All other specialty trade contractors	33,453	-	-	-
Total		**710,431**	**209,332**	**178,834**	**148,540**

a Before allocating entities within *Land Subdivision* (NAICS 237210) among the four building categories - NAICS 236115, 236116, 236210, and 236220.

Source: U.S. Census Bureau's Economic Census (2005a)

4.1.2 Determining the Firm Universe Likely To Be Affected by the C&D Regulation

Since the Economic Census reports data by establishment and not at the level of the firm, EPA used SUSB data to develop the firm-level data needed for this analysis: number of firms, employees, and receipts by revenue size. Further, because the 2002 SUSB data are reported in the 1997 NAICS framework, EPA used the 2002 Economic Census data on the number of establishments, employees, and value of construction by revenue size, to reconfigure the 2002 SUSB data within the 2002 NAICS framework, as described below:

1. The most significant difference between the 2002 and 1997 NAICS frameworks involves the framework for reporting data on the residential construction sectors. The *1997 NAICS* framework reports residential sector data in two sectors – (1) Single-Family Housing Construction and (2) Multifamily Housing Construction – while the *2002 NAICS* framework reports residential sector data in four sectors: (1) New Single-Family Housing Construction, (2) New Multifamily Housing Construction, (3) Residential Remodelers, and (4) New Housing Operative Builders. To achieve consistency in its analyses using data from both the 1997 and 2002 frameworks, EPA needed to reconfigure the 1997 framework data to align with the 2002 framework – by excluding Residential Remodelers from the two 1997 framework sectors and by breaking out New Housing Operative Builders as a separate sector. Specifically, EPA used Economic Census data to disaggregate the SUSB data among the four 2002 NAICS residential categories. EPA based this disaggregation on the Census proportions of establishments, employees, and value within the four residential building categories as compared to the totals within residential building construction.

2. In addition, Economic Census data were used to break down some of the SUSB revenue size ranges into size ranges that are more relevant for reflecting differences in baseline financial performance/condition by business size and for understanding potential economic/financial impacts by business size. The specific revenue ranges used in this analysis are:

   - Less than $1 million
   - $1 - $2.5 million
   - $2.5 - $5 million
   - $5 - $10 million
   - $10 - $50 million
   - $50 - $100 million
   - $100 million and greater

EPA used Economic Census proportions to break the SUSB $1 - $5 million range into $1 - $2.5 million and $2.5 - $5 million revenue ranges.

3. As noted above, because of data limitations, EPA allocated the firm level information for NAICS 237210 (*Land Subdivision*) among the four building sectors according to the each sector's proportion of establishments, employees, and value out of the total.

Because regulatory coverage and compliance costs are expected to vary over states by regulatory option, it was also necessary to break out the firm data by state. Although Economic Census reports establishments, employees, and value of construction for each sector by state, SUSB does not report firm-level information by state for specific construction sectors. As a result, to develop firm-level data by state, EPA apportioned the national level SUSB data over states based on the Economic Census' proportions by state for each of the relevant firm-level data items. EPA further applied sector-specific national revenue range distributions – from Economic Census and SUSB, as described above – to the state totals to develop revenue range estimates by state.

4.1.2.1 Baseline Firm Universe Used in the Regulatory Analysis for the C&D Regulation

Reflecting the adjustments described above, *Table 4-3* presents the baseline universe of firms, revenue, employees, and average firm revenue by construction sector and revenue range, which underlies this regulatory analysis.[40] As described above, the baseline industry "snapshot" data are derived from 2002 Economic Census and SUSB data.

EPA further adjusted the population of affected firms to estimate the number of firms in the C&D industry that are small businesses, in accordance with SBA criteria. EPA describes this method in *Chapter 2*.

Table 4-3: Baseline Firm Level Data by Revenue Range and NAICS Sector

	Revenue Ranges						
NAICS Sector[a]	**Range 1: $100 thousand - $1 million**	**Range 2: $1 million - $2.5 million**	**Range 3: $2.5 million - $5 million**	**Range 4: $5 million - $10 million**	**Range 5: $10 million - $50 million**	**Range 6: $50 million - $100 million**	**Range 7: $100 million and more**
Average Revenue Values (Rounded to the Nearest Thousand)							
236115	$335,000	$1,555,000	$3,424,000	$6,685,000	$18,515,000	$58,703,000	$256,404,000
236116	$326,000	$1,635,000	$3,403,000	$6,876,000	$18,675,000	$59,211,000	$258,622,000
236117	$408,000	$1,586,000	$3,566,000	$6,814,000	$18,737,000	$60,317,000	$294,450,000
236210	$315,000	$1,628,000	$3,559,000	$6,657,000	$17,653,000	$50,416,000	$191,930,000
236220	$379,000	$1,607,000	$3,537,000	$7,013,000	$19,872,000	$61,150,000	$209,888,000
237310	$375,000	$1,602,000	$3,430,000	$6,928,000	$20,279,000	$57,507,000	$162,938,000
Number of Firms							
236115	49,620	10,650	3,580	893	443	49	56
236116	3,134	724	497	182	239	26	31
236117	12,750	6,484	3,209	1,231	1,305	139	147
236210	1,630	485	233	165	167	23	103
236220	21,238	8,428	5,272	3,540	3,534	439	442
237310	5,314	2,002	1,324	998	1,213	174	185
Total Revenue (in Millions of Dollars)							
236115	$16,647	$16,559	$12,258	$5,973	$8,197	$2,867	$14,470
236116	$1,021	$1,183	$1,692	$1,254	$4,471	$1,564	$7,892
236117	$5,204	$10,282	$11,441	$8,390	$24,452	$8,364	$43,384
236210	$514	$789	$830	$1,098	$2,943	$1,152	$19,861
236220	$8,051	$13,547	$18,651	$24,823	$70,219	$26,824	$92,679
237310	$1,992	$3,208	$4,541	$6,914	$24,605	$9,984	$30,066

[40] Alaska and Hawaii are not included in this baseline. The acreage estimates developed from Multi-Resolution Land Characteristics (MRLC) Consortium's National Land Cover Database (NLCD) do not include Hawaii and Alaska (NLCD acreage totals are presented in *Table 4-10*). As a result, this analysis does not explicitly consider potential regulatory impacts for activities in these states.

Table 4-3: Baseline Firm Level Data by Revenue Range and NAICS Sector

	Revenue Ranges						
NAICS Sector[a]	Range 1: $100 thousand - $1 million	Range 2: $1 million - $2.5 million	Range 3: $2.5 million - $5 million	Range 4: $5 million - $10 million	Range 5: $10 million - $50 million	Range 6: $50 million - $100 million	Range 7: $100 million and more
Number of Employees							
236115	122,637	60,751	31,345	17,605	13,306	3,796	12,797
236116	7,838	5,727	5,255	4,305	8,550	2,439	8,223
236117	30,066	27,823	22,489	17,892	50,773	14,417	50,143
236210	5,213	5,627	5,681	5,288	16,427	3,374	82,718
236220	76,752	86,069	80,276	83,313	168,179	49,960	139,859
237310	16,751	19,935	25,168	32,310	92,130	31,511	90,343

a NAICS 236115 is New single-family housing construction (except operative builders), NAICS 236116 is New multifamily housing construction (except operative builders), NAICS 236117 is New housing operative builders, NAICS 236210 is Industrial building construction, NAICS 236220 is Commercial and institutional building construction, NAICS 237310 is Highway, street, and bridge construction

b Alaska and Hawaii are not included in this firm-level baseline.

Source: U.S. SBA (2004) and U.S. Census Bureau's Economic Census (2005a)

4.1.3 Baseline Financial Information for Model Firms

As described in *Chapter 3*, EPA based its assessment of industry impacts on an analysis of model firms that were defined for the specific construction industry sectors and revenue ranges outlined above. This section summarizes key financial information for the model firm baseline.

To develop the model firms, EPA assigned financial characteristics – balance sheet, income statement, and metrics of financial performance and condition – to each of the model firms as defined by the six NAICS sectors and seven revenue size ranges, from financial statement information reported by Risk Management Association (RMA). *Table 4-4* through *Table 4-6* present key baseline financial information – Pre-Tax Income/Total Assets, Earnings Before Interest and Taxes (EBIT)/Interest, and Net Income Margin – for model firms in each of the construction sectors and revenue ranges. The values presented are based on the *General Business Conditions* case relationships (i.e., an averaged dataset over the 5-year period April 2002 through March 2007). As described in *Chapter 3*, the values necessarily show improvement in baseline financial performance over the three quartile values – First Quartile (weakest performance), Median, and Third Quartile (strongest performance). In addition, these data generally show strengthening financial performance as business size increases within each NAICS sector. This observation underscores the importance of accounting for variation in baseline financial condition and performance by business size in the cost and economic impact analysis for this regulation.

Table 4-4: Model Firms: Pre-Tax Income/Total Assets

Revenue Range	Quartile	NAICS Sector[a]					
		236115	236116	236117	236210	236220	237310
Revenue Range 1: $100 thousand to $1 million	First Quartile	-2.1%	-5.1%	-2.4%	-3.8%	-2.7%	-11.7%
	Median	2.6%	2.6%	3.6%	2.0%	4.2%	2.8%
	Third Quartile	13.8%	15.2%	14.1%	14.1%	15.3%	15.0%
Revenue Range 2: $1 million to $3 million	First Quartile	0.6%	0.9%	-1.1%	-1.6%	-1.7%	0.2%
	Median	5.2%	6.6%	5.2%	5.6%	5.8%	6.1%
	Third Quartile	14.4%	17.2%	24.0%	17.5%	18.3%	16.9%
Revenue Range 3: $3 million to $5 million	First Quartile	1.1%	1.9%	0.5%	-1.7%	-0.7%	-0.5%
	Median	5.2%	7.2%	3.7%	4.5%	5.6%	5.7%
	Third Quartile	13.0%	18.4%	12.5%	14.1%	14.8%	17.6%
Revenue Range 4: $5 million to $10 million	First Quartile	1.4%	2.0%	1.7%	-0.1%	1.1%	0.8%
	Median	5.6%	6.5%	6.3%	5.3%	6.1%	6.6%
	Third Quartile	13.4%	14.6%	15.4%	14.2%	14.8%	15.0%
Revenue Range 5: $10 million to $50 million	First Quartile	1.9%	1.9%	1.7%	1.4%	1.3%	2.0%
	Median	6.7%	7.2%	5.6%	5.0%	5.5%	6.6%
	Third Quartile	14.9%	17.4%	12.9%	12.4%	12.5%	14.9%
Revenue Range 6: $50 million to $100 million	First Quartile	4.5%	4.3%	3.7%	2.0%	1.9%	2.4%
	Median	9.6%	9.0%	8.3%	5.5%	5.3%	6.4%
	Third Quartile	16.9%	17.8%	15.7%	11.3%	10.4%	12.2%
Revenue Range 7: $100 million and more	First Quartile	4.5%	4.3%	3.7%	2.0%	1.9%	2.4%
	Median	9.6%	9.0%	8.3%	5.5%	5.3%	6.4%
	Third Quartile	16.9%	17.8%	15.7%	11.3%	10.4%	12.2%

a NAICS 236115 is New single-family housing construction (except operative builders), NAICS 236116 is New multifamily housing construction (except operative builders), NAICS 236117 is New housing operative builders, NAICS 236210 is Industrial building construction, NAICS 236220 is Commercial and institutional building construction, NAICS 237310 is Highway, street, and bridge construction.

Source: EPA Estimates based on RMA 2007

Table 4-5: Model Firms: EBIT/Interest

Revenue Range	Quartile	NAICS Sector[a]					
		236115	236116	236117	236210	236220	237310
Revenue Range 1: $100 thousand to $1 million	First Quartile	-0.6	-4.2	0.3	-6.6	-0.3	-1.9
	Median	2.4	1.7	4.1	2.1	3.7	1.7
	Third Quartile	9.1	12.1	10.2	8.7	9.5	7.2
Revenue Range 2: $1 million to $3 million	First Quartile	1.2	1.4	-0.5	0.2	-0.5	0.7
	Median	4.3	4.5	5.4	3.6	4.0	3.3
	Third Quartile	14.5	18.0	23.5	13.5	12.8	11.8
Revenue Range 3: $3 million to $5 million	First Quartile	1.6	2.2	1.5	-0.3	0.1	0.3
	Median	5.0	6.4	6.6	4.5	4.9	3.5
	Third Quartile	20.3	20.0	20.9	15.7	18.4	11.6
Revenue Range 4: $5 million to $10 million	First Quartile	1.9	1.6	2.0	0.3	1.7	1.2
	Median	5.9	5.7	5.3	6.2	7.0	5.6
	Third Quartile	23.5	19.7	23.8	22.8	24.9	15.7
Revenue Range 5: $10 million to $50 million	First Quartile	2.5	2.3	2.1	2.5	2.4	2.2
	Median	8.0	9.1	7.4	7.5	9.2	6.1
	Third Quartile	29.4	43.5	33.4	37.6	39.2	18.4
Revenue Range 6: $50 million to $100 million	First Quartile	3.5	4.5	2.8	3.7	5.0	2.7
	Median	8.6	18.2	10.5	16.2	18.4	6.1
	Third Quartile	29.7	102.3	55.8	62.0	73.4	17.0
Revenue Range 7: $100 million and more	First Quartile	3.5	4.5	2.8	3.7	5.0	2.7
	Median	8.6	18.2	10.5	16.2	18.4	6.1
	Third Quartile	29.7	102.3	55.8	62.0	73.4	17.0

a NAICS 236115 is New single-family housing construction (except operative builders), NAICS 236116 is New multifamily housing construction (except operative builders), NAICS 236117 is New housing operative builders, NAICS 236210 is Industrial building construction, NAICS 236220 is Commercial and institutional building construction, NAICS 237310 is Highway, street, and bridge construction.

Source: EPA Estimates based on RMA 2007

Table 4-6: Model Firms: Net Income Margin

Revenue Range	Quartile	NAICS Sector[a]					
		236115	236116	236117	236210	236220	237310
Revenue Range 1: $100 thousand to $1 million	First Quartile	-3.8%	-11.7%	-6.3%	-5.8%	-3.5%	-11.9%
	Median	1.8%	1.8%	2.7%	0.9%	1.7%	1.2%
	Third Quartile	4.2%	3.9%	2.8%	3.1%	3.2%	3.3%
Revenue Range 2: $1 million to $3 million	First Quartile	0.5%	0.7%	-1.1%	-0.9%	-1.1%	0.1%
	Median	2.3%	2.7%	2.1%	1.7%	1.8%	2.2%
	Third Quartile	3.5%	3.4%	3.8%	3.5%	3.2%	3.7%
Revenue Range 3: $3 million to $5 million	First Quartile	0.8%	1.1%	0.4%	-0.9%	-0.3%	-0.3%
	Median	2.0%	2.0%	1.5%	1.2%	1.4%	1.8%
	Third Quartile	2.5%	2.9%	2.2%	2.0%	2.0%	3.2%
Revenue Range 4: $5 million to $10 million	First Quartile	0.8%	1.0%	0.9%	-0.1%	0.4%	0.4%
	Median	1.8%	1.6%	2.0%	1.0%	1.1%	1.8%
	Third Quartile	2.6%	1.9%	2.6%	2.0%	2.0%	3.1%
Revenue Range 5: $10 million to $50 million	First Quartile	0.9%	0.8%	0.7%	0.4%	0.3%	0.7%
	Median	2.2%	1.6%	1.6%	0.9%	1.0%	1.7%
	Third Quartile	3.2%	2.6%	2.5%	1.8%	1.8%	3.0%
Revenue Range 6: $50 million to $100 million	First Quartile	2.2%	1.8%	2.1%	0.4%	0.4%	0.9%
	Median	3.3%	1.9%	3.2%	1.0%	1.0%	1.8%
	Third Quartile	4.0%	2.5%	3.6%	1.7%	1.5%	2.7%
Revenue Range 7: $100 million and more	First Quartile	2.2%	1.8%	2.1%	0.5%	0.4%	0.9%
	Median	3.3%	1.9%	3.0%	1.0%	1.0%	1.8%
	Third Quartile	4.0%	2.5%	3.4%	1.7%	1.5%	2.7%

a NAICS 236115 is New single-family housing construction (except operative builders), NAICS 236116 is New multifamily housing construction (except operative builders), NAICS 236117 is New housing operative builders, NAICS 236210 is Industrial building construction, NAICS 236220 is Commercial and institutional building construction, NAICS 237310 is Highway, street, and bridge construction.

Source: EPA Estimates based on RMA 2007

In the impact analysis, cost and impacts are assessed at the level of the model firms based on the estimated compliance activity that the model firms undertake and the resulting compliance costs assigned to the firms. These model firm-based findings are then extrapolated to the construction industry, based on the numbers of firms within each combination of NAICS sector and revenue range as summarized in *Table 4-3: Baseline Firm Level Data by Revenue Range and NAICS Sector*, above (see *Chapter 3)*.

4.2 Construction Activity and Acreage Developed by Industry and Model Firms

In any year, the cost of the C&D rule to the construction industry and society will depend on the quantity of acreage on which in-scope construction activity is performed. Accordingly, the baseline estimate of construction activity and acreage is a key element of the baselines for this regulatory analysis.

EPA used two methods to estimate total acreage that could fall within the scope of the C&D rule:

1. A "top-down" estimate of acreage developed annually, nationally and by state, from the Multi-Resolution Land Characteristics (MRLC) Consortium's National Land Cover Dataset (NLCD)[41]
2. A "bottom-up" estimate (that estimates for each model firm) the quantity of acreage and construction activity that can be performed based on the revenue size category. This is important for determining if the firms' annual revenue is sufficiently high enough to reflect a scale of activity – i.e., by acreage – that would be within the regulation's scope. The individual model firm estimates were aggregated to the industry level, based on the number of firms by NAICS sector and revenue range, as reported in *Table 4-3*.

[41] Multi-Resolution Land Characteristics (MRLC) Consortium is a group of federal agencies who use Landsat 5 imagery for the conterminous United States to develop a land cover dataset called the National Land Cover Dataset.

In order to incorporate the projected in-scope acres and compliance for each option into the impact analysis, the "bottom-up," model firm-based estimates were reconciled to the "top-down," NLCD-based development estimates by modestly adjusting the parameter values used to estimate the acreage and construction activity that could be performed by the model firms.

4.2.1 "Top-down"-Based Acreage Estimate

The *Top-Down* estimate of developed acreage is derived from comparing NLCD data for 1992 and 2001. The NLCD data indicate that, on average, approximately 590,000 acres of land were newly developed each year during this period (U.S. EPA, 2008). EPA interprets these data as representing the annual average quantity of acreage developed for that time period on sites of at least one acre and therefore potentially within the scope of the regulatory options that were considered in developing the C&D proposed rule. EPA is using this estimate to represent the expected level of development for the purpose of the economic analysis.

EPA used Notice of Intent (NOI) data for permits under the Stormwater Regulation to disaggregate the NLCD acreage among sectors and states. EPA spread the 590,000 total acres among three construction activity categories: (1) residential building, approximately 287,000 acres; (2) non-residential building, 248,000 acres, and (3) transportation, 55,000 acres. The NOI data were also used to estimate acreage, for the residential and non-residential building sectors, in two size categories that were important in defining and estimating the impact of regulatory options: (1) small projects – 1 to 10 acres; and (2) large projects – 10 or more acres. Additionally, state level breakouts were provided according to the NOI data. The acreage breakouts by general sector, project size, and state are provided in *Table 4-7*, below.

Table 4-7: NLCD Acreage by General Sector, Size Category, and State

State	Residential Acres Regulated		Non-Residential Acres Regulated		Transportation
	Small Sites	Large Sites	Small Sites	Large Sites	
Alabama	798	6,251	1,059	5,033	1,363
Arizona	750	5,874	995	4,729	1,281
Arkansas	467	3,657	619	2,945	798
California	1,508	11,818	2,002	9,515	2,578
Colorado	871	6,823	1,156	5,493	1,488
Connecticut	55	434	73	349	95
Delaware	46	359	61	289	78
Florida	2,094	16,406	2,779	13,208	3,578
Georgia	1,793	14,047	2,379	11,309	3,064
Idaho	312	2,445	414	1,969	533
Illinois	1,128	8,836	1,497	7,114	1,927
Indiana	680	5,332	903	4,293	1,163
Iowa	555	4,351	737	3,503	949
Kansas	1,240	9,714	1,645	7,821	2,119
Kentucky	549	4,300	728	3,462	938
Louisiana	706	5,535	938	4,457	1,207
Maine	247	1,938	328	1,560	423
Maryland	359	2,817	477	2,268	614
Massachusetts	183	1,431	242	1,152	312
Michigan	1,237	9,695	1,642	7,806	2,115
Minnesota	513	4,022	681	3,238	877
Mississippi	652	5,110	865	4,114	1,114
Missouri	745	5,840	989	4,702	1,274
Montana	355	2,783	471	2,240	607
Nebraska	334	2,620	444	2,109	571
Nevada	449	3,515	595	2,830	767
New Hampshire	98	770	130	620	168
New Jersey	235	1,840	312	1,481	401
New Mexico	257	2,013	341	1,620	439
New York	425	3,328	564	2,679	726
North Carolina	1,031	8,076	1,368	6,502	1,761

Table 4-7: NLCD Acreage by General Sector, Size Category, and State

State	Residential Acres Regulated		Non-Residential Acres Regulated		Transportation
	Small Sites	Large Sites	Small Sites	Large Sites	
North Dakota	360	2,817	477	2,268	614
Ohio	957	7,499	1,270	6,037	1,635
Oklahoma	920	7,211	1,221	5,805	1,573
Oregon	401	3,140	532	2,528	685
Pennsylvania	880	6,897	1,168	5,553	1,504
Rhode Island	21	162	28	131	35
South Carolina	889	6,969	1,180	5,611	1,520
South Dakota	457	3,582	607	2,884	781
Tennessee	720	5,641	955	4,542	1,230
Texas	3,372	26,422	4,475	21,272	5,763
Utah	461	3,616	612	2,911	789
Vermont	31	245	42	197	53
Virginia	833	6,528	1,106	5,256	1,424
Washington	704	5,513	934	4,439	1,202
West Virginia	193	1,514	256	1,219	330
Wisconsin	416	3,262	553	2,626	711
Wyoming	156	1,225	208	987	267
District of Columbia	4	28	5	23	6
Total	**32,447**	**254,251**	**43,063**	**204,699**	**55,450**

Source: NLCD and NOI data

To use the NLCD acreage estimates in the firm-level analysis required further disaggregating these values into the specific NAICS sectors for which the regulatory analysis was performed. EPA based this *sector-level* disaggregation on information from the 2006 Census Bureau's *Characteristics of New Housing* and from Reed Construction Data.

Reed Construction Data (Reed) is a commercial construction industry data service that collects and reports information on multifamily, commercial/institutional, and industrial construction projects undertaken nationally. Project data reported by Reed that are relevant to this analysis, include site size, constructed square footage, and project value. This economic analysis used data from Reed for over 30,000 projects over the period 2001 through February 2008, which is the data period used in the analysis.

EPA used the Reed data to develop a distribution of acreage by the small and large project classifications, and by the relevant categories of construction activity: commercial, industrial, and multifamily residential. Reed does not report a large enough set of single-family projects to support development of reliable size distributions or to determine the percent of single-family acreage that would fall within site size ranges for the single-family residential project category. However, Reed does report information for approximately 6,000 multifamily projects and EPA used site size information for these projects to determine the percent of acreage that falls within the small and large multifamily construction category. For the multifamily residential sector, EPA determined that approximately 86 percent of acreage is within projects greater than or equal to ten acres. The remaining 14 percent of acreage is within projects less than ten acres. The non-residential information was used to distribute non-residential acreage between the commercial and industrial categories, and accordingly to the NAICS sectors that specifically engage in commercial and industrial construction activity.[42] *Table 4-8*, following page, presents the acreage distribution by project size category for the non-residential sector. The *non-residential* percentages represent the percent of acreage within each non-residential construction sector for each size category.

[42] In working with the Reed data, EPA used a subset of project records that were "cleaned" to remove outlier observations that appear to contain erroneous data (e.g., site size data that appeared to be reported in square feet instead of acres) and that might otherwise have skewed the findings from the Reed data. The "cleaning" concept is based on analysis of the indicated "acreage intensity" – acreage per reported dollar value of activity – from the Reed data observations. The observation subset included those records that fell within the 5th and 95th percentiles of calculated acreage intensity values.

Table 4-8: Acreage Distribution of Non-Residential Activity by Project Size Category

Sector	Percent of Acres in Projects	
	Less than 10 acres	Greater than or equal to 10 acres
Industrial Building Construction	7.1%	32.9%
Commercial and Institutional Building Construction	92.9%	67.1%
Total	**100%**	**100%**

Source: Reed Construction Data (2008)

EPA examined additional data sources to determine the breakout between single-family and multifamily acreage within the residential category. In combination with the Reed data for multifamily projects, data on the characteristics of multi-family and single-family units from the 2006 Census Bureau's *Characteristics of New Housing* support a break-out of total acreage by each of the four residential classifications.

Census reports the annual number of multifamily units completed by unit size ranges. The Reed data provide both the number of units and site size, which supports calculating the average site size per building by the unit size ranges provided within Census data. Multiplying the number of buildings by the average site size per building within each unit size range yields the total number of acres within each unit size range. EPA summed the totals by unit size range to arrive at the total number of acres for multi-family buildings. Census also reports the number of attached single-family units (townhomes) by site size. Since EPA classified townhomes within the multifamily residential category, EPA included the total acreage for attached single-family units in the multifamily category. EPA then determined the average site size within each site size range. Multiplying the average site size by the number of units by site size range yielded the total number of acres within each site size range. EPA summed the totals by site size range to arrive at the total number of acres for attached single-family units. The total number of acres completed for multifamily buildings and attached single-family units were summed to arrive at the total acreage completed for the multifamily residential category.

In addition, Census reports the number of detached single-family units by site size range. The average site size within each site size range multiplied by the number of units in the site size range yields an estimate of the total number of acres by site size range. EPA summed these totals by site size range to arrive at the total number of acres for detached single-family units. The percent of single-family and multi-family acreage out of the total residential acreage was then estimated from the total number of acres for the single-family and multifamily residential categories. These percentages, as shown within *Table 4-9*, were applied to the top-down estimate of total *residential* acreage to arrive at the total of single-family and multi-family acreage.

Table 4-9: Acreage Distribution Among Residential Construction Sectors

Sector	Percent of total new residential acreage
Single-Family Housing Construction	71%
Multifamily Housing Construction	29%

Source: U.S Census Bureau's Characteristics of New Housing (2008)

The percentage of acres within the small and large *multifamily* classification, as shown within *Table 4-8*, determines the total number of small and large multifamily acres. The residual number of acres is expected to apply to the small and large single-family classification.

These estimated allocations of acreage by construction activity yield the following breakdown of the "top-down" acreage by the NAICS sectors under analysis (see *Table 4-10*, following page).

Table 4-10: NLCD (Top-Down) Gross Acreage Developed

Sector Name	Acreage
New Single-Family Housing Construction[a]	203,000
New Multifamily Housing Construction[a]	84,000
Industrial Building Construction	71,000
Commercial and Institutional Building Construction	177,000
Highway, Street, and Bridge Construction	55,000
Total	**590,000**

a Includes acreage developed by New Housing Operative Builders

4.2.2 "Bottom-up"-Based Acreage Estimate

The "top-down" approach provided an estimate of acreage developed based in the MRLC's NLCD, while the "bottom-up" approach is based on industry level data – i.e., assigning acreage to the model firms. To develop the "bottom-up" estimates, EPA used industry level data, as presented in *Table 4-3*, with acreage data from 2006 Census Bureau's *Characteristics of New Housing* and Reed Construction. In developing the "bottom-up" estimate, EPA in effect estimated the quantity of acreage and construction activity that a model firm *could* engage in – either as a started or completed construction project – annually, given the revenue size of the model firm and the historical relationship of project acreage and value – *acreage intensity* – for projects in the various broad categories of construction activity. After developing bottom-up estimates of acreage and construction activity for the model firms, by construction activity category, and for the total industry, EPA examined these values in relation to the top-down estimates and decided to *reconcile* the bottom-up estimates to the top-down estimates for the development of the model firm and industry baseline, and for assignment of compliance costs to model firms in the cost and economic impact analysis.

To assign acreage to the model firms, EPA relied on data from the Census Bureau's *Characteristics of New Housing*, for single-family housing, and from Reed Construction, for the multifamily and nonresidential building construction sectors, to derive a relationship between project acreage and value. This concept, *acreage intensity*, is defined as the number of acres developed per dollar value of activity accruing as revenue to the firm. The acreage intensity concept asks the question: *how much acreage of construction activity is required to generate a given project value*? EPA used data from the Census Bureau's *Characteristics of New Housing* to develop an acreage intensity distribution for the single-family building construction sector. Reed Construction data provided acreage intensity distributions for the multifamily and nonresidential building construction sectors. In developing these acreage intensity distributions, EPA expressed all dollar values from different years in a single common data year, 2002, based on the Construction Cost Index. An acreage intensity distribution was not available for the transportation sector. Therefore, a single, average value was used for this sector (derived from the Federal Highway Administration's (FHWA) *Highway Statistics*).

In using the project site size data from the Census Bureau's *Characteristics of New Housing* and the project size data within Reed Construction, EPA recognized that these data sources do not account for road development associated with a building's construction. As a result, the reported acreage values and acreage intensity calculated from these datasets would understate affected project acreage and acreage intensity. To address this omission, EPA applied a multiplier to scale-up all of acreage and resulting acreage intensity values to account for the typical road development "overhead" associated with new construction activity. These multipliers (see *Table 4-11*), were derived from information in the Center for Watershed Protection's *Impervious Cover and Land Use in the Chesapeake Bay Watershed* (Capiella, 2001). This document provides data, by sector, on the acreage allocations among the different elements of a lot, e.g., buildings, roads, sidewalks, open space, etc. EPA determined the percent allocation for roads within a lot area and applied these multipliers to the acreage intensity values. *Table 4-12*, following page, presents the derived acreage intensity values for all the NAICS sectors (with distribution values for all sectors except transportation).

Table 4-11: Acreage Intensity Multiplier

Construction Category	Acreage Intensity Multiplier
Residential Construction	1.13
Non-Residential Construction	1.06

Source: Center for Watershed Protection (2001)

Table 4-12: Distribution of Acreage Intensity by Sector (acreage per $ million of project value, $2002)

NAICS Code	Sector Name	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
236115	New Single-Family Housing Construction (except Operative Builders)	0.40	0.74	1.04	1.51	3.11
236116	New Multifamily Housing Construction (except Operative Builders)	0.14	0.31	0.71	1.51	4.30
236117	New Housing Operative Builders	0.24	0.62	1.04	1.51	3.26
236210	Industrial Building Construction	0.39	0.66	1.29	2.20	7.73
236220	Commercial and Institutional Building Construction	0.26	0.51	1.06	2.17	5.15
237310	Highway, Street, and Bridge Construction [a]	-	-	-	-	-

a A distribution of acreage intensity was not available for the highway sector. Therefore, EPA developed average acreage intensity from FHWA's *Highway Statistics*, available within *Table 4-13*.

Source: U.S. Census Bureau's Characteristics of New Housing (2008) and Reed Construction Data (2008)

At the level of the model firm, acreage intensity determines the total amount of acreage that a firm *can* develop annually: that is, multiplying a model firm's revenue value by acreage intensity (acreage per dollar of project value) indicates the total amount of construction activity acreage for which the model firm can begin (or complete) projects in a given year. To develop the initial estimates of baseline acreage by model firm and for the industry in aggregate, EPA *multiplied* the median acreage intensity values reported above in conjunction by the average revenue value for the model firms by revenue range in each NAICS sector.[43] Summing the indicated acreage values across the number of firms by revenue range within a sector yields the total amount of acreage by general sector (i.e., residential, non-residential, transportation). As described here, this calculation provides an estimate of total acreage and construction activity by model firm, but does not account for the configuration of that activity in terms of number of projects and size of individual projects. Thus, by itself, this calculation does not indicate whether a given model firm would complete *contiguous* projects that would be within the scope of a regulatory option (depending on the acreage coverage threshold of the option, e.g., projects of at least one acre, projects of at least 10 acres, etc.). Therefore, to estimate the *compliance acreage* that could be undertaken by a given model firm and, as a result, the compliance costs that the model firm would incur (as described in *Chapter 3*), it was necessary to make an assumption about the configuration of the acreage *on which projects could be performed* by a given model firm. In this calculation, EPA assumed that *all* of the construction activity started (or completed) in a year was for *a single project* and so occurred on one contiguous site.

As might be expected, the acreage estimates in aggregate and by broad construction category, as derived from this bottom-up method, differ from the top-down estimates reported in *Table 4-10* of the preceding section. For four of the building categories (all except Commercial and Institutional Building Construction) – i.e., New Single-Family Housing Construction (except Operative Builders), New Multifamily Housing Construction (except Operative Builders), New Housing Operative Builders, and Industrial Building Construction – the bottom-up estimate of acreage based on the median acreage intensity value was *less* than the estimated top-down values. As described above, EPA used the *median* acreage intensity value as the starting point for the acreage calculations described in this section. In using the median percentile acreage intensity values as the starting point for this analysis, EPA did not expect the bottom-up acreage calculation to match the top-down value, if for no other reason than the *mean*, and not the *median*, of the acreage intensity distribution would be the appropriate measure for estimating total acreage development. Implicitly, the calibration to reconcile the bottom-up estimates to the top-down estimates is

[43] For each construction sector, the acreage intensity distribution is right skewed, i.e. the mean is greater than the median.

finding the mean of the acreage intensity distribution. That the mean is greater than median for four of the distributions is consistent with the "right" or positive skewness of these distributions: that is, the distributions are bounded on the low-side by a value greater than zero but are open-ended on the up-side and with a relatively long "right tail" of higher acreage intensity values. The presence of the longer right tail of high acreage intensity values on these distributions "pulls" the mean above the median.

Apart from the difference in the top-down and bottom-up calculations due to use of the median acreage intensity value, instead of the mean, as the starting point for calculating the bottom-up acreage estimates, there are numerous potential sources of discrepancy that could be attributed to aspects of both the top-down and bottom-up approaches. EPA considers one source of this discrepancy to be the project values used in the calculation of acreage intensity.

As a final step in developing the acreage and construction activity baseline, EPA adjusted the acreage intensity values used in the acreage calculation to reconcile the bottom-up estimates to the top-down estimates, by sector – i.e., a higher acreage intensity value *increases* the acreage developed per dollar of revenue, thus *increasing* the overall acreage developed for these categories. For the Commercial and Institutional Building Construction category, the bottom-up estimate exceeded the top-down estimate. Accordingly, for this category, EPA reduced the acreage intensity to reconcile the bottom-up estimate to the top-down estimate – i.e., a lower acreage intensity value *decreases* the acreage developed per dollar of revenue, thus *decreasing* the overall acreage developed for the non-residential categories. A similar adjustment was required for the transportation sector, where estimated bottom-up acreage also exceeded the top-down estimate. *Table 4-13* reports the initial and adjusted acreage intensity values and percentiles that were required to reconcile the bottom-up estimates to the top-down estimates, by construction sector and regulatory option.

As shown in *Table 4-13*, the initial acreage intensity values and the adjusted values – which reconcile acreage to the top-down derived values for the regulatory options – differ by varying degrees. The values for the non-residential sectors (*Industrial Building Construction* and *Commercial and Institutional Building*) are quite close to the median, with the Industrial Building Construction sector value being slightly above the median for all options and the Commercial and Institutional Building value being slightly above the median for Options 1 and 3. The values for the residential sectors lie consistently above and somewhat farther from the median, perhaps suggesting that the positive skewness phenomenon described above is of greater importance for the residential sector distributions. Regardless, given that the top-down and bottom-up estimates derive from completely independent estimation methods, the finding that these independently derived estimates are approximately close provides a degree of assurance about the reasonableness of the methods for estimating the total acreage and construction activity values, and the allocation of these values over construction activity categories and industry segments.

Table 4-13: Initial and Adjusted Acreage Intensity Values by Sector

NAICS Code	Sector Name	Initial Intensity and Percentile	Adjusted Intensity and Percentile		
			Option 1	Option 2	Option 3
236115	New Single-Family Housing Construction (except Operative Builders)	1.04 (50%)	1.66 (81%)	1.48 (71%)	1.90 (85%)
236116	New Multifamily Housing Construction (except Operative Builders)	0.71 (50%)	1.78 (79%)	1.36 (71%)	2.07 (84%)
236117	New Housing Operative Builders	1.04 (50%)	1.78 (81%)	1.51 (74%)	2.05 (85%)
236210	Industrial Building Construction	1.29 (50%)	1.56 (59%)	1.34 (53%)	1.71 (64%)
236220	Commercial and Institutional Building Construction	1.06 (50%)	1.33 (58%)	0.95 (46%)	1.38 (59%)
237310	Highway, Street, and Bridge Construction	3.10	1.30	1.52	1.35

EPA Estimates

The resulting baseline acreage values by sector (shown within *Table 4-14*) are derived from the number of firms, average revenue, and the adjusted acreage intensity values by sector. As documented above, the total acreage and

the acreage grouped by general sector (i.e., residential, non-residential, and highway construction) necessarily align to the values developed by the top-down method as reported in *Table 4-10*, above.

Table 4-14: Industry (Bottom-Up) Gross Acreage Developed

NAICS Code	Sector Name	Acreage
236115	New Single-Family Housing Construction (except Operative Builders)	99,000
236116	New Multifamily Housing Construction (except Operative Builders)	25,000
236117	New Housing Operative Builders	163,000
236210	Industrial Building Construction	35,000
236220	Commercial and Institutional Building Construction	213,000
237310	Highway, Street, and Bridge Construction	55,000
Total		**590,000**

EPA Estimates

4.3 Number of Units and Projects Developed

As a final step in developing the acreage and construction activity baseline, EPA calculated the numbers of single-family units and of multifamily, non-residential, and transportation projects that are indicated by the acreage aggregates, based on the distribution of single-family housing units by lot size or project size (see *Table 4-15*, below). For each construction activity category, dividing total acreage by the relevant unit or project size yields the number of construction activity units or projects.

Table 4-15: Average Lot or Project Size by Sector

NAICS Code	Sector Name	Average Lot Size[a]	Median Lot Size	Average Project Size	Median Project Size
236115	New Single-Family Housing Construction (except Operative Builders)	0.39	0.20	-	-
236116	New Multifamily Housing Construction (except Operative Builders)	-	-	15.84	6.00
236210	Industrial Building Construction	-	-	49.11	19.00
236220	Commercial and Institutional Building Construction	-	-	12.77	3.00
237310	Highway, Street, and Bridge Construction	-	-	23.00	-

a The average lot size is reported for the single-family housing construction sector but is not used to calculate the number of construction activity single-family units.

Source: U.S. Census Bureau's Characteristics of New Housing (2008), Reed Construction Data (2008), and Notice of Intent Database

For the estimate of single-family units, EPA used the distribution of single-family units among lot size ranges, as reported by the Census Bureau's *Characteristics of New Housing*. As compared to the average lot size, the distribution of single-family units among the lot size ranges provides a more precise estimation as to the number of construction activity units. Within the industry sector and model firm framework, single-family units may be constructed by firms in both NAICS 236115 and 236117. The number of units in NAICS 236115 is determined by 1) apportioning the total acreage for that NAICS sector among the different lot size ranges (according to the distribution of units among the lot size ranges) and then 2) dividing the relevant acreage apportioned to each lot size range by the average lot size within the range. However, because firms in NAICS 236117 may perform activities in both the single-family construction and multifamily construction category, EPA first disaggregated the total NAICS 236117 acreage between the two construction activity categories using the acreage distribution percentages reported in *Table 4-9*. Subsequently, EPA performed the same disaggregation of acreage falling in the single-family construction category among the different lot size ranges and then divided the number of acres by the average single-family lot size within the relevant range to derive the number of single-family housing units for NAICS 236117. The remaining acreage is divided by the average *project* size for multifamily housing construction to derive the number of multifamily housing projects for NAICS 236117.

Average project size data for the non-residential sectors is available at the project level from the Reed Construction data. Dividing the total acreage values by the average project size values yields the number of projects for the non-residential building sectors.

Average project size data for the transportation sector is not available from Reed Construction data or from the FHWA. Therefore, EPA used the average project size previously determined from the NOI data to calculate the implied number of transportation projects.

Table 4-16, below, reports the indicated number of unit or project starts, by year, for each of the construction activity categories and related business sectors.

Table 4-16: Indicated Number of Units or Projects by Sector

NAICS Code	Sector Name	Units[a]	Projects
236115	New Single-Family Housing Construction (except Operative Builders)	434,765	-
236116	New Multifamily Housing Construction (except Operative Builders)		1,575
236117	New Housing Operative Builders[b]	510,119	3,031
236210	Industrial Building Construction		718
236220	Commercial and Institutional Building Construction	-	16,669
237310	Highway, Street, and Bridge Construction	-	2,411
Total		**944,883**	**24,404**

a No information is available on the number of individual housing units within a single-family project. Therefore, the *units* count for NAICS 236115 and NAICS 236117 is for the number of units, not projects.

b The number of single-family units and multifamily projects is determined for NAICS 236117 based on the residential acreage breakout reported in *Table 4-9*.

As a test of validity, EPA then compared the estimated the number of single-family units to single-family unit data present in the Census Bureau's *Characteristics of New Housing*. *Table 4-17* reports the average number of single-family housing units started during the 1990's reported within the Census data. EPA's estimated number of units reported within *Table 4-16* – approximately 950,000, which is reasonably comparable to the Census's reported average of approximately 1.1 million units. This simple data comparison is used as an example to help demonstrate and verify the overall reasonableness of EPA's approach for estimating total developed acreage.

Table 4-17: Number of Single-family Units Estimated from Census data (in Thousands of Units)

Sector Name	Units[a]
New Privately Owned Housing Units Started	1,103.4

a Based on the average number of new privately owned housing units started during the 1990's.

Source: U.S. Census Bureau's Characteristics of New Housing (2008c)

Comparable data are not available for multi-family, non-residential, and non-building projects, and therefore, this simple validity test is only performed for the single-family sector.

4.4 Key Sources of Uncertainty and Limitations

The primary sources of uncertainty and limitations in the analysis baseline are highlighted below:

- ***Compilation of the C&D Firm Universe Potentially Subject to Regulation.*** As described in Section *4.1.2*, to develop the firm-level analysis baseline, EPA blended together firm-level data from the Economic Census and SUSB to reconcile inconsistencies between data reported at the level of the establishment versus the level of C&D firms. In addition, EPA reconfigured these data to develop firm-level data by state. This process, although appropriate and credible for the stated purpose, inevitably introduces error into the baseline economic data. EPA has no basis for knowing the quantity or direction of error in these data.

- ***Model Firm Revenue Values and Number of Firms by Industry Segment and Revenue Range are based on 2002 Data.*** EPA used C&D industry activity – in terms of numbers of firms, revenues, employees – for the year 2002 as the base year for the economic analysis. This year was chosen because it is the most recent year for which SUSB and Economic Census data are available for the C&D sectors. Although the current and future average values of revenue for firms in the various revenue range categories will most likely differ from the values observed in 2002, there is no obvious basis – e.g., an index of business revenue change – on which to adjust the average revenue values.
- ***Baseline Financial Data for Model Firms.*** To develop the model firms, EPA assigned financial characteristics – balance sheet, income statement, and metrics of financial performance and condition – to each of the model firms as defined by the six NAICS sectors and seven revenue size ranges, from financial statement information reported by Risk Management Association (RMA) (see *Section 4.1.3*). RMA compiles and reports financial statement information by industry as provided by member commercial lending institutions. Because the financial statements received by RMA are for businesses applying for credit from member institutions, these data do not constitute a statistically valid random sample. Nevertheless, EPA, which has utilized the same data in previous economic analyses, believes these data are of high quality and do offer the advantage of being available at the 6-digit NAICS level and for quartile ranges of baseline financial performance and condition.
- ***Acreage Intensity Source Data.*** There is uncertainty with respect to the Reed Construction data that underlies the estimated acreage intensity distributions for the multifamily and nonresidential building construction sectors. Recall that *acreage intensity* is defined as the number of acres developed per dollar value of activity accruing as revenue to the firm. Acreage intensity is an important data input to the economic analysis used for multiple purposes, including: to establish the baseline estimate of construction acreage across sectors and revenue range, and to establish the quantity of acreage developed by a model firm that *could be* within the scope of the regulation. The source of potential error derives from the Reed "value of construction" data, which is used as the denominator in estimating acreage intensity. The value field is intended to capture the value of the construction activity itself, and may not capture other components of eventual total project revenue, e.g., land value, financing costs, or developer's markups. As such, the Reed-reported value may understate the overall project value, and thus revenue that could accrue from these activities (thus overstating the quantity of acreage developed – and therefore compliance cost incurred – per dollar of total project value). Furthermore, because this information is self-reported by builders/developers and not subsequently verified at the end of a project, there is fundamentally an unknown amount of error in the value estimates (see *Section 4.2.2*).

5 Economic Impact Analysis Results

As described in *Chapter 3,* EPA undertook a number of analyses to gauge the cost and economic impact of the three regulatory options considered for the C&D industry regulation. These analyses include:

1. An assessment of the potential cost and economic/financial impact of alternative regulatory options on the industries and firms likely to face compliance requirements and incur compliance costs from a C&D industry regulation. This analysis yields estimates of the numbers of firms in the affected C&D industry sectors that may incur adverse economic/financial effects: costs exceeding thresholds of concern relative to revenue, incurrence of financial stress from weakened financial performance and condition, and potential incurrence of negative business value, which may indicate a risk of business closure. This analysis also produces a first-order estimate (i.e., before accounting for potential market adjustment effects) of the resource cost of regulatory compliance (i.e., the cost of resources consumed by society in meeting regulatory requirements) and of the acreage affected by the regulatory options. Finally, this analysis supports an assessment of the potential for C&D regulatory options to pose a barrier to entry for new businesses seeking to enter the C&D industry

2. An assessment of the potential single-family housing affordability effects of alternative regulatory options. This analysis estimates, by Metropolitan Statistical Area, the potential change in price for newly constructed single-family homes, and the associated number of prospective home buyers whose purchasing decisions may be affected by the potential increase in new home prices due to compliance requirements.

3. An assessment of the total social cost of alternative regulatory options, reflecting the potential for change in the total output of the affected C&D industries as a result of cost-induced price increases in construction product markets. The reduction in construction industry activity and output reduces the resource cost of compliance estimated in the firm and industry impact analysis (the so-called "first-order" estimate). However, the reduction in construction industry activity and output also reduces the net economic welfare to society from production and consumption of C&D industry output. The estimates of impact on industry output are based on an analysis of market response to the regulatory options undertaken on a state-by-state basis. The social cost estimate reported from this analysis accounts for both the output reduction and the loss in net economic welfare from production and consumption of C&D industry output. The social cost estimate also accounts for expected Federal, State, and local government administrative costs for reviewing and processing discharge monitoring reports (DMRs), which are required for each in-scope project under Option 2 and Option 3, the most stringent option.

4. An assessment of the economy-wide effects of alternative regulatory options, including the output and employment effects resulting from the consumption of society's resources to achieve compliance with regulatory options, the output and employment effects resulting from reduced activity in the C&D industries, and the output and employment effects resulting from administrative activities performed by Federal, State, and local governments.

5. An assessment of future cost and acreage effects of alternative regulatory options. As explained in earlier chapters, EPA's analyses of the alternative regulatory options are based on a construction industry and construction activity baseline for 2002, which is the most recent year for which detailed economic information on the construction industry is available from the Economic Census and Small Business Administration, the two principal sources of baseline information for this analysis. Because the regulation will be implemented at a later time than this baseline analysis year, EPA projected forward the cost and acreage effects accounting for the expected levels of construction industry activity during the years in

which the regulation will begin to be implemented, and also accounting for the phase-in of the regulation as states renew their Construction General Permits, which will adopt and apply the provisions of this regulation to construction and development activities in their states. This projection relies on a recent forecast of total construction industry activity over the next several years.

The remainder of this chapter first reviews the regulatory options considered in this analysis and then summarizes the findings from the impact analyses outlined above. The chapter includes four appendixes:

1. *Appendix 5-1: Primary Analysis Case – Detailed Firm and Industry Analysis Results by Industry Sector and Revenue Range*
2. *Appendix 5-2*: *Adverse Analysis Case – Summary of Firm and Industry Analysis Results*
3. *Appendix 5-3*: *Detailed Results for the Single-Family Housing Affordability Analysis*
4. *Appendix 5-4*: *State-Level Compliance Cost and Acreage*

5.1 Overview of Proposed Regulatory Options

This economic analysis evaluates the economic impacts of three regulatory options:

- *Option* 1 would establish minimum sizing criteria for sediment basins used at construction sites with 10 or more disturbed acres draining to one location. Under this option, permittees would be required to install sediment basins that provide *either* 3,600 cubic feet per acre of runoff storage, or be designed to store runoff from the local 2-year, 24-hour storm event, whichever is less expensive. This option also includes requirement for implementing a variety of erosion and sediment controls on all construction sites that are required to obtain a permit (e.g., larger than one acre).
- *Option 2* incorporates the same requirements as Option 1, and in addition, requires construction sites of 30 or more acres to meet a numeric turbidity limit in stormwater discharges from the site. The numeric turbidity standard would be applicable to stormwater discharges for all storm events up to the local 2-year, 24-hour event. The turbidity standard would only apply to construction sites located in areas where the rainfall runoff erosivity factor (R-factor) as defined in the Revised Universal Soil Loss Equation (RUSLE) is greater than or equal to 50 and if the soils on the site contain 10% or more by mass of soil particles smaller than 2 microns in diameter.
- *Option 3* incorporates the same requirements as Option 1, and in addition, requires all sites with 10 or more acres of disturbed land to meet a numeric turbidity standard. Unlike Option 2, the turbidity standard would apply to all sites, regardless of soil types or R-factor. The turbidity standard would apply to all stormwater discharges for all storm events up to the local 2-year, 24-hour event.

EPA is proposing *Option 2* for this rulemaking.

5.2 Key Findings

In this section, EPA reports the results from the five cost and impact analyses described in *Chapter 3* and summarized at the beginning of this chapter. *Table 5-1* summarizes the key cost and sediment removal figures for each option as provided by the engineering analysis.

Table 5-1: Summary of Costs and Sediment Removed by Option			
	Option 1	**Option 2**	**Option 3**
Sediment Removed			
Mass Removed (million lbs/yr)	670	26,000	50,000
Percent Removed (%)	1.2%	46.0%	87.8%
Compliance Cost			
Cost (million $/yr)	$132	$1,891	$3,797
Cost per pound removed ($/lb)	$0.20	$0.07	$0.08

5.2.1 Firm- and Industry-Level Cost and Impacts & Barriers to Entry Analysis

5.2.1.1 Firm- and Industry-Level Cost and Impacts

Table 5-2, below, presents EPA's estimates of the cost and firm- and industry-level impact of the regulatory options. These results are based on the 2002 snapshot of industry and activity and are *before* possible reductions in the quantity of construction activity resulting from market adjustment to compliance cost-induced price increases. As described in *Chapter 3*, EPA performed these analyses for two impact assessment cases: the primary impact analysis case and the adverse impact analysis case. The results presented below are for the *primary analysis case*. EPA presents that the primary case impact analysis as its best estimate of firm- and industry-level impacts under general, long-term business conditions for the construction industry. The results for the *adverse analysis case* are presented in *Appendix 6.2*. Recall from *Chapter 3* that the primary and adverse analysis cases are differentiated in the following ways:

- The *primary analysis case* assumes that firms in the C&D industry pass through some of the incremental compliance costs and uses the *general business conditions case* definition for model C&D firms. The general business conditions case is meant to reflect the financial performance and condition of C&D industry businesses during *normal* – neither excessively strong nor weak – economic conditions for the specific industrial segments. The financial performance and condition of the C&D industry businesses for this case is reflected in the RMA model-firm financial statements and their costs of debt and equity.
- The *adverse analysis case* assumes that firms in the C&D industry pass through *none* of the incremental compliance costs and uses the *adverse business conditions case* definition for model C&D firms. The adverse business conditions case is meant to reflect the financial performance and condition of C&D industry businesses during relatively weak economic conditions for the specific industrial segments. The financial performance and condition of the C&D industry businesses for this case is reflected in the relatively weaker RMA model-firm financial statements and by their relatively higher costs of debt and equity. In addition, the adverse analysis case assumes a slight contraction of the overall C&D industry relative to the primary analysis case. Additional detail on the adverse analysis case is provided with the results in Appendix 6.2.

The results presented in *Table 5-2* are aggregated across the affected industry sectors and revenue ranges used in the analysis. Disaggregated results, by industry sector and by revenue range for the primary analysis case, are presented in *Appendix 6-1*.

Table 5-2: Summary of Cost and Economic Impact Analysis for Proposed Rule Options

Impact Analysis Concept		Option 1	Option 2	Option 3
Resource Cost of Compliance and Affected Acreage and Firms (before market adjustments)				
Total Costs (millions of $2008)		$132	$1,890	$3,797
Total Acreage Incurring Cost[a]		119,136	289,617	524,052
Number of Firms	All Firms	152,298	152,298	152,298
	Firms In-Scope	81,628	81,628	81,628
	Firms Incurring Cost	3,207	6,396	13,765
Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact				
Costs Unadjusted for Effect of Cost Pass-Through				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	774	2,475
	% of All Firms	0.0%	0.5%	1.6%
	% of Firms In-Scope	0.0%	0.9%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	33	146
	% of All Firms	0.0%	0.0%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.2%
Costs Adjusted for Effect of Cost Pass-Through[b]				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	15	39
	% of All Firms	0.0%	0.0%	0.0%
	% of Firms In-Scope	0.0%	0.0%	0.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	0
	% of All Firms	0.0%	0.0%	0.0%
	% of Firms In-Scope	0.0%	0.0%	0.0%
Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance				
Firms Incurring Financial Stress	Number Incurring Effect	17	147	445
	% of All Firms	0.0%	0.1%	0.3%
	% of Firms In-Scope	0.0%	0.2%	0.5%
Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)				
Firms with Negative Business Value	Number Incurring Effect	18	103	389
Because of Regulation (Potential Closures)	% of All Firms	0.0%	0.1%	0.3%
	% of Firms In-Scope	0.0%	0.1%	0.5%

a Option costs for the economic impact analysis vary slightly from the engineering compliance cost estimates due to the reconciliation process described in *Chapter **4***.

b Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors.

EPA Estimates

The estimated levels of cost, affected acreage, and resulting firm and industry impacts reported in *Table 5-2* vary substantially over the three primary regulatory options analyzed.

- For *Option 1*, the least costly of the three options, EPA estimates total costs of $132 million ($2008) occurring on a total of 119,000 affected acres. A total of 3,200 firms are estimated to incur compliance costs under this option. Out of these 3,200 firms, none are estimated to incur costs exceeding 1 or 3 percent of revenue, while 17 firms are estimated to incur financial stress. These 17 firms represent 0.5 percent of all firms incurring cost and essentially zero percent of all firms in the affected industry sectors. A total of 18 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.
- For *Option 2*, EPA estimates total costs of $1,890 million ($2008) occurring on a total of 290,000 affected acres. Thus, cost and affected acreage under Option 2 are approximately 14.3 and 2.4 times the corresponding values under Option 1. A total of 6,400 firms are estimated to incur compliance costs under this option. Out of these 6,400 firms, 774 are estimated to incur costs exceeding 1 percent of revenue, and 33 are estimated to incur costs exceeding 3 percent of revenue. The 774 firms incurring cost exceeding 1 percent of revenue represent 12 percent of the firms that are estimated to incur costs, but less than 1 percent of all firms in the affected industry sectors. When the effect of cost pass-through is accounted for in the cost-to-revenue analysis – i.e., costs are reduced by the amount of estimated offsetting revenue

increase – 15 firms are estimated to incur (*net*) costs exceeding 1 percent of revenue. A total of 147 firms are estimated to incur financial stress as a result of regulatory requirements. These 147 firms represent 2.3 percent of all firms incurring cost but less than 0.1 percent of all firms in the affected industry sectors. A total of 103 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

- For *Option 3*, the most costly option, EPA estimates total costs of $3,797 million ($2008) occurring on a total of 524,000 affected acres. Thus cost and affected acreage under Option 3 are approximately of 2.0 and 1.8 times the corresponding values under Option 2. A total of 13,800 firms are estimated to incur compliance costs under this option. Out of these 13,800 firms, 2,475 are estimated to incur costs exceeding 1 percent of revenue, and 146 are estimated to incur costs exceeding 3 percent of revenue. The 2,475 firms with cost greater than 1 percent of revenue represent 18 percent of firms estimated to incur costs and 2.4 percent of all firms in the affected industry sectors. The 220 firms incurring cost greater than 3 percent of revenue represent 1.6 percent of firms estimated to incur costs. When the effect of cost pass-through is accounted for in the cost-to-revenue analysis – i.e., costs are reduced by the amount of estimated offsetting revenue increase – 39 firms are estimated to incur (*net*) costs exceeding 1 percent of revenue. A total of 445 firms are estimated to incur financial stress as a result of regulatory requirements. These 445 firms represent 3.2 percent of all firms incurring cost but 0.3 percent of all firms in the affected industry sectors. A total of 389 firms are estimated to experience negative business value as a result of regulatory requirements. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

5.2.1.2 Barriers to Entry Analysis

Overall, the C&D industry is a dynamic industry, with a relatively high rate of entry and exit as compared to the national economy. At the outset, this observation suggests relatively low barriers to entry for the industry and may suggest that an increase in factors associated with high barriers to entry would need to be substantial before a material barriers-to-entry effect would be observed. *Table 5-3* reports the total number of firm or establishment entries and exits for the construction industry and for the total U.S. economy for the seven-year period 1998 to 2004.[44] EPA compared these numbers to the total base of firms or establishments to determine the percentage of entries and exits for each year, and calculated the average of these values over the seven data years. As reported in *Table 5-3*, the percentage of entries and exits for the C&D industry is higher than the comparable values for all U.S. industries.

Table 5-3: Number and Percent of Firm/Establishment Entries and Exits

	Entry		Exit	
	Number	**Percent**	**Number**	**Percent**
Construction Sector [a,b]	84,461	14.1%	76,166	12.7%
U.S. Total [a,b]	736,599	11.7%	677,272	10.7%

Percentages are calculated as number of entries or exits divided by total firm/establishment base
a SBA reports the U.S. total by number of firms and reports the Construction sector by number of establishments.
b Average from 1998 to 2004
Source: SBA 2004

As described in *Chapter 3: Economic Impact Analysis Methodology*, EPA assessed the potential for the C&D regulatory options to pose an entry barrier for new businesses by examining the extent to which the regulation

[44] U.S. SBA reports the U.S. total figures by the number of *firms* and reports the Construction sector figures by the number of *establishments*. Since the relevant comparison is based on the *percent* of entries/exits as compared to the total base, the difference in reporting does not inhibit the comparison. 2004 is the latest year for which data are available from SBA.

would increase the capital required by firms of various revenue sizes to participate in the industry. A substantial increase in capital requirements could mean that some firms might not be able to assemble the capital necessary to participate in the industry.

Table 5-4 summarizes the results from this analysis for the three regulatory options by business sector and revenue range. As shown in *Table 5-4*, under all options, nearly all model firms in the three lowest revenue ranges are expected to incur no compliance outlay and hence would experience no change in financing requirements for entering the C&D industry. Thus, the regulatory options are expected to create no more than a minimal additional barrier to entry for firms in these revenue ranges, which across the board, are comprised of small businesses.

Within the higher revenue ranges (generally Revenue Range 4 and up) in which firms are estimated to perform projects that will be subject to compliance requirements, the additional financing requirement varies by regulatory option. For Option 2 (*Table 5-4*), the increase in financing requirement varies from approximately 0.6 percent to 5.6 percent of baseline assets over the business sectors. This comparison assumes that the compliance outlay would be financed and recorded on the model firm's balance sheet. To the extent that the compliance outlay is financed and recorded *not on the firm's baseline sheet but as part of a separate project-based financing for each individual project*, this comparison is likely to overstate, perhaps substantially, the incremental burden of financing in relation to the going concern asset base of the model firms.

The variation by business sector reflects differences in baseline assets in relation to revenue as reported in the Risk Management Association financial statements underlying the model firms. For example, in no instance for Option 2 is the estimated increase in financing requirements substantial in relation to baseline assets.

It is important to note that EPA does not consider the estimated financing requirement and the relative burden of that requirement – additional financing requirement relative to baseline assets – to vary between existing C&D industry businesses and businesses seeking to enter the industry. As a result, EPA foresees no *differential* regulatory burden that would more adversely affect entering businesses than existing business and thus lead to a comparative barrier to entry for firms seeking to enter the industry.

Finally, the expectation of an increase in financing requirements occurs primarily among the larger revenue ranges in the analysis. Given their business size, the firms in these revenue ranges would be expected to have better access to financing – both for debt and equity capital – than firms in the lower revenue ranges. Thus, the burden of any additional financing is comparatively less than would have been the case if the regulation was expected to impose compliance requirements on smaller businesses, which, in general, have less favorable access to capital.

The less costly Option 1 would impose a comparatively lower increase in financing requirements while the more costly Option 3 would impose a comparatively high increase in financing requirements.

Table 5-4: Compliance Outlay as a Percent of Total Assets[a]

NAICS Sector[b]	Revenue Ranges						
	Range 1: $100 thousand - $1 million	Range 2: $1 million - $2.5 million	Range 3: $2.5 million - $5 million	Range 4: $5 million - $10 million	Range 5: $10 million - $50 million	Range 6: $50 million - $100 million	Range 7: $100 million and more
Option 1							
236115	0.0%	0.0%	0.0%	0.8%	0.8%	0.8%	0.8%
236116	0.0%	0.0%	0.0%	1.1%	1.2%	1.3%	1.3%
236117	0.0%	0.0%	0.0%	0.9%	1.1%	0.8%	0.8%
236210	0.0%	0.0%	0.0%	0.7%	0.8%	0.8%	0.8%
236220	0.0%	0.0%	0.0%	0.8%	0.8%	0.9%	0.9%
237310	0.0%	0.0%	0.0%	0.4%	0.5%	0.4%	0.4%
Option 2							
236115	0.0%	0.0%	0.0%	0.6%	3.3%	3.9%	3.9%
236116	0.0%	0.0%	0.0%	0.7%	3.9%	5.6%	5.6%
236117	0.0%	0.0%	0.0%	0.6%	4.0%	3.8%	3.8%
236210	0.0%	0.0%	0.0%	0.6%	3.2%	4.5%	4.5%
236220	0.0%	0.0%	0.0%	0.0%	2.1%	3.9%	3.9%
237310	0.0%	0.0%	0.0%	0.0%	3.4%	3.1%	3.1%
Option 3							
236115	0.0%	0.0%	0.0%	6.4%	6.5%	6.2%	6.2%
236116	0.0%	0.0%	7.7%	9.0%	9.8%	10.3%	10.3%
236117	0.0%	0.0%	7.1%	7.1%	8.3%	6.2%	6.2%
236210	0.0%	0.0%	0.0%	5.3%	5.8%	6.0%	6.0%
236220	0.0%	0.0%	0.0%	5.7%	6.0%	6.0%	6.0%
237310	0.0%	0.0%	0.0%	3.2%	3.4%	3.1%	3.1%

a Based on the median performance financial statement. Analysis assumes compliance-related outlays are financed from, and recorded on, the model firm's balance sheet and not financed as part of separate project financings for each individual projects. As a result, EPA estimates that this analysis may overstate substantially the financing burden in comparing the financing requirement to the firm's going concern assets instead of project assets that are financed separately from the model firm's balance sheet.

b NAICS 236115 is New single-family housing construction (except operative builders), NAICS 236116 is New multifamily housing construction (except operative builders), NAICS 236117 is New housing operative builders, NAICS 236210 is Industrial building construction, NAICS 236220 is Commercial and institutional building construction, NAICS 237310 is Highway, street, and bridge construction

EPA Estimates

5.2.2 Single-Family Housing Affordability Analysis

Because the C&D rule may increase the cost of housing construction and, as a result, the price (or rent) of housing, the regulation has the potential to affect the purchasing decisions of consumers of newly constructed housing. Given this potential effect, EPA performed a regional-level analysis (i.e., level of Metropolitan Statistical Areas (MSA)) that estimates the number and fraction of potential single-family home buyers whose purchasing decision may be affected by the potential price of newly constructed, single-family housing. The results of the analysis are *produced* at the MSA-level and *reported* at the national-level by aggregating the total number of impacted households across all MSAs. Detailed state-level results are presented in *Appendix 6-2*. As described in *Chapter 3*, EPA performed this analysis at two home price levels: the median price and lower quartile price for new single-family homes, by MSA. Also, as described in *Chapter 3*, for this analysis, EPA assumed that compliance costs would be *fully passed through* to consumers in increased housing prices. This assumption is effectively contradictory to the assumptions of *partial* and *no cost pass-through* that underlie the analysis of firm and industry-level regulatory impacts.

Performing this analysis at the level of the MSA, instead of at the national level, is important because of the substantial variation in home prices and household income – and ultimately, affordability effects – across MSAs in the United States. *Table 5-5*, which reports the 5th percentile, 95th percentile, and average of new single-family home prices from the set of median- and lower-quartile MSA prices used in the analysis, underscores this observation in relation to new home prices.

Table 5-5: Baseline New Home Prices (2006$)[a]

	5th Percentile	95th Percentile
Median Baseline New Home Price	$110,300	$560,400
Lower Quartile Baseline New Home Price	$66,486	$403,593

a These values are based on the set of MSA home prices.
Source: U.S. Census Bureau. American Community Survey. 2006a.

5.2.2.1 Results of the Median-Priced Single-Family Home Analysis

Table 5-6 shows, by regulatory option, the estimated dollar value and percentage change in the price for a new single-family home and the number of households in the market for a new, median-priced single family home whose purchasing decision may be practically affected by the price change. The price increase assumes: (1) a compliance cost based on the median lot size, 0.23 acres, for all new single-family housing as reported in the Census of Housing and (2) that compliance costs are fully passed through as an increased price to the home purchaser.[45] This table also shows the number of affected households as a percentage of the total number of home-purchasing households that also qualify to purchase the median-priced home, before compliance cost effect. The key conclusion from this analysis is that, for all regulatory options, the total number of households incurring an affordability effect is small in comparison to the number of all likely single-family home buyers in any given year who can also afford the same home. For Option 2, this percentage is less than 0.1 percent.

Table 5-6: Price and Household Affordability Effects – Median-Price, Single-Family Housing Affordability Analysis (2006$)

		Option 1	Option 2	Option 3
National Average Price Change per New Single-Family Home	Price Change[a]	$330	$2,061	$2,242
	Percent Change[b]	0.10%	0.64%	0.70%
Number of Households with an Affordability Effect	Number	39	2,195	4,523
	As % of qualifying single-family home buyers	0.00%	0.08%	0.17%

a These are national average price changes estimated from the national average engineering estimate of per acre compliance cost converted to the equivalent of compliance costs per housing unit. Price changes for MSAs are estimated individually using engineering estimates of state-level compliance costs.
b The national average percent change in home price is estimated using the national average price change and the weighted-average median home price across all 543 MSAs.
EPA Estimates

Table 5-7 shows the effect of the estimated national average change in home prices on a typical monthly payment by comparing the baseline and post-compliance monthly payments for each option. For example, the median home price analysis shows increases in monthly payments of $1 for *Option 1*, $14 for *Option 2*, and $15 for *Option 3*. In each case, the percentage increase in the monthly payment due to regulatory requirements is low – for example, 0.69 percent for Option 2.

Table 5-7: Change in the Monthly Mortgage Payment – Median-Price, Single-Family Housing Affordability Analysis (2006$)[a]

		Option 1	Option 2	Option 3
Baseline Weighted Average Monthly Mortgage Payment		$1,971	$1,971	$1,971
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,972	$1,985	$1,986
	Percent Change	0.02%	0.69%	0.75%

a These values are weighted by the number of households within each state.
EPA Estimates

The marginal affordability effects for likely buyers of newly constructed, single-family homes – in this case, a median-priced home – as illustrated in *Table 5-6* and *Table 5-7*, do not mean that these households would be unable to afford a single-family home, or even not be able afford the exact same new single-family home. *Any*

[45] The 0.23 acre lot size is the median value for new single-family housing as reported in the Census' *2006 Characteristics of New Housing*, adjusted for additional land development associated with roadways, which is not accounted for in the Census' lot size data.

potentially affected home buyer has a number of avenues through which any price increase due to the regulation might be mitigated:

- *Price negotiation.* The home buyer may be able to offset the price increase through negotiation of the sales price.
- *Attribute substitution.* The home buyer may be able to mitigate the effect of the price increase through substitution (e.g., purchasing a new home with marginally different attributes, or effectively the same new home in a marginally different location).
- *Purchase deferment*. The home buyer may be able to mitigate the effect of the regulation by increasing the down-payment so that the there is no change in what would have otherwise been the monthly payment. If the home buyer lacks the financial resources to increase the down-payment *at the preferred time of purchase,* the increase in the down-payment might be achieved by delaying the purchase, and saving from current income to reach the needed down-payment value.
- *Purchase a home whose price is not affected by the regulation.* Each of the preceding adjustments involves changes to purchase the desired new, in-scope home. However, the prospective home buyer may be able to mitigate the effect of the price increase by purchasing a new or existing home whose price does not increase as a result of the regulation.[46]

The *purchase deferment* mitigation option means that the purchaser might need to delay the home purchase long enough to save the requisite increase in the down-payment. Depending on a household's income and the amount of time over which the household saves the additional funds, the impact on a given household's disposable income will vary. For example, *for any given amount to be saved*, the fraction of income that would have to be set-aside over a 3-month period is twice the fraction of income set-aside if savings are accrued over a six-month deferment period.[47]

Table 5-8, below, presents the fraction of household income required to be saved, to offset the effect of the regulation on the monthly mortgage payment via an increase in the initial down-payment. The table shows the fraction of income required to be saved in order to accumulate the increase in down-payment over 3, 6, and 12 month periods. In each case, the income used in the calculation is the income at which the prospective home buyer would just be able to purchase the home at the baseline price under conventional financing criteria. The results show, for example, that under Option 2, a household would need to set-aside 5.7% of its income over a 6-month period to offset the regulation's effect on the mortgage payment. The fraction of income required to be saved decreases, *for any savings time period*, for households that earn income in excess of this minimum income requirement. Therefore, the required increases in down payment in this table are overstated to the extent that the income of households interested in purchasing the median-priced home exceeds the minimum income threshold value.

[46] Such substitutes are expected to be readily available given that nearly 93% of single-family homes available in the market *would not* be expected to incur cost under Option 2.

[47] With no allowance for interest earned on the savings during the accumulation period.

Table 5-8: Change in Down-Payment Required to Offset Effect of the Regulation – Median-Price, Single-Family Housing Affordability Analysis

	Baseline	Option 1	Option 2	Option 3
Income necessary to pay baseline mortgage PITI	$72,464			
Required increase in down-payment to offset regulation price effect	$0	$330	$2,064	$2,245
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.5%	2.8%	3.1%
6 months	0.0%	0.9%	5.7%	6.2%
3 months	0.0%	1.8%	11.4%	12.4%

Source: EPA Estimates

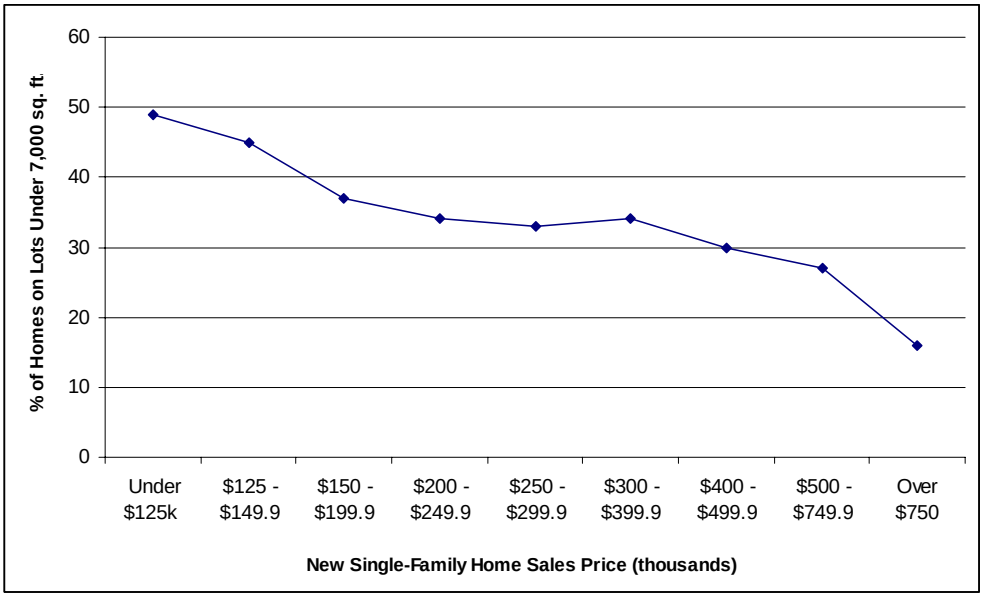
5.2.2.2 Results of the Lower-Quartile-Priced Single-Family Home Analysis

The mitigating factors described in the preceding section also apply to the lower-quartile home price analysis and are likely to reduce the ultimate *practical effects* of the regulation on single-family home buyers. But in addition, other qualifications in this analysis are critical for properly understanding the practical implications of whether and to what extent households – in particular low/moderate-income households and first-time home buyers – could be affected by the regulation:

- ***Home price changes due to the regulation are likely to decrease with baseline home sales price.*** An important factor to be accounted for in the analysis for the lower-quartile price home is that the compliance cost burden and potential home price increase will typically be less for the lower-quartile price home than for the median price home. As a result, simply carrying forward the same price effect as used for the median price analysis will overstate the typical impact. This occurs because, as shown in Census data, lot size typically declines with price for new single-family homes, thereby reducing the compliance cost burden, which is directly associated with lot size, and the resulting price impact per home. As shown in *Figure 5-1*, Census data indicate that about half of new, lower priced single-family homes are constructed on lots *less than* 7,000 square feet, and this fraction declines as home price increases. Based on the Census data, lower-priced homes will often have lot sizes that are smaller than the median value used in the preceding analysis.[48] To account for this factor, EPA performed the affordability analysis for the lower-quartile price home under two compliance cost/price effect cases:
  - Using the median lot size for *all* new single-family housing, 0.23 acres, which yields the same compliance cost and price effect as in *Table 5-6*, above
  - Using a smaller lot size that is based on the Census-reported median lot size of *attached* new single-family housing, 0.08 acres (as described in *Section 3.4.2*), which yields a compliance cost and price effect that is approximately 64 percent less than under the median lot size case (see *Table 5-9*, below).

[48] The home price and lot size resolution for this analysis are limited by the data ranges reported by the Census: "$125,000 and below" and is the lowest home price range reported, and "7,000 square feet and below" is the lowest lot size range reported.

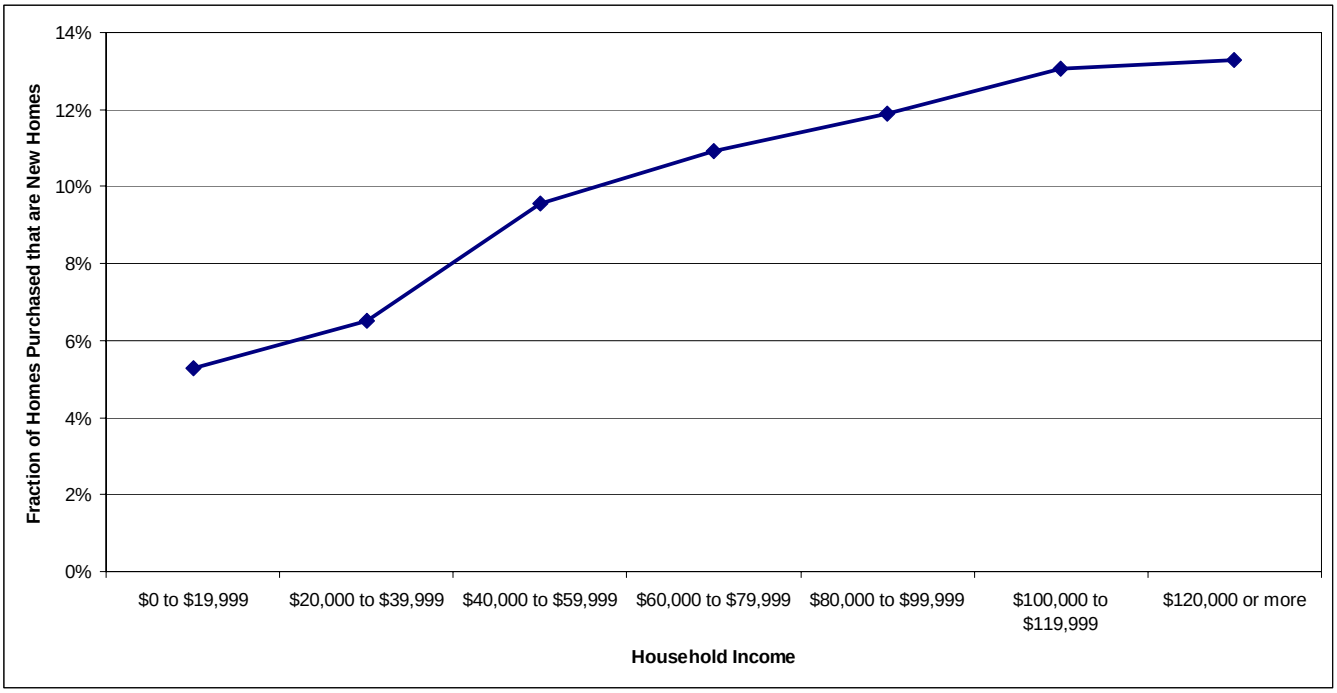
Figure 5-1: Percentage of New Single Family Homes Sold with Lot Sizes Under 7,000 Square Feet, by Price Range



Source: U.S. Census Characteristics of New Housing (2006)

- ***Low/moderate-income home buyers are less likely to purchase newly constructed single-family homes than higher income home buyers.*** The practical impact of the regulation on low/moderate-income (and first-time home buyers, to the extent these home buyers are more likely to have low/moderate incomes) is also probably overstated in the analysis because these households are less likely to purchase newly constructed housing than higher income home buyers. As reported in the 2005 American Housing Survey (HUD, 2006a), in any given income range, the fraction of home purchases that are new, generally increases with income (see *Figure 5-2*). This information indicates that, in general, households with higher incomes are more likely to purchase a new home than households with lower income.

Figure 5-2: Fraction of Homes Purchased that are New Homes, by Income Range



Source: U.S. Department of Housing and Urban Development (2006)

In addition to these specific considerations for low/moderate-income and first-time home buyers, it is also important to emphasize again that this affordability analysis assumes 100 percent cost pass through of compliance costs from builders to consumers. This assumption implies that the demand for new housing is highly *inelastic* (all costs pass through as a price increase with no change in the equilibrium quantity of new housing sold or rented). Such conditions would generally be expected to prevail during relative "boom" periods in the market for housing (e.g., most recently in 2005 - 2006).[49] While it is possible that a substantial fraction of compliance costs could be passed through to housing consumers, the actual fraction is expected to be *less than* 100 percent *in the steady state*. Moreover, during periods of relative "bust" periods (e.g., today's housing market weakness), the ability of home builders to pass through compliance costs could be *considerably* curtailed. The key point is that cost pass-through, which is ultimately reflected in the supply and demand price elasticity for new housing, is – in the steady state – expected to be less than 100 percent due to several factors, including (1) the availability of substitutes for any given home, and (2) the determination that rule is only expected to affect a small fraction – about 7 percent under Option 2 – of the total number of single-family home sales.[50] As such, to the extent that actual cost pass-through is less than 100 percent, the potential affordability effects for all home-buyers are overstated.

Below, *Table 5-9* and *Table 5-10* present the results of the affordability analysis for the lower-quartile priced home. *Table 5-9* reports, by regulatory option and for the two lot size cases outlined above, the estimated dollar value and percentage change in the price for a new single-family home and the number of households with an affordability effect. As expected, the number of households estimated to incur annually the affordability effect is

[49] It should be noted that EPA's use of 2006 home prices for the analysis, described in Chapter 3, is therefore consistent with the analysis' assumption of 100% cost pass-through given that "peak" market conditions generally prevailed during 2006. It would have been a relatively poor assumption to associate 100% cost-pass-through with price and market conditions present currently.

[50] Based on 2006 home sales data, EPA estimates that approximately 470,000 new, single-family home sales would be expected to incur cost under Option 2 out of a total of approximately 6.7 million single-family home sales.

smaller under the smaller lot size case of 0.08 acres (based on the median lot size for *attached* new single-family housing) than under the larger lot size of 0.23 acres (based on the median lot size for *all* new single-family housing): under Option 2, the estimated number of affected households declines from 3,243 to 1,165. As described above, EPA judges that the smaller lot size provides a better basis for assessing the affordability effect for the lower-quartile price analysis than the larger lot size used in the analysis for the median price. Regardless of the lot size case, the number of affected home buyers is small in relation to the number of single-family home purchasers who qualify to purchase the lower-quartile price home in the baseline (e.g., about 0.03% to 0.08% of such households, depending on the lot size case).

Table 5-9: Price and Household Affordability Effects – Lower-Quartile Price, Single-Family Housing Affordability Analysis (2006$)

		Option 1	Option 2	Option 3
Using Median Lot Size (0.23 acres) for *All* New Single-Family Housing as Basis for Compliance Cost				
National Average Price Change per New Single-Family Home[a]	Price Change[a]	$330	$2,061	$2,242
	Percent Change[b]	0.16%	1.03%	1.12%
Number of Households with an Affordability Effect	Number	53	3,243	6,633
	As % of qualifying single-family home buyers	0.00%	0.08%	0.16%
Using Median Lot Size (0.08 acres) for *Attached* New Single-Family Housing as Basis for Compliance Cost				
National Average Price Change per New Single-Family Home[a]	Price Change	$118	$738	$803
	Percent Change	0.06%	0.37%	0.40%
Number of Households with an Affordability Effect	Number	19	1,165	2,384
	As % of qualifying single-family home buyers	0.00%	0.03%	0.06%

a These are national average price changes estimated from the national average engineering estimate of per acre compliance cost converted to the equivalent of compliance costs per housing unit. Price changes for MSAs are estimated individually using engineering estimates of state-level compliance costs.
b The national average percent change in home price is estimated using the national average price change and the weighted-average lower-quartile home price across all 543 MSAs.
EPA Estimates

Table 5-10 shows the effect of the estimated national average change in lower-quartile home prices on the total monthly payment by comparing the baseline and post-compliance monthly payments for each option and for the two lot size cases outlined above. The analysis shows small increases in monthly payments, ranging from 0.36% - 1% for Option 2, depending on the lot size case.

Table 5-10: Change in the Monthly Mortgage Payment – Lower-Quartile Price Single-Family Housing Affordability Analysis (2006$)[a]

		Option 1	Option 2	Option 3
Using Median Lot Size (0.23 acres) for *All* New Single-Family Housing as Basis for Compliance Cost				
Baseline Weighted Average Monthly Mortgage Payment		$1,358	$1,358	$1,358
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,359	$1,372	$1,373
	Percent Change	0.04%	1.00%	1.09%
Using Median Lot Size (0.08 acres) for *Attached* New Single-Family Housing as Basis for Compliance Cost				
Baseline Weighted Average Monthly Mortgage Payment		$1,358	$1,358	$1,358
New Weighted Average Monthly Mortgage Payment	Monthly Payment	$1,359	$1,363	$1,364
	Percent Change	0.01%	0.36%	0.39%

a These values are weighted by the number of households within each state.
EPA Estimates

Lastly, *Table 5-11* presents the fraction of household income required to be saved to offset the effect of the regulation on the monthly mortgage payment via an increase in the initial down-payment. The results for Option 2 show that a household would need to set-aside between 3% and 8.5% of its income over a 6-month period to offset the regulation's effect on the mortgage payment.

Table 5-11: Change in Down-Payment Required to Offset Effect of the Regulation – Lower-Quartile Price, Single-Family Housing Affordability Analysis

	Baseline	Option 1	Option 2	Option 3
Using Median Lot Size (0.23 acres) for *All* New Single-Family Housing as Basis for Compliance Cost				
Income necessary to pay baseline mortgage PITI	$49,660			
Required increase in down-payment to offset regulation price effect	$0	$330	$2,064	$2,245
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.7%	4.2%	4.5%
6 months	0.0%	1.3%	8.5%	9.0%
3 months	0.0%	2.7%	16.9%	18.1%
Using Median Lot Size (0.08 acres) for *Attached* New Single-Family Housing as Basis for Compliance Cost				
Income necessary to pay baseline mortgage PITI	$49,660			
Required increase in down-payment to offset regulation price effect	$0	$118	$739	$804
Percent of income required to be saved to accumulate increase in down-payment over:				
12 months	0.0%	0.2%	1.5%	1.6%
6 months	0.0%	0.5%	3.0%	3.2%
3 months	0.0%	1.0%	6.0%	6.5%

Source: EPA Estimates

5.2.3 Social Cost of the Proposed Options

EPA reported, in *Section 5.2.1*, the resource cost of compliance for each C&D industry sector and proposed option that was estimated using the firm-analysis methodology described in *Chapter 3*. The firm-level estimate compliance cost, however, does not account for the potential affect of the proposed options on the quantity of construction activity/units performed in the various C&D markets. The incremental cost of compliance for each proposed option has the effect of increasing builders' costs and can cause an upward shift the market's supply curve. Part of the increased costs may raise the price of new housing, with the balance of increased costs being absorbed by the builder, depending on the relative elasticities of supply and demand. The resulting shift in market equilibrium may also reduce the quantity of construction units produced in a given market.

EPA estimated a state-by-state linear partial equilibrium market model for each C&D building sector to estimate this potential market effect on the quantity of output. EPA's assumption that compliance costs are will result in only small marginal changes in prices and quantities provides the basis for assuming that the supply and demand curves are linear in the relevant range of market effect. The estimated change in the quantity of output produced in each C&D market segment is then used to not only adjust the firm-level resource cost of compliance, but also to compute the economic value of the reduction in C&D output, and estimate the total loss of consumer and producer surplus (e.g., deadweight loss).

The total social cost of the regulatory options is comprised of the quantity-adjusted resource cost of compliance, the deadweight loss to society, and government administrative costs for reviewing and processing discharge monitoring reports (DMR). The results of the social cost analysis are presented in *Table 5-12*.

For *Option 1*, the least costly option, the total social cost is approximately $132 million with the total dead weight loss under $1 million (approximately $40,000). For *Option 2*, the total social cost is approximately $1,887 million with approximately $3.5 million in dead weight loss. *Option 3*, the most costly option, has a total social cost of approximately $3,790 million with approximately $8.2 million in dead weight loss.

Table 5-12: Total Social Cost of the Proposed Regulation, (millions of $2008)

	Option 1	Option 2	Option 3
Total Resource Costs, Unadjusted for Quantity Effect	$132	$1,890	$3,797
Change in Resource Costs Due to Quantity Effect	$0.1	$7	$16
Total Resource Costs, Adjusted for Quantity Effect	$132	$1,883	$3,780
Dead Weight Loss	$0.0	$3.5	$8.2
Federal, State, and Local Government Cost for DMR Review & Processing	$0.0	$0.7	$1.2
Total Social Cost of the Regulation	$132	$1,887	$3,790
Total Acreage Incurring Cost	119,071	288,757	522,300

EPA Estimates

5.2.4 Economy-Wide Effects of the Proposed Options

EPA also estimated the total economic effects on output and employment due to the regulatory options. The analysis of total economic effects is intended to account for inter-industry linkages in the national economy by estimating the magnitude of output and employment changes derived from both the resource cost of compliance, the direct change C&D industry output, and the output and employment effects resulting from administrative activities performed by Federal, State, and Local governments. EPA used input-output multipliers from BEA to estimate the total economic effects of each option on the overall U.S. economy. The results are presented in *Table 5-13*. It is important to emphasize that the total economic effects reported below, whether derived from resource cost outlays or the change in C&D industry output, are *not costs in addition to* the social cost of the rule. The reported output and employment effects are manifestations of activity arising from social cost. Moreover, the reported employment effects should not be interpreted strictly as jobs *created* or jobs *lost*. Employment effects in this context is simply a conversion of economic activity into employment equivalents – EPA does not have any basis for knowing whether all, none, or some of these "jobs" will actually be created or lost.

Table 5-13: Total Economic Output and Employment Effects, (millions of $2008)

	Option 1	Option 2	Option 3
Economic Effects Arising from the Resource Cost of Compliance			
Total Change in Economic Output Arising from Compliance Cost Outlays	$271	$3,856	$7,743
Total Change in Employment Arising from Compliance Cost Outlays (jobs)	471	6,698	13,450
Economic Effects Arising from the Change in C&D Industry Output			
Change in C&D Industry Output	($126)	($3,102)	($3,500)
Direct Employment Effect from Reduced C&D Industry Output (jobs)	(4)	(87)	(98)
Total Change in Economic Output from Reduced C&D Industry Output	($257)	($6,345)	($7,159)
Total Change in Employment from Reduced C&D Industry Output (jobs)	(98)	(2,407)	(2,716)
Economic Effects Arising from Government Administrative Cost			
Total Change in Economic Output Arising from Government Admin Cost	$0	$1.2	$2.0
Total Change in Employment Arising from Government Admin Cost (jobs)	0	0.1	0.3
Net Economic Effects on Output and Employment			
Net Change in Demand for Society's Resources, Measured in Economic Output	$14	($2,489)	$584
Net Change in Demand for Society's Resources, Measured in Employment (jobs)	373	4,291	10,734

EPA Estimates

5.2.5 Projections of Future Social Cost and Compliance Acreage through 2025

This section presents a projection of total social cost based on to more accurately reflect the industry's anticipated activity level during 2010, when the rule begins, and out to 2025. In this analysis, EPA takes into consideration the expected "phase-in" of compliance across over the first five years after promulgation as states renew their Construction General Permit, which will adopt and apply the provisions of this regulation to construction and development activities in their states (i.e., not all states will come into compliance during 2010; compliance will phase-in from 2010 to 2014).

The primary estimates of total social cost, based on industry activity in 2002 and the assumption of full compliance by states subject to each regulatory option, are reported in *Table 5-12* as $132 million for Option 1, $1,887 million for Option 2, and $3,790 million for Option 3. The results presented below in *Table 5-14* differ in two important ways: they account for the phase-in of compliance from 2010 – 2014 as states renew their CGPs, and they account for the expected change in industry activity from 2002 to each year from 2010 and beyond. In *Table 5-14*, the first year of full compliance is 2014 because this is the first year when all states will have renewed their CGPs, and the total cost of Option 2 is $2,178 million. The difference between the 2002-based estimate of $1,887 million and the estimate of $2,178 in 2014 is created by the expected increase in overall C&D industry activity. In 2010, the total cost of the regulatory options is expected to be $0 for Option 1, $173 million for Option 2, and $284 million for Option 3.[51]

Table 5-14: Total Value of Construction Activity and Social Cost, by Year – Accounting for State-Specific Phase-In Beginning 2010 (millions of $2008)

	2010	2011	2012	2013	2014	2020	2025
Total Value of Construction	$1,214,460	$1,283,936	$1,316,002	$1,351,038	$1,387,007	$1,623,850	$1,851,833
annual percent change	*5.1%*	*5.7%*	*2.5%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*
Total Estimated Acreage	595,473	629,538	645,261	662,440	680,076	796,204	907,989
Annual percent change	*5.1%*	*5.7%*	*2.5%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*
Intensity (acres per $million)	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Estimated Compliance Cost and In-Scope Acreage							
Option 1							
Cost	$0	$10	$49	$149	$153	$179	$204
Acres Incurring Cost	0	15,932	49,035	133,708	137,268	160,707	183,270
Cost as % of Value	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%
Option 2							
Cost	$173	$292	$583	$1,831	$2,178	$2,550	$2,908
Acres Incurring Cost	23,789	45,998	94,514	270,161	333,695	390,676	445,526
Cost as % of Value	0.01%	0.02%	0.04%	0.14%	0.16%	0.16%	0.16%
Option 3							
Cost	$284	$518	$1,115	$3,724	$4,376	$5,123	$5,842
Acres Incurring Cost	41,105	77,289	167,050	481,995	603,809	706,914	806,162
Cost as % of Value	0.02%	0.04%	0.08%	0.28%	0.32%	0.32%	0.32%

EPA Estimates

Table 5-15 presents EPA estimate of the annualized value of total social cost from 2010 – 2025, using both a 3% and 7% discount rate (in 2008 dollars). The annualized cost of Option 2 is $1,829 to $1,970 million, depending on the discount rate.

Table 5-15: Annualized Total Social Cost of the Proposed Regulation, 2010 - 2025 (millions of $2008)

Regulatory Option	Net Present Value of Social Cost		Annualized Social Cost	
	3%	*7%*	*3%*	*7%*
Option 1	$1,737	$1,212	$138	$128
Option 2	$24,744	$17,280	$1,970	$1,829
Option 3	$49,578	$34,590	$3,947	$3,662

EPA Estimates

[51] Option 1 costs are $0 in 2010 because none of the states subject to Option 1 will have a renewed CGP permit in that year.

Appendix 5-1: Primary Analysis Case - Detailed Results for the Firm-Level Impact Analysis

Table 5-16 through *Table 5-21* report the detailed results for the firm-level impact analysis for Options 1, 2, and 3. The results reported are for the 2002 general business conditions case: i.e. assuming the primary acreage assignment case and, unless otherwise reported, partial cost pass-through of the compliance outlay.

Table 5-16: Option 1 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	$1,000 to $3,000	$3,000 to $5,000	$5,000 to $10,000	$10,000 to $50,000	$50,000 to $100,000	$100,000 to $1,000,000	All Firms	Small Firms
Total Firms in Sectors, all States (from SUSB and Economic Census)									
Number of Firms	**93,687**	**28,772**	**14,115**	**7,010**	**6,901**	**849**	**964**	**152,298**	**148,760**
Total Revenue in Range ($000,000)	**$41,462**	**$56,517**	**$61,287**	**$60,095**	**$167,298**	**$62,951**	**$258,417**	**$708,027**	**$344,835**
Estimated Employment	**259,258**	**205,932**	**170,213**	**160,713**	**349,365**	**105,498**	**384,084**	**1,635,064**	**1,058,140**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements									
Number of In-Scope Firms	**24,151**	**27,716**	**14,115**	**7,010**	**6,901**	**849**	**964**	**81,706**	**78,168**
Number of Firms	**0**	**0**	**0**	**1,069**	**1,691**	**207**	**239**	**3,207**	**2,337**
Total Revenue in Range ($000,000)	**$0**	**$0**	**$0**	**$8,529**	**$38,304**	**$14,425**	**$61,188**	**$122,446**	**$37,257**
Estimated Employment	**0**	**0**	**0**	**22,644**	**85,647**	**25,864**	**98,627**	**232,782**	**86,879**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors									
Total Indicated Compliance Acreage	**0**	**0**	**0**	**9,249**	**36,745**	**13,509**	**59,633**	**119,136**	**36,808**
Total Indicated Cost ($000,000)	**$0**	**$0**	**$0**	**$10**	**$41**	**$15**	**$66**	**$132**	**$41**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures									
Pre-Tax Income/Total Assets									
Number of Firms	0	0	0	4	11	1	1	17	12
Percentage of All Firms	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%
EBIT/Interest									
Estimated Number of Firms	0	0	0	3	9	1	1	14	10
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%
Composite Result (calculated as average of separate estimate values)									
Estimated Number of Firms	0	0	0	4	11	1	1	17	12
Percentage of All Firms	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.0%	0.0%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)									

Table 5-16: Option 1 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	**$1,000 to $3,000**	**$3,000 to $5,000**	**$5,000 to $10,000**	**$10,000 to $50,000**	**$50,000 to $100,000**	**$100,000 to $1,000,000**	**All Firms**	**Small Firms**
with Compliance Costs Unadjusted for Cost Pass-Through Effect									
Number exceeding 1.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue									
Number exceeding 1.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation									
Number of Firms	0	0	0	6	10	1	1	18	14
Percentage of All Firms	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Table 5-17: Option 1 Results by NAICS Sector Aggregated over Firm Revenue Size Ranges

	NAICS Sectors						All
	236115	236116	236117	236210	236220	237310	Sectors
Total Firms in Sectors, all States (from SUSB and Economic Census)							
Number of Firms	**65,291**	**4,834**	**25,265**	**2,807**	**42,892**	**11,209**	**152,298**
Total Revenue in Sector ($000,000)	**$95,465**	**$23,660**	**$138,313**	**$33,721**	**$316,019**	**$100,849**	**$708,027**
Estimated Employment	**262,236**	**42,337**	**213,604**	**124,328**	**684,409**	**308,149**	**1,635,064**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements							
Number of In-Scope Firms	**33,609**	**2,620**	**17,295**	**1,688**	**20,797**	**5,696**	**81,706**
Number of Firms	**325**	**122**	**724**	**118**	**1,422**	**495**	**3,207**
Total Revenue in Sector ($000,000)	**$10,349**	**$4,046**	**$22,841**	**$10,132**	**$54,512**	**$20,565**	**$122,446**
Estimated Employment	**10,832**	**5,627**	**28,451**	**32,881**	**94,477**	**60,514**	**232,782**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors							
Total Indicated Compliance Acreage	**12,268**	**6,582**	**40,049**	**6,018**	**42,198**	**12,021**	**119,136**
Total Indicated Cost ($000,000)	**$13**	**$7**	**$45**	**$7**	**$47**	**$13**	**$132**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures							
Pre-Tax Income/Total Assets							
Number of Firms	1	0	3	1	10	2	17
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
EBIT/Interest							
Estimated Number of Firms	1	0	2	1	9	1	14
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Composite Result (calculated as average of separate estimate values)							
Estimated Number of Firms	1	0	3	1	10	2	17
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)							
with Compliance Costs Unadjusted for Cost Pass-Through Effect							
Number exceeding 1.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue							
Number exceeding 1.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation							
Number of Firms	3	0	1	1	12	1	18
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Table 5-18: Option 2 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	**$1,000 to $3,000**	**$3,000 to $5,000**	**$5,000 to $10,000**	**$10,000 to $50,000**	**$50,000 to $100,000**	**$100,000 to $1,000,000**	**All Firms**	**Small Firms**
Total Firms in Sectors, all States (from SUSB and Economic Census)									
Number of Firms	**93,687**	**28,772**	**14,115**	**7,010**	**6,901**	**849**	**964**	**152,298**	**148,760**
Total Revenue in Range ($000,000)	**$41,462**	**$56,517**	**$61,287**	**$60,095**	**$167,298**	**$62,951**	**$258,417**	**$708,027**	**$344,835**
Estimated Employment	**259,258**	**205,932**	**170,213**	**160,713**	**349,365**	**105,498**	**384,084**	**1,635,064**	**1,058,140**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements									
Number of In-Scope Firms	**24,151**	**27,716**	**14,115**	**7,010**	**6,901**	**849**	**964**	**81,706**	**78,168**
Number of Firms	**0**	**0**	**0**	**419**	**4,321**	**773**	**881**	**6,396**	**3,660**
Total Revenue in Range ($000,000)	**$0**	**$0**	**$0**	**$3,256**	**$104,037**	**$58,301**	**$243,401**	**$408,995**	**$81,284**
Estimated Employment	**0**	**0**	**0**	**6,751**	**206,928**	**90,808**	**341,133**	**645,620**	**161,947**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors									
Total Indicated Compliance Acreage	**0**	**0**	**0**	**3,544**	**75,698**	**39,286**	**171,089**	**289,617**	**60,318**
Total Indicated Cost ($000,000)	**$0**	**$0**	**$0**	**$4**	**$461**	**$265**	**$1,159**	**$1,890**	**$350**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures									
Pre-Tax Income/Total Assets									
Number of Firms	0	0	0	1	92	18	20	132	70
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	1.3%	2.1%	2.1%	0.1%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	1.3%	2.1%	2.1%	0.2%	0.1%
EBIT/Interest									
Estimated Number of Firms	0	0	0	1	88	15	17	121	67
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	1.3%	1.7%	1.8%	0.1%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	1.3%	1.7%	1.8%	0.1%	0.1%
Composite Result (calculated as average of separate estimate values)									
Estimated Number of Firms	0	0	0	1	106	18	21	147	81
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	1.5%	2.1%	2.2%	0.1%	0.1%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	1.5%	2.1%	2.2%	0.2%	0.1%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)									
with Compliance Costs Unadjusted for Cost Pass-Through Effect									
Number exceeding 1.0% of Revenue	0	0	0	0	526	115	133	774	395
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	7.6%	13.6%	13.7%	0.5%	0.3%

Table 5-18: Option 2 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	**$1,000 to $3,000**	**$3,000 to $5,000**	**$5,000 to $10,000**	**$10,000 to $50,000**	**$50,000 to $100,000**	**$100,000 to $1,000,000**	**All Firms**	**Small Firms**
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	7.6%	13.6%	13.7%	0.9%	0.5%
Number exceeding 3.0% of Revenue	0	0	0	0	23	5	5	33	17
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.3%	0.6%	0.5%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.3%	0.6%	0.5%	0.0%	0.0%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue									
Number exceeding 1.0% of Revenue	0	0	0	0	10	3	3	15	7
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.3%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	0.3%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation									
Number of Firms	0	0	0	2	72	13	16	103	56
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	1.0%	1.6%	1.6%	0.1%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	1.0%	1.6%	1.6%	0.1%	0.1%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Table 5-19: Option 2 Results by NAICS Sector Aggregated over Firm Revenue Size Ranges

	NAICS Sectors						All
	236115	236116	236117	236210	236220	237310	Sectors
Total Firms in Sectors, all States (from SUSB and Economic Census)							
Number of Firms	**65,291**	**4,834**	**25,265**	**2,807**	**42,892**	**11,209**	**152,298**
Total Revenue in Sector ($000,000)	**$95,465**	**$23,660**	**$138,313**	**$33,721**	**$316,019**	**$100,849**	**$708,027**
Estimated Employment	**262,236**	**42,337**	**213,604**	**124,328**	**684,409**	**308,149**	**1,635,064**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements							
Number of In-Scope Firms	**33,609**	**2,620**	**17,295**	**1,688**	**20,797**	**5,696**	**81,706**
Number of Firms	**598**	**263**	**1,536**	**272**	**2,853**	**873**	**6,396**
Total Revenue in Sector ($000,000)	**$30,720**	**$15,966**	**$86,841**	**$29,185**	**$198,089**	**$48,195**	**$408,995**
Estimated Employment	**29,306**	**17,264**	**104,258**	**99,186**	**281,218**	**114,388**	**645,620**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors							
Total Indicated Compliance Acreage	**29,891**	**14,144**	**94,566**	**16,468**	**100,416**	**34,133**	**289,617**
Total Indicated Cost ($000,000)	**$189**	**$96**	**$626**	**$109**	**$650**	**$220**	**$1,890**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures							
Pre-Tax Income/Total Assets							
Number of Firms	5	3	24	9	67	23	132
Percentage of All Firms	0.0%	0.1%	0.1%	0.3%	0.2%	0.2%	0.1%
Percentage of Firms In-Scope	0.0%	0.1%	0.1%	0.6%	0.3%	0.4%	0.2%
EBIT/Interest							
Estimated Number of Firms	4	2	17	7	76	15	121
Percentage of All Firms	0.0%	0.1%	0.1%	0.3%	0.2%	0.1%	0.1%
Percentage of Firms In-Scope	0.0%	0.1%	0.1%	0.4%	0.4%	0.3%	0.1%
Composite Result (calculated as average of separate estimate values)							
Estimated Number of Firms	5	4	25	10	81	23	147
Percentage of All Firms	0.0%	0.1%	0.1%	0.3%	0.2%	0.2%	0.1%
Percentage of Firms In-Scope	0.0%	0.1%	0.1%	0.6%	0.4%	0.4%	0.2%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)							
with Compliance Costs Unadjusted for Cost Pass-Through Effect							
Number exceeding 1.0% of Revenue	53	33	195	28	394	71	774
Percentage of All Firms	0.1%	0.7%	0.8%	1.0%	0.9%	0.6%	0.5%
Percentage of Firms In-Scope	0.2%	1.3%	1.1%	1.7%	1.9%	1.3%	0.9%
Number exceeding 3.0% of Revenue	2	2	7	0	22	0	33
Percentage of All Firms	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue							
Number exceeding 1.0% of Revenue	0	0	0	0	15	0	15
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation							
Number of Firms	5	2	12	5	65	15	103
Percentage of All Firms	0.0%	0.0%	0.0%	0.2%	0.2%	0.1%	0.1%
Percentage of Firms In-Scope	0.0%	0.1%	0.1%	0.3%	0.3%	0.3%	0.1%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Table 5-20: Option 3 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	**$1,000 to $3,000**	**$3,000 to $5,000**	**$5,000 to $10,000**	**$10,000 to $50,000**	**$50,000 to $100,000**	**$100,000 to $1,000,000**	**All Firms**	**Small Firms**
Total Firms in Sectors, all States (from SUSB and Economic Census)									
Number of Firms	**93,687**	**28,772**	**14,115**	**7,010**	**6,901**	**849**	**964**	**152,298**	**148,760**
Total Revenue in Range ($000,000)	**$41,462**	**$56,517**	**$61,287**	**$60,095**	**$167,298**	**$62,951**	**$258,417**	**$708,027**	**$344,835**
Estimated Employment	**259,258**	**205,932**	**170,213**	**160,713**	**349,365**	**105,498**	**384,084**	**1,635,064**	**1,058,140**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements									
Number of In-Scope Firms	**24,151**	**27,716**	**14,115**	**7,010**	**6,901**	**849**	**964**	**81,706**	**78,168**
Number of Firms	**0**	**0**	**181**	**4,871**	**6,901**	**849**	**964**	**13,765**	**10,227**
Total Revenue in Range ($000,000)	**$0**	**$0**	**$791**	**$41,573**	**$167,298**	**$62,951**	**$258,417**	**$531,031**	**$167,838**
Estimated Employment	**0**	**0**	**1,392**	**106,102**	**349,365**	**105,498**	**384,084**	**946,441**	**369,518**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors									
Total Indicated Compliance Acreage	**0**	**0**	**1,282**	**46,057**	**160,303**	**58,971**	**257,439**	**524,052**	**167,566**
Total Indicated Cost ($000,000)	**$0**	**$0**	**$9**	**$333**	**$1,161**	**$427**	**$1,866**	**$3,797**	**$1,213**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures									
Pre-Tax Income/Total Assets									
Number of Firms	0	0	4	120	225	29	33	413	293
Percentage of All Firms	0.0%	0.0%	0.0%	1.7%	3.3%	3.5%	3.5%	0.3%	0.2%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	1.7%	3.3%	3.5%	3.5%	0.5%	0.4%
EBIT/Interest									
Estimated Number of Firms	0	0	4	85	217	25	28	359	251
Percentage of All Firms	0.0%	0.0%	0.0%	1.2%	3.1%	2.9%	2.9%	0.2%	0.2%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	1.2%	3.1%	2.9%	2.9%	0.4%	0.3%
Composite Result (calculated as average of separate estimate values)									
Estimated Number of Firms	0	0	4	123	253	30	34	445	318
Percentage of All Firms	0.0%	0.0%	0.0%	1.8%	3.7%	3.5%	3.5%	0.3%	0.2%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	1.8%	3.7%	3.5%	3.5%	0.5%	0.4%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)									
with Compliance Costs Unadjusted for Cost Pass-Through Effect									
Number exceeding 1.0% of Revenue	0	0	41	898	1,239	138	160	2,475	1,868
Percentage of All Firms	0.0%	0.0%	0.3%	12.8%	18.0%	16.2%	16.6%	1.6%	1.3%

Table 5-20: Option 3 Results by Firm Revenue Size Range and Estimated Total for All Firms in NAICS Sectors

	Firm Revenue Size Range, Based on SUSB/Economic Census Data ($000)								
	$100 to $1,000	**$1,000 to $3,000**	**$3,000 to $5,000**	**$5,000 to $10,000**	**$10,000 to $50,000**	**$50,000 to $100,000**	**$100,000 to $1,000,000**	**All Firms**	**Small Firms**
Percentage of Firms In-Scope	0.0%	0.0%	0.3%	12.8%	18.0%	16.2%	16.6%	3.0%	2.4%
Number exceeding 3.0% of Revenue	0	0	4	55	71	8	9	146	111
Percentage of All Firms	0.0%	0.0%	0.0%	0.8%	1.0%	1.0%	0.9%	0.1%	0.1%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.8%	1.0%	1.0%	0.9%	0.2%	0.1%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue									
Number exceeding 1.0% of Revenue	0	0	0	12	22	3	3	39	28
Percentage of All Firms	0.0%	0.0%	0.0%	0.2%	0.3%	0.3%	0.3%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.2%	0.3%	0.3%	0.3%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation									
Number of Firms	0	0	17	131	196	21	24	389	295
Percentage of All Firms	0.0%	0.0%	0.1%	1.9%	2.8%	2.5%	2.5%	0.3%	0.2%
Percentage of Firms In-Scope	0.0%	0.0%	0.1%	1.9%	2.8%	2.5%	2.5%	0.5%	0.4%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Table 5-21: Option 3 Results by NAICS Sector Aggregated over Firm Revenue Size Ranges

	NAICS Sectors						All
	236115	236116	236117	236210	236220	237310	Sectors
Total Firms in Sectors, all States (from SUSB and Economic Census)							
Number of Firms	**65,291**	**4,834**	**25,265**	**2,807**	**42,892**	**11,209**	**152,298**
Total Revenue in Sector ($000,000)	**$95,465**	**$23,660**	**$138,313**	**$33,721**	**$316,019**	**$100,849**	**$708,027**
Estimated Employment	**262,236**	**42,337**	**213,604**	**124,328**	**684,409**	**308,149**	**1,635,064**
Total Firms in Sectors Adjusted for Expected In-Scope Exclusions and Overlapping State Requirements							
Number of In-Scope Firms	**33,609**	**2,620**	**17,295**	**1,688**	**20,797**	**5,696**	**81,706**
Number of Firms	**1,396**	**514**	**2,967**	**430**	**6,365**	**2,093**	**13,765**
Total Revenue in Sector ($000,000)	**$38,696**	**$18,980**	**$105,557**	**$30,843**	**$252,281**	**$84,675**	**$531,031**
Estimated Employment	**46,600**	**23,893**	**134,242**	**106,907**	**403,920**	**230,880**	**946,441**
Total Annual Compliance Acreage and Cost, based on Adjusted Total Firms in Sectors							
Total Indicated Compliance Acreage	**56,008**	**29,321**	**172,880**	**22,954**	**191,162**	**51,727**	**524,052**
Total Indicated Cost ($000,000)	**$398**	**$220**	**$1,272**	**$165**	**$1,362**	**$379**	**$3,797**
Percent and Number of Firms Falling Below NAICS Sector 1st Quartile Values for Financial Performance Measures							
Pre-Tax Income/Total Assets							
Number of Firms	37	15	91	19	202	49	413
Percentage of All Firms	0.1%	0.3%	0.4%	0.7%	0.5%	0.4%	0.3%
Percentage of Firms In-Scope	0.1%	0.6%	0.5%	1.1%	1.0%	0.9%	0.5%
EBIT/Interest							
Estimated Number of Firms	26	9	59	18	216	31	359
Percentage of All Firms	0.0%	0.2%	0.2%	0.7%	0.5%	0.3%	0.2%
Percentage of Firms In-Scope	0.1%	0.3%	0.3%	1.1%	1.0%	0.5%	0.4%
Composite Result (calculated as average of separate estimate values)							
Estimated Number of Firms	37	16	91	22	230	49	445
Percentage of All Firms	0.1%	0.3%	0.4%	0.8%	0.5%	0.4%	0.3%
Percentage of Firms In-Scope	0.1%	0.6%	0.5%	1.3%	1.1%	0.9%	0.5%
Cost-to-Revenue Comparisons (based on distribution of in-scope acreage of activity per $ million of in-scope revenue)							
with Compliance Costs Unadjusted for Cost Pass-Through Effect							
Number exceeding 1.0% of Revenue	270	101	692	63	1,218	132	2,475
Percentage of All Firms	0.4%	2.1%	2.7%	2.2%	2.8%	1.2%	1.6%
Percentage of Firms In-Scope	0.8%	3.8%	4.0%	3.7%	5.9%	2.3%	3.0%
Number exceeding 3.0% of Revenue	12	13	55	0	66	0	146
Percentage of All Firms	0.0%	0.3%	0.2%	0.0%	0.2%	0.0%	0.1%
Percentage of Firms In-Scope	0.0%	0.5%	0.3%	0.0%	0.3%	0.0%	0.2%
with Compliance Costs Reduced by Cost Pass-Through Increase in Revenue							
Number exceeding 1.0% of Revenue	0	0	0	0	39	0	39
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Number exceeding 3.0% of Revenue	0	0	0	0	0	0	0
Percentage of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Firms With Negative Net Worth Because of Regulation							
Number of Firms	25	7	61	11	250	35	389
Percentage of All Firms	0.0%	0.1%	0.2%	0.4%	0.6%	0.3%	0.3%
Percentage of Firms In-Scope	0.1%	0.3%	0.4%	0.7%	1.2%	0.6%	0.5%

a Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors

Appendix 5-2: Adverse Analysis Case – Summary of Results for the Firm-Level Impact Analysis

Method for Determining the Adverse Analysis Case Variables and Model Firms

EPA estimated firm- and industry-level impacts under an *adverse analysis case* according to the specifications detailed within *Section 5.2.1.1*. This case is meant to illustrate the potential industry-level impact of the regulatory options during periods when the C&D industry or a given sector within the industry is operating under adverse business conditions. The *adverse analysis case* differs from the *primary analysis case* as follows:

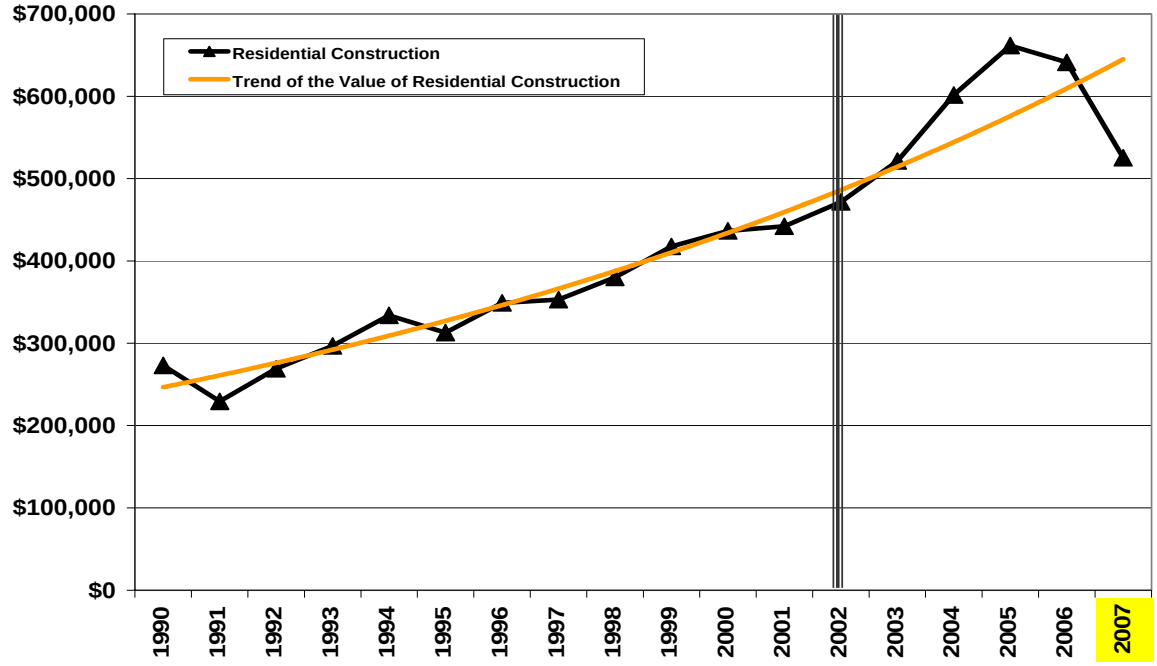
1. Model firms are defined on the basis of financial statements taken from an adverse performance period, as outlined below. The baseline financial condition and performance are thus *weaker* than the baseline condition and performance as used for the primary analysis case.
2. Model firms are assigned a higher cost of capital, reflecting more difficult credit and equity financing conditions during a period of business weakness, than the cost of capital used in the primary analysis case.
3. Model firms are assumed to recover none of the cost of compliance through product price increases.
4. The total operating level of the C&D industry and total construction activity subject to regulatory requirements are assumed to be less than the baseline activity estimates.

To perform this analysis, EPA adjusted the baseline financial statements for each of the model firms and the total estimated activity level in the C&D industry. EPA used Census data on the value of construction for each of the three general industry sectors from 1990 to 2007 to select the adverse business conditions year underlying the model firm financial statements and also to estimate an average deviation from trend during adverse performance years.

Figure 5-3 through *Figure 5-5* present the actual and estimated trend values[52] of construction from 1990 to 2007 for the residential, non-residential, and non-building sectors. *Figure 5-6* through *Figure 5-8* present the average annual growth of construction and the actual percent change in construction value from the previous year from 1990 to 2007 for the residential, non-residential, and non-building sectors. As described previously, Risk Management Association provides financial statement data by industry sector and revenue range for the data years following the line drawn during the 2002 period. The highlighted data years – 2007 for the residential sector and 2003 for both the non-residential and non-building sectors – are the RMA data-years used to define the model firm financial statements for the adverse analysis case.

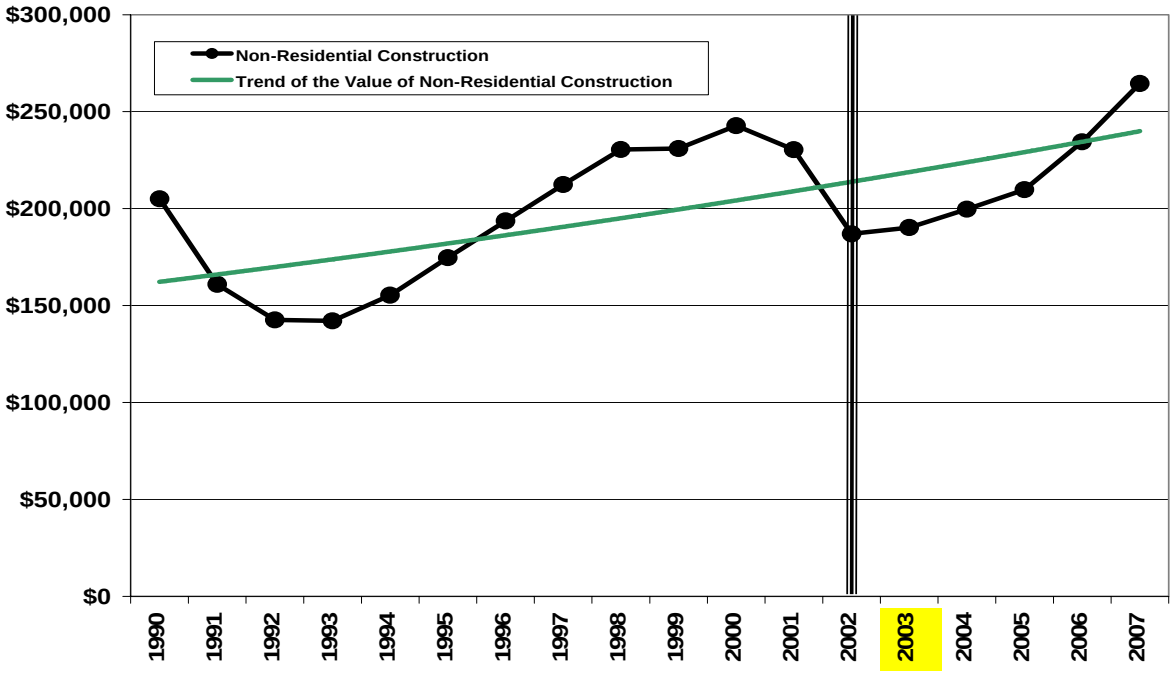
[52] Based on an estimated exponential growth trend of constant dollar activity.

Figure 5-3: Residential Actual and Estimated Trend Values of Construction Put in Place (2006 $Millions)



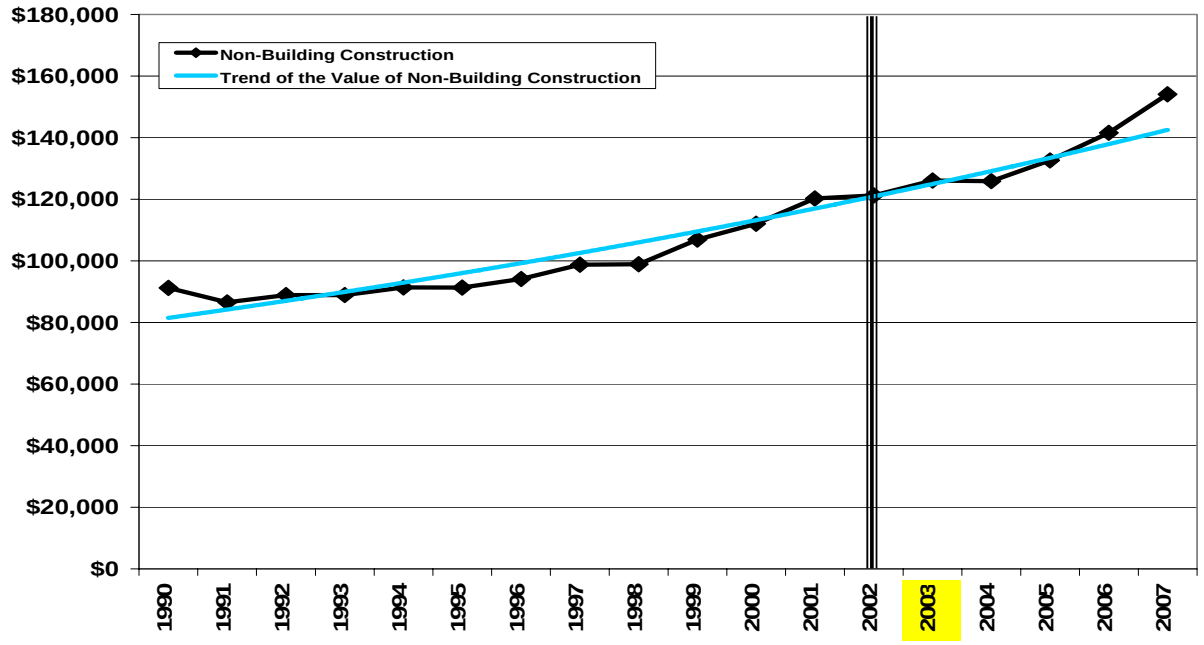
Source: U.S. Census Bureau's Construction Spending (2008a)

Figure 5-4: Non-Residential Actual and Estimated Trend Values of Construction Put in Place (2006 $Millions)



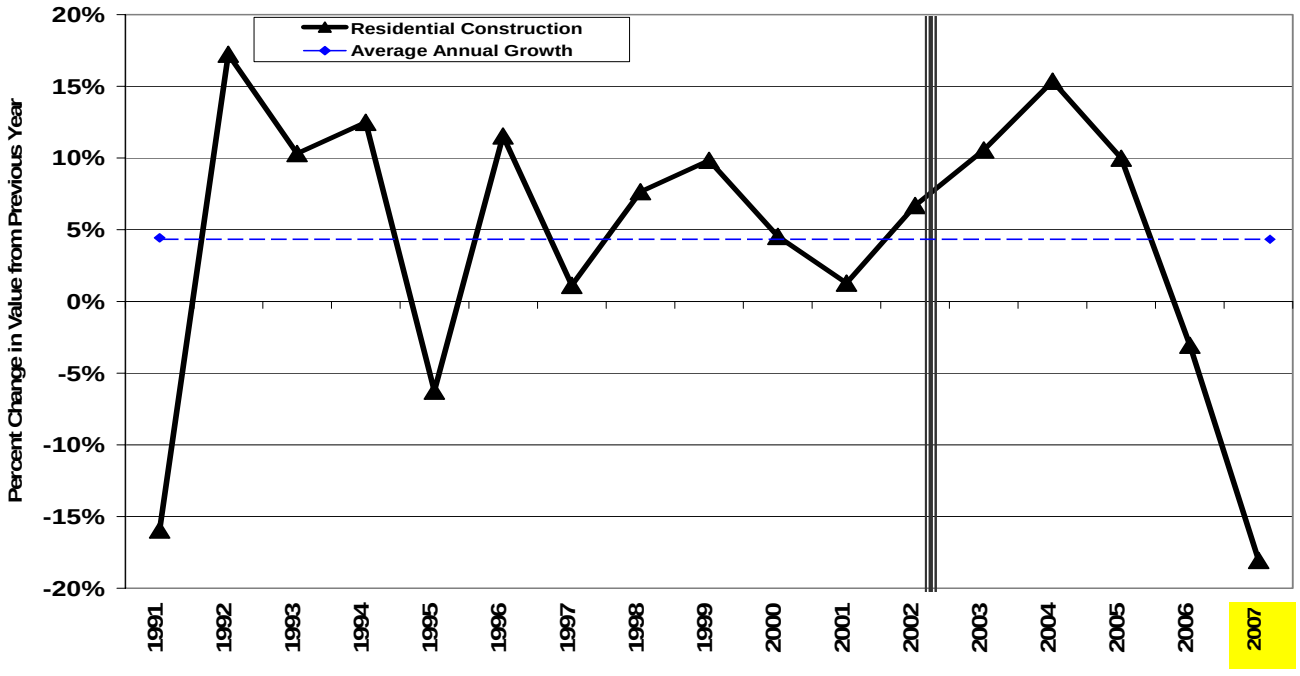
Source: U.S. Census Bureau's Construction Spending (2008a)

Figure 5-5: Non-Building Actual and Estimated Trend Values of Construction Put in Place (2006 $Millions)



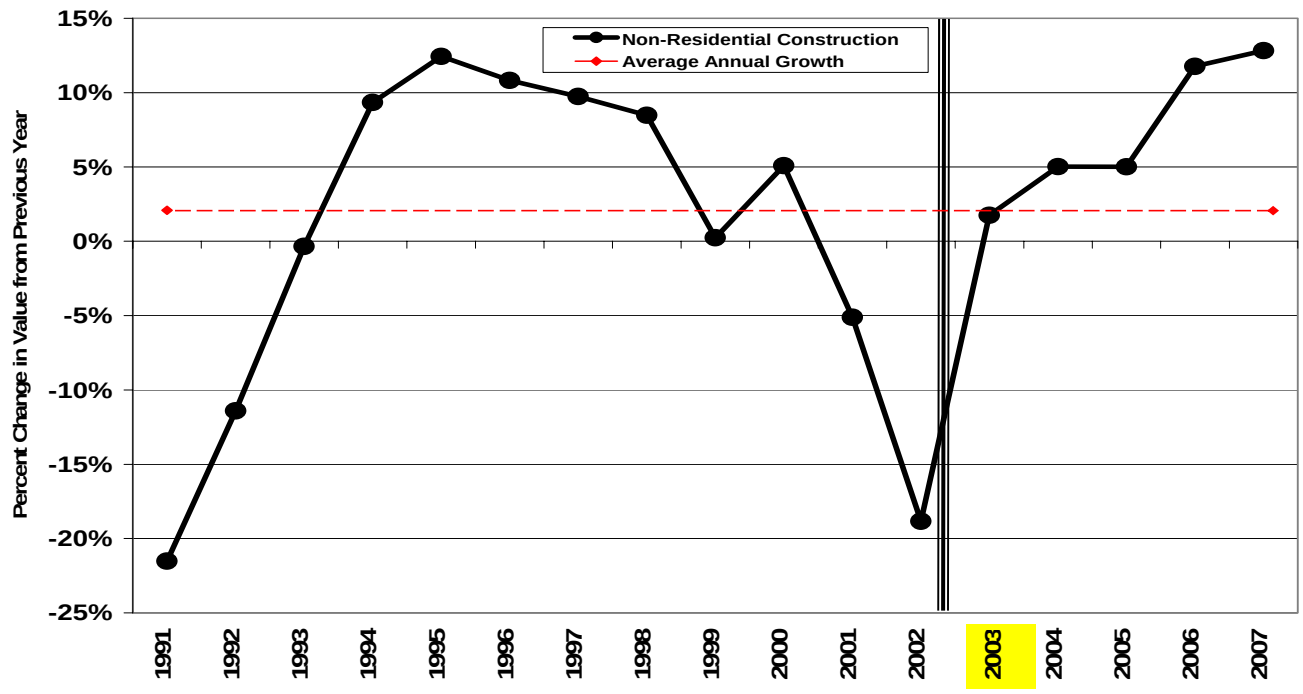
Source: U.S. Census Bureau's Construction Spending (2008a)

Figure 5-6: Residential Actual and Average Annual Growth of Construction Put in Place



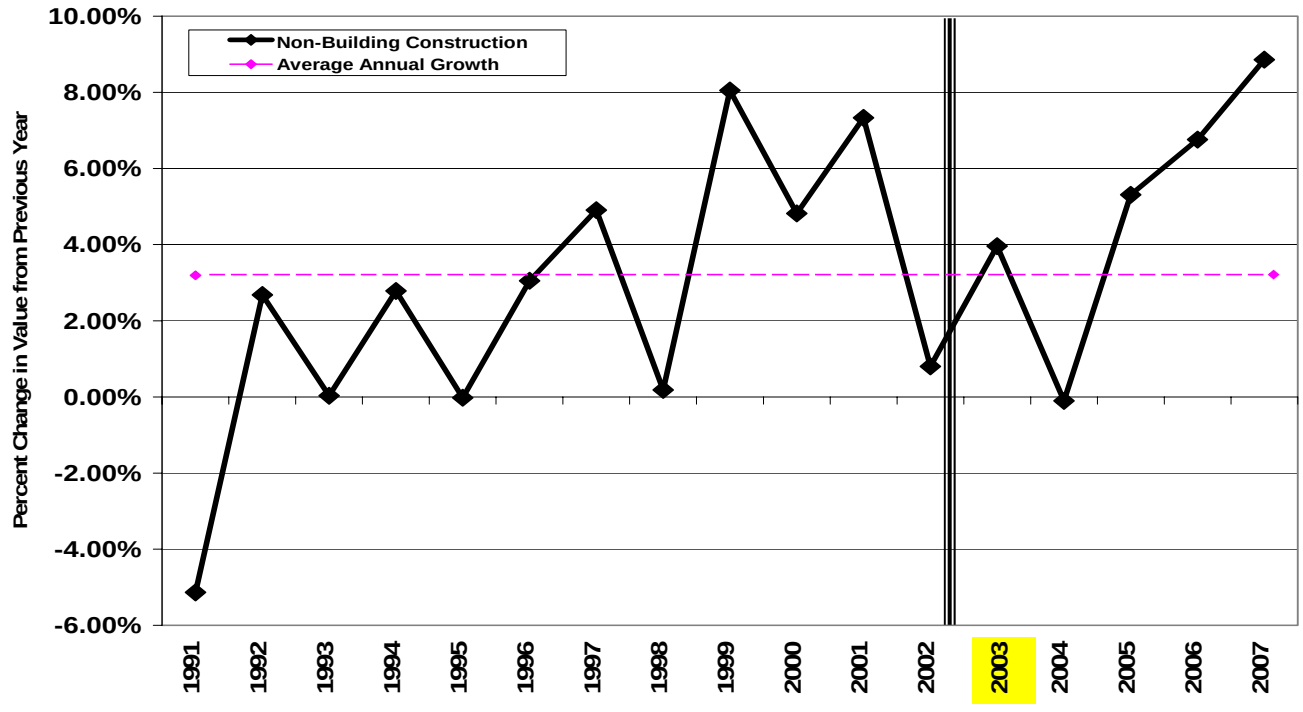
Source: U.S. Census Bureau's Construction Spending (2008a)

Figure 5-7: Non-Residential Actual and Average Annual Growth of Construction Put in Place



Source: U.S. Census Bureau's Construction Spending (2008a)

Figure 5-8: Non-Building Actual and Average Annual Growth of Construction Put in Place



Source: U.S. Census Bureau's Construction Spending (2008a)

Table 5-22 through *Table 5-24* present the data used to determine the *adverse analysis case* variables for each general industry sector. RMA provides financial statement data for the years in bold. The highlighted data year (2007 for the residential sector and 2003 for both the non-residential and non-building sectors) is the year used to define the *adverse analysis case*.

Each table presents, by year, the actual value of construction as reported by Census. EPA estimated an exponential trend line from the actual values and, for each year, determined the percent deviation from the trend based on the difference between the actual value and the estimated trend line value. EPA then assigned years into categories of *at trend*, *above trend*, and *below trend* based on a *deviation from trend* value (e.g., ± 2.5 percent for the residential sector) that assigned an approximately equal number of years from the 18-year period into each of the performance categories. This assignment is the primary basis for determining the *adverse performance* years.

EPA also looked at the difference in actual year-to-year growth from average growth over the period as a secondary indicator of *adverse performance* years. In the same way as described for the *difference from trend* determination, EPA assigned years into *at trend growth*, *above trend growth*, and *below trend growth* categories based on a *deviation from trend* value (e.g., ± 5.5 percent for the residential sector) that assigned an approximately equal number of years from the 17 years of year-to-year growth values into each of the performance categories. The average growth rate for each sector is reported in *Table 5-25*.[53] Similar to determining whether a data year is at, above, or below the trend line, a deviation variable allowing for an approximately equal distribution of at, above, and below data years is introduced to determine the years that are at, above, or below average growth.

For the residential sector, the adverse analysis year is straightforward: 2007 is by far the poorest performance year for which RMA data are available.[54] The choice of 2003 as the adverse analysis case year for the non-residential and non-building sectors is less obvious: each of years 2002, 2003, and 2004 show weak performance for the non-residential sector and the non-building sector's performance is relatively *on-trend* for the entire RMA data period. EPA based its choice of 2003 as the adverse case year for the non-residential and non-building sectors on inspection of the RMA data and determination that this year generally showed the weakest financial performance and condition metrics for all of the revenue ranges in these sectors.[55]

[53] The average growth rate is an average of the annual percent change in the actual value of construction from 1990-1991 to 2006-2007.

[54] Financial data for full-year 2007 and part- or full-year 2008 were not available at the time of the analysis for the proposed regulation. For the analysis of the final regulation, EPA will update the financial data to include more current data (full-year 2007 and part- or full-year 2008), which are expected to show more adverse financial performance and condition as business conditions in the construction and real estate sectors further deteriorated.

[55] Examining RMA data confirmed EPA's decision to use 2003 as the adverse analysis year for the non-building sector.

Table 5-22: Actual and Estimated Trend Values for the Residential Construction Sector (2006 $Millions)

Year	Actual Value of Construction	Estimated Trend Line Value of Construction	Deviation from Trend Line	Annual Percent Change in the Actual Value of Construction	Difference from Annual Percent Change in the Actual Value of Construction to Average Growth of 4.43%	At, Above, or Below Trend Line[a]	At, Above, or Below Average Growth[b]
1990	$273,027	$246,620	10.7%			Above	
1991	$229,494	$260,981	-12.1%	-15.94%	-20.37%	Below	Below
1992	$269,059	$276,179	-2.6%	17.24%	12.81%	Below	Above
1993	$296,844	$292,261	1.6%	10.33%	5.90%	At	Above
1994	$333,924	$309,281	8.0%	12.49%	8.06%	Above	Above
1995	$313,041	$327,291	-4.4%	-6.25%	-10.68%	Below	Below
1996	$349,153	$346,350	0.8%	11.54%	7.11%	At	Above
1997	$353,088	$366,518	-3.7%	1.13%	-3.30%	Below	At
1998	$380,139	$387,862	-2.0%	7.66%	3.23%	At	At
1999	$417,542	$410,448	1.7%	9.84%	5.41%	At	At
2000	$436,493	$434,349	0.5%	4.54%	0.11%	At	At
2001	$442,053	$459,642	-3.8%	1.27%	-3.16%	Below	At
2002	**$471,608**	**$486,408**	**-3.0%**	**6.69%**	**2.26%**	**Below**	**At**
2003	**$521,400**	**$514,733**	**1.3%**	**10.56%**	**6.13%**	**At**	**Above**
2004	**$601,489**	**$544,707**	**10.4%**	**15.36%**	**10.93%**	**Above**	**Above**
2005	**$661,590**	**$576,427**	**14.8%**	**9.99%**	**5.56%**	**Above**	**Above**
2006	**$641,332**	**$609,994**	**5.1%**	**-3.06%**	**-7.49%**	**Above**	**Below**
2007	**$525,443**	**$645,515**	**-18.6%**	**-18.07%**	**-22.50%**	**Below**	**Below**

a Given a deviation variable of 2.5 percent; i.e. if the deviation from the trend line was ± 2.5 percent from zero, the year was considered to be "at" the trend.

b Given a deviation variable of 5.5 percent; i.e. if the difference from the annual percent change in the actual value of construction to the average was ± 5.5 percent from zero, the year was considered to be "at" average growth.

Source: U.S. Census Bureau's Construction Spending (2008a) and EPA Estimates

Table 5-23: Actual and Estimated Trend Values for the Non-Residential Construction Sector (2006 $Millions)

Year	Actual Value of Construction	Estimated Trend Line Value of Construction	Deviation from Trend Line	Annual Percent Change in the Actual Value of Construction	Difference from Annual Percent Change in the Actual Value of Construction to Average Growth of 2.08%	At, Above, or Below Trend Line[a]	At, Above, or Below Average Growth[b]
1990	$205,026	$162,215	26.4%			Above	
1991	$160,914	$165,990	-3.1%	-21.52%	-23.59%	At	Below
1992	$142,558	$169,852	-16.1%	-11.41%	-13.48%	Below	Below
1993	$142,067	$173,803	-18.3%	-0.34%	-2.42%	Below	At
1994	$155,343	$177,847	-12.7%	9.35%	7.27%	Below	Above
1995	$174,668	$181,985	-4.0%	12.44%	10.36%	At	Above
1996	$193,580	$186,219	4.0%	10.83%	8.75%	At	Above
1997	$212,423	$190,552	11.5%	9.73%	7.66%	Above	Above
1998	$230,435	$194,985	18.2%	8.48%	6.40%	Above	Above
1999	$230,989	$199,522	15.8%	0.24%	-1.83%	Above	At
2000	$242,740	$204,164	18.9%	5.09%	3.01%	Above	At
2001	$230,329	$208,914	10.3%	-5.11%	-7.19%	At	Below
2002	**$186,938**	**$213,775**	**-12.6%**	**-18.84%**	**-20.91%**	**Below**	**Below**
2003	**$190,196**	**$218,749**	**-13.1%**	**1.74%**	**-0.33%**	**Below**	**At**
2004	**$199,745**	**$223,839**	**-10.8%**	**5.02%**	**2.94%**	**Below**	**At**
2005	**$209,743**	**$229,046**	**-8.4%**	**5.01%**	**2.93%**	**At**	**At**
2006	**$234,414**	**$234,376**	**0.0%**	**11.76%**	**9.69%**	**At**	**Above**
2007	**$264,459**	**$239,829**	**10.3%**	**12.82%**	**10.74%**	**Above**	**Above**

a Given a deviation variable of 10.26 percent; i.e. if the deviation from the trend line was ± 10.26 percent from zero, the year was considered to be "at" the trend.

b Given a deviation variable of 3.5 percent; i.e. if the difference from the annual percent change in the actual value of construction to the average was ± 3.5 percent from zero, the year was considered to be "at" average growth.

Source: U.S. Census Bureau's Construction Spending (2008a) and EPA Estimates

Table 5-24: Actual and Estimated Trend Values for the Non-Building Construction Sector (2006 $Millions)

Year	Actual Value of Construction	Estimated Trend Line Value of Construction	Deviation from Trend Line	Annual Percent Change in the Actual Value of Construction	Difference from Annual Percent Change in the Actual Value of Construction to Average Growth of 3.19%	At, Above, or Below Trend Line[a]	At, Above, or Below Average Growth[b]
1990	$91,242	$81,478	12.0%			Above	
1991	$86,556	$84,203	2.8%	-5.14%	-8.33%	Above	Below
1992	$88,873	$87,020	2.1%	2.68%	-0.51%	Above	At
1993	$88,897	$89,930	-1.1%	0.03%	-3.16%	At	Below
1994	$91,369	$92,938	-1.7%	2.78%	-0.41%	At	At
1995	$91,349	$96,047	-4.9%	-0.02%	-3.21%	Below	Below
1996	$94,136	$99,259	-5.2%	3.05%	-0.14%	Below	At
1997	$98,757	$102,579	-3.7%	4.91%	1.72%	Below	At
1998	$98,940	$106,010	-6.7%	0.19%	-3.01%	Below	Below
1999	$106,904	$109,556	-2.4%	8.05%	4.86%	Below	Above
2000	$112,055	$113,220	-1.0%	4.82%	1.63%	At	At
2001	$120,267	$117,007	2.8%	7.33%	4.14%	Above	Above
2002	**$121,232**	**$120,920**	**0.3%**	**0.80%**	**-2.39%**	**At**	**Below**
2003	**$126,033**	**$124,965**	**0.9%**	**3.96%**	**0.77%**	**At**	**At**
2004	**$125,904**	**$129,145**	**-2.5%**	**-0.10%**	**-3.29%**	**Below**	**Below**
2005	**$132,588**	**$133,464**	**-0.7%**	**5.31%**	**2.12%**	**At**	**Above**
2006	**$141,548**	**$137,928**	**2.6%**	**6.76%**	**3.57%**	**Above**	**Above**
2007	**$154,087**	**$142,541**	**8.1%**	**8.86%**	**5.67%**	**Above**	**Above**

a Given a deviation variable of 2 percent; i.e. if the deviation from the trend line was ± 2 percent from zero, the year was considered to be "at" the trend.
b Given a deviation variable of 2 percent; i.e. if the difference from the annual percent change in the actual value of construction to the average was ± 2 percent from zero, the year was considered to be "at" average growth.
Source: U.S. Census Bureau's Construction Spending (2008a) and EPA Estimates

The data presented in *Table 5-22* through *Table 5-24* were also used to determine the average percentage deviation from the trend in the *below trend line* years by sector. EPA used this percentage value, presented in *Table 5-25*, in the *adverse analysis case* to adjust downward the baseline level of activity by sector, affecting total compliance costs accordingly. EPA also reduced the *total number of firms* by sector and revenue range expected to engage in compliance activities based on this estimated percentage deviation from trend.

Table 5-25: Average Growth, Estimated Trend, and the Typical Deviation in Below Trend Years

	Residential	Non-Residential	Non-Building
Average Growth	4.43%	2.08%	3.19%
Estimated Trend	5.66%	2.30%	3.29%
Average Deviation in Below Trend Years	-6.88%	-13.89%	-4.23%

Source: U.S. Census Bureau's Construction Spending (2008a) and EPA Estimates

Adverse Analysis Case Results

As stated previously, the *adverse analysis case* assumes that firms in the C&D industry pass through none of the incremental compliance costs and uses the *adverse business conditions case* definition for model C&D firms. The *adverse analysis case* reflects the model firm financial statements drawn from the adverse analysis year (shown in *Table 5-22* and *Table 5-24*) as well as the contraction in the C&D industry sectors and total costs due to incorporating the average deviation of construction activity from trend in adverse performance years. As a result of the contraction in the number of firms and total activity, total estimated compliance costs decreased by approximately 10 percent under all three regulatory options. The number of firms incurring costs also decreased for each option. The results for the adverse analysis case are presented in *Table 5-26*.

With respect to the firms incurring costs that exceed 1 and 3 percent of revenues, the impacts under the *adverse analysis case* are exactly the same *regardless of whether one accounts for the effect of cost pass-through*. This is simply because the cost pass-through fraction is assumed to be 0% in the adverse case, and thus, the effect is the same as though cost pass-through had not been taken into account.

Table 5-26: Summary of Cost and Economic Impact Analysis for Proposed Rule Options – Adverse Conditions Analysis

Impact Analysis Concept		Option 1	Option 2	Option 3
Resource Cost of Compliance and Affected Acreage and Firms[a]				
Total Costs (millions $2008)		$121	$1,721	$3,457
Total Acreage Incurring Cost[a]		108,469	263,830	476,974
Number of Firms	All Firms	139,565	139,565	139,565
	Firms In-Scope	74,927	74,927	74,927
	Firms Incurring Cost	2,909	5,795	12,473
Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact				
Costs Unadjusted for Effect of Cost Pass-Through				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	698	2,233
	% of All Firms	0.0%	0.5%	1.6%
	% of Firms In-Scope	0.0%	0.9%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	30	132
	% of All Firms	0.0%	0.0%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.2%
Costs Adjusted for Effect of Cost Pass-Through				
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	698	2,233
	% of All Firms	0.0%	0.5%	1.6%
	% of Firms In-Scope	0.0%	0.9%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	30	132
	% of All Firms	0.0%	0.0%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.2%
Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance				
Firms Incurring Financial Stress	Number Incurring Effect	51	479	1,534
	% of All Firms	0.0%	0.3%	1.1%
	% of Firms In-Scope	0.1%	0.6%	2.0%
Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)				
Firms with Negative Business Value	Number Incurring Effect	88	662	2,164
Because of Regulation (Potential Closures)	% of All Firms	0.1%	0.5%	1.6%
	% of Firms In-Scope	0.1%	0.9%	2.9%

a Note the number of firms and compliance cost/activity for each option is less than that reported previously in Table 5-2 because the adverse analysis case reflects the expected contraction in the C&D industry sectors during years of relatively adverse business conditions, which is based on the estimated average deviation from trend in adverse years.

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Table 5-27 reports the firm-level impacts under the *adverse analysis case* in comparison to the firm-level impacts under the *general analysis case* (originally reported in *Table 5-2*). As reported in this table, the total compliance cost, compliance acreage, and numbers of firms in-scope and incurring cost *declines* in the adverse analysis case. This finding results from the modeled contraction in the C&D industry during periods of relative economic/ market weakness. That is, because the total quantity of C&D industry activity is shown to contract during periods of adverse business conditions (i.e., based on the deviation from trend analysis above), so to is the expected quantity of in-scope industry activity.

Table 5-27: Comparison of Cost and Economic Impacts – General vs. Adverse Conditions Analyses

Impact Analysis Concept		Option 1		Option 2		Option 3	
		General	Adverse	General	Adverse	General	Adverse
Resource Cost of Compliance and Affected Acreage and Firms[a]							
Total Costs (millions $2008)		$132	$121	$1,890	$1,721	$3,797	$3,457
Total Acreage Incurring Cost[a]		119,136	108,469	289,617	263,830	524,052	476,974
Number of Firms	All Firms	152,298	139,565	152,298	139,565	152,298	139,565
	Firms In-Scope	81,628	74,927	81,628	74,927	81,628	74,927
	Firms Incurring Cost	4,738	2,909	6,396	5,795	13,765	12,473
Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact							
Costs Unadjusted for Effect of Cost Pass-Through							
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	0	774	698	2,475	2,233
	% of All Firms	0.0%	0.0%	0.5%	0.5%	1.6%	1.6%
	% of Firms In-Scope	0.0%	0.0%	0.9%	0.9%	3.0%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	33	30	146	132
	% of All Firms	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%
Costs Adjusted for Effect of Cost Pass-Through							
Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	0	15	698	39	2,233
	% of All Firms	0.0%	0.0%	0.0%	0.5%	0.0%	1.6%
	% of Firms In-Scope	0.0%	0.0%	0.0%	0.9%	0.0%	3.0%
Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	0	30	0	132
	% of All Firms	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	% of Firms In-Scope	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance							
Firms Incurring Financial Stress	Number Incurring Effect	17	51	147	479	445	1,534
	% of All Firms	0.0%	0.0%	0.1%	0.3%	0.3%	1.1%
	% of Firms In-Scope	0.0%	0.1%	0.2%	0.6%	0.5%	2.0%
Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)							
Firms with Negative Business ValueBecause of Regulation (Potential Closures)	Number Incurring Effect	18	88	103	662	389	2,164
	% of All Firms	0.0%	0.1%	0.1%	0.5%	0.3%	1.6%
	% of Firms In-Scope	0.0%	0.1%	0.1%	0.9%	0.5%	2.9%

EPA Estimates

Table 5-27 also reports the numbers of firms estimated to incur an economic/financial impact according to the various impact measures presented earlier in this chapter.

Firms Incurring Costs in Excess of One or Three Percent of Revenue – Without Accounting for the Effect of Cost Pass-Through

The comparison of the General and Adverse Conditions cases for this measure indicates:

- The number of impacted firms in the adverse case cost-to-revenue analysis is less than the absolute number of impacted firms in the general analysis case. This is due to the effect of industry contraction described above.
- However, the number of impacted firms *as percentages of all firms and all in-scope firms* do not change. This results from the assumed linear contraction in C&D industry activity during adverse conditions.

Firms Incurring Costs in Excess of One or Three Percent of Revenue – Accounting for the Effect of Cost Pass-Through

When the cost-to-revenue impact measure is calculated *accounting for the effect of cost pass-through*, the impact results are very different between the two cases. Under the General Conditions Case, firms receive the benefit of the estimated cost pass-through as an offset to compliance costs. However, under the Adverse Conditions Case, the expected cost pass-through declines to zero. As a result, *even though this cost-to-revenue analysis accounts for cost pass-through*, the effect of cost pass-through is zero in the Adverse Conditions Case, and the numbers and percentages of firms affected Adverse Conditions Case remains the same as though cost pass-through was not accounted for. Looking at the firm-level impact on this basis – *accounting for the effect of cost pass-through, but with cost pass-through set to zero for the Adverse Analysis Case* – provides a more realistic assessment of the potential economic/financial impact of incurring compliance costs during a period weak industry performance.

In short, looking at the impacts *adjusted* for the effect of cost pass-through in both cases provides a comparison that aligns better with the relative pass-through conditions that would be expected during general and adverse performance periods. This comparison indicates:

- The impacts on firms in the Adverse Conditions Case cost-to-revenue analysis increases substantially under Options 2 and 3 when compared to the General Conditions Case analysis. This is due to the fact that cost pass-through in the General Conditions Case is 85% for residential sectors and 71% for non-residential sectors, while cost pass-through is assumed to be 0% in the Adverse Conditions Case. In this comparison, the number of firms estimated to incur costs exceeding 1 percent of revenue increases from 15 to 698 under Option 2, and from 39 to 2,233 under Option 3. At the 3 percent of revenue threshold, the impact numbers increase from 0 to 30 under Option 2, and from 0 to 132 under Option 3.
- And because the number of firms operating in the industry in the Adverse Conditions Case is assumed to be less than in the General Conditions Case, the relative increase in percentages of total firms incurring the indicated impact is greater than the increase in numbers of affected firms. In other words, although there is a contraction in in-scope activity during periods of adverse market conditions, the differential effect of cost pass-through outweights this effect, causing a net increase in the number of impacted firms.

Firms Incurring Financial Stress and Negative Business Value

Similarly, a comparison of the impact metrics for firm financial performance – incurrence of financial stress and negative business value – shows a significant increase in firm impacts under the Adverse Conditions Case. As described previously, this is due to a combination of factors, including: weaker baseline firm financial performance, higher costs of debt and equity, and the assumed inability to pass through costs in the adverse analysis case. That said, even though the number and percentage of adversely affected firms increases under the adverse analysis case, these numbers and percentages of impacted firms remains quite low relative to the C&D industry as a whole.

Appendix 5-3: Detailed Results for the Single-Family Housing Affordability Analysis

Table 5-28: Price Change per New Median Priced Home, by State (2006$)

State	2006 Weighted-Average Median Home Price	Option 1		Option 2		Option 3	
		Price Change	Percent Change	Price Change	Percent Change	Price Change	Percent Change
Alabama	$191,200	$356	0.19%	$2,926	1.53%	$4,142	2.17%
Arkansas	$173,400	$0	0.00%	$3,601	2.08%	$3,601	2.08%
Arizona	$321,800	$0	0.00%	$341	0.11%	$341	0.11%
California	$557,200	$0	0.00%	$847	0.15%	$847	0.15%
Colorado	$315,500	$356	0.11%	$678	0.21%	$960	0.30%
Connecticut	$446,900	$0	0.00%	$2,641	0.59%	$2,641	0.59%
District of Columbia	$435,200	$0	0.00%	$0	0.00%	$1,842	0.42%
Delaware	$331,900	$0	0.00%	$2,667	0.80%	$2,667	0.80%
Florida	$310,300	$0	0.00%	$4,670	1.50%	$4,670	1.50%
Georgia	$233,700	$356	0.15%	$2,592	1.11%	$3,672	1.57%
Iowa	$206,700	$0	0.00%	$2,176	1.05%	$2,176	1.05%
Idaho	$257,700	$0	0.00%	$0	0.00%	$500	0.19%
Illinois	$321,100	$0	0.00%	$1,458	0.45%	$1,458	0.45%
Indiana	$189,700	$356	0.19%	$1,957	1.03%	$2,774	1.46%
Kansas	$214,400	$0	0.00%	$2,556	1.19%	$2,556	1.19%
Kentucky	$177,700	$0	0.00%	$2,660	1.50%	$2,660	1.50%
Louisiana	$174,200	$0	0.00%	$4,975	2.86%	$4,975	2.86%
Massachusetts	$413,600	$0	0.00%	$1,871	0.45%	$1,871	0.45%
Maryland	$442,500	$0	0.00%	$2,608	0.59%	$2,608	0.59%
Maine	$228,000	$0	0.00%	$2,460	1.08%	$2,460	1.08%
Michigan	$235,000	$0	0.00%	$1,520	0.65%	$1,520	0.65%
Minnesota	$273,900	$0	0.00%	$1,269	0.46%	$1,269	0.46%
Missouri	$207,500	$0	0.00%	$2,605	1.26%	$2,605	1.26%
Mississippi	$150,400	$0	0.00%	$4,007	2.66%	$4,007	2.66%
Montana	$267,800	$29	0.01%	$387	0.14%	$549	0.20%
North Carolina	$209,300	$356	0.17%	$2,197	1.05%	$3,110	1.49%
North Dakota	$183,200	$0	0.00%	$710	0.39%	$710	0.39%
Nebraska	$222,700	$356	0.16%	$1,425	0.64%	$2,017	0.91%
New Hampshire	$362,600	$0	0.00%	$1,775	0.49%	$1,775	0.49%
New Jersey	$477,400	$356	0.07%	$2,316	0.49%	$3,278	0.69%
New Mexico	$234,800	$0	0.00%	$682	0.29%	$682	0.29%
Nevada	$384,000	$0	0.00%	$0	0.00%	$168	0.04%
New York	$369,600	$0	0.00%	$2,257	0.61%	$2,257	0.61%
Ohio	$223,600	$356	0.16%	$1,799	0.80%	$2,550	1.14%
Oklahoma	$171,300	$0	0.00%	$1,448	0.85%	$1,448	0.85%
Oregon	$317,200	$0	0.00%	$2,172	0.68%	$2,172	0.68%
Pennsylvania	$273,700	$0	0.00%	$2,381	0.87%	$2,381	0.87%
Rhode Island	$420,700	$356	0.08%	$2,025	0.48%	$3,050	0.73%
South Carolina	$214,000	$0	0.00%	$2,005	0.94%	$2,005	0.94%
South Dakota	$176,600	$0	0.00%	$937	0.53%	$937	0.53%
Tennessee	$189,300	$0	0.00%	$2,034	1.07%	$2,034	1.07%
Texas	$171,800	$0	0.00%	$1,435	0.84%	$1,435	0.84%
Utah	$301,800	$0	0.00%	$0	0.00%	$642	0.21%
Virginia	$454,900	$0	0.00%	$2,481	0.55%	$2,481	0.55%
Vermont	$221,100	$356	0.16%	$1,567	0.71%	$2,202	1.00%
Washington	$369,500	$0	0.00%	$1,556	0.42%	$1,556	0.42%
Wisconsin	$266,700	$203	0.08%	$1,447	0.54%	$2,044	0.77%
West Virginia	$171,600	$0	0.00%	$2,301	1.34%	$2,301	1.34%
Wyoming	$256,400	$192	0.07%	$598	0.23%	$842	0.33%
U.S. Average	**$322,391**	**$330**	**0.10%**	**$2,061**	**0.64%**	**$2,242**	**0.70%**

EPA Estimates

Table 5-29: Price Change per New Lower Quartile Priced Home, by State (2006$)

State	2006 Weighted-Average Lower Quartile Home Price	Option 1		Option 2		Option 3	
		Price Change	Percent Change	Price Change	Percent Change	Price Change	Percent Change
Alabama	$114,720	$356	0.31%	$2,926	2.55%	$4,142	3.61%
Arkansas	$107,290	$0	0.00%	$3,601	3.36%	$3,601	3.36%
Arizona	$201,516	$0	0.00%	$341	0.17%	$341	0.17%
California	$369,872	$0	0.00%	$847	0.23%	$847	0.23%
Colorado	$227,854	$356	0.16%	$678	0.30%	$960	0.42%
Connecticut	$304,861	$0	0.00%	$2,641	0.87%	$2,641	0.87%
District of Columbia	$297,292	$0	0.00%	$0	0.00%	$1,842	0.62%
Delaware	$223,167	$0	0.00%	$2,667	1.20%	$2,667	1.20%
Florida	$192,424	$0	0.00%	$4,670	2.43%	$4,670	2.43%
Georgia	$149,341	$356	0.24%	$2,592	1.74%	$3,672	2.46%
Iowa	$137,310	$0	0.00%	$2,176	1.58%	$2,176	1.58%
Idaho	$168,079	$0	0.00%	$0	0.00%	$500	0.30%
Illinois	$182,844	$0	0.00%	$1,458	0.80%	$1,458	0.80%
Indiana	$129,820	$356	0.27%	$1,957	1.51%	$2,774	2.14%
Kansas	$126,878	$0	0.00%	$2,556	2.01%	$2,556	2.01%
Kentucky	$107,901	$0	0.00%	$2,660	2.46%	$2,660	2.46%
Louisiana	$98,567	$0	0.00%	$4,975	5.05%	$4,975	5.05%
Massachusetts	$288,091	$0	0.00%	$1,871	0.65%	$1,871	0.65%
Maryland	$275,918	$0	0.00%	$2,608	0.95%	$2,608	0.95%
Maine	$135,463	$0	0.00%	$2,460	1.82%	$2,460	1.82%
Michigan	$155,287	$0	0.00%	$1,520	0.98%	$1,520	0.98%
Minnesota	$185,363	$0	0.00%	$1,269	0.68%	$1,269	0.68%
Missouri	$130,258	$0	0.00%	$2,605	2.00%	$2,605	2.00%
Mississippi	$90,308	$0	0.00%	$4,007	4.44%	$4,007	4.44%
Montana	$155,341	$29	0.02%	$387	0.25%	$549	0.35%
North Carolina	$132,109	$356	0.27%	$2,197	1.66%	$3,110	2.35%
North Dakota	$103,084	$0	0.00%	$710	0.69%	$710	0.69%
Nebraska	$147,221	$356	0.24%	$1,425	0.97%	$2,017	1.37%
New Hampshire	$263,930	$0	0.00%	$1,775	0.67%	$1,775	0.67%
New Jersey	$306,156	$356	0.12%	$2,316	0.76%	$3,278	1.07%
New Mexico	$133,364	$0	0.00%	$682	0.51%	$682	0.51%
Nevada	$265,096	$0	0.00%	$0	0.00%	$168	0.06%
New York	$144,843	$0	0.00%	$2,257	1.56%	$2,257	1.56%
Ohio	$152,485	$356	0.23%	$1,799	1.18%	$2,550	1.67%
Oklahoma	$110,031	$0	0.00%	$1,448	1.32%	$1,448	1.32%
Oregon	$216,919	$0	0.00%	$2,172	1.00%	$2,172	1.00%
Pennsylvania	$161,166	$0	0.00%	$2,381	1.48%	$2,381	1.48%
Rhode Island	$315,561	$356	0.11%	$2,025	0.64%	$3,050	0.97%
South Carolina	$129,204	$0	0.00%	$2,005	1.55%	$2,005	1.55%
South Dakota	$99,749	$0	0.00%	$937	0.94%	$937	0.94%
Tennessee	$121,330	$0	0.00%	$2,034	1.68%	$2,034	1.68%
Texas	$105,341	$0	0.00%	$1,435	1.36%	$1,435	1.36%
Utah	$220,146	$0	0.00%	$0	0.00%	$642	0.29%
Virginia	$252,412	$0	0.00%	$2,481	0.98%	$2,481	0.98%
Vermont	$145,834	$356	0.24%	$1,567	1.07%	$2,202	1.51%
Washington	$237,082	$0	0.00%	$1,556	0.66%	$1,556	0.66%
Wisconsin	$182,857	$203	0.11%	$1,447	0.79%	$2,044	1.12%
West Virginia	$102,922	$0	0.00%	$2,301	2.24%	$2,301	2.24%
Wyoming	$165,308	$192	0.12%	$598	0.36%	$842	0.51%
U.S. Average	**$200,558**	**$330**	**0.16%**	**$2,061**	**1.03%**	**$2,242**	**1.12%**

EPA Estimates

Table 5-30: Number of Households Whose Purchasing Decision for a New Single-Family Median Price Home Would Be Affected by a Regulation-Induced Increase in Housing Prices, by State

State	Option 1		Option 2		Option 3	
	Number	Percent	Number	Percent	Number	Percent
Alabama	3	0.01%	67	0.12%	175	0.33%
Arkansas	0	0.00%	45	0.15%	84	0.27%
Arizona	0	0.00%	7	0.01%	12	0.02%
California	0	0.00%	25	0.02%	46	0.04%
Colorado	3	0.01%	11	0.02%	30	0.06%
Connecticut	0	0.00%	17	0.10%	32	0.19%
District of Columbia	0	0.00%	0	0.00%	3	0.07%
Delaware	0	0.00%	7	0.09%	13	0.18%
Florida	0	0.00%	269	0.18%	501	0.34%
Georgia	7	0.01%	116	0.10%	305	0.27%
Iowa	0	0.00%	24	0.09%	45	0.17%
Idaho	0	0.00%	0	0.00%	4	0.03%
Illinois	0	0.00%	49	0.05%	91	0.09%
Indiana	5	0.01%	60	0.07%	157	0.20%
Kansas	0	0.00%	32	0.11%	59	0.21%
Kentucky	0	0.00%	47	0.11%	88	0.20%
Louisiana	0	0.00%	111	0.20%	206	0.36%
Massachusetts	0	0.00%	33	0.07%	62	0.13%
Maryland	0	0.00%	30	0.07%	57	0.13%
Maine	0	0.00%	13	0.12%	24	0.23%
Michigan	0	0.00%	72	0.07%	133	0.12%
Minnesota	0	0.00%	26	0.05%	48	0.09%
Missouri	0	0.00%	81	0.13%	151	0.24%
Mississippi	0	0.00%	48	0.17%	90	0.31%
Montana	0	0.00%	1	0.02%	3	0.05%
North Carolina	7	0.01%	104	0.09%	273	0.23%
North Dakota	0	0.00%	2	0.04%	3	0.07%
Nebraska	1	0.01%	8	0.06%	22	0.17%
New Hampshire	0	0.00%	7	0.07%	13	0.14%
New Jersey	2	0.00%	25	0.06%	67	0.15%
New Mexico	0	0.00%	5	0.03%	9	0.05%
Nevada	0	0.00%	0	0.00%	2	0.01%
New York	0	0.00%	118	0.09%	219	0.17%
Ohio	9	0.01%	108	0.08%	286	0.20%
Oklahoma	0	0.00%	23	0.06%	42	0.11%
Oregon	0	0.00%	31	0.10%	58	0.18%
Pennsylvania	0	0.00%	131	0.11%	245	0.20%
Rhode Island	0	0.00%	4	0.06%	12	0.16%
South Carolina	0	0.00%	49	0.09%	91	0.16%
South Dakota	0	0.00%	2	0.04%	4	0.07%
Tennessee	0	0.00%	62	0.08%	115	0.15%
Texas	0	0.00%	195	0.07%	363	0.13%
Utah	0	0.00%	0	0.00%	11	0.05%
Virginia	0	0.00%	46	0.08%	85	0.15%
Vermont	0	0.01%	2	0.06%	4	0.15%
Washington	0	0.00%	28	0.05%	53	0.10%
Wisconsin	2	0.00%	30	0.07%	78	0.18%
West Virginia	0	0.00%	23	0.10%	43	0.19%
Wyoming	0	0.00%	1	0.03%	1	0.07%
U.S. Total	39	**0.00%**	**2,195**	**0.08%**	**4,523**	**0.17%**

EPA Estimates

Table 5-31: Number of Households Whose Purchasing Decision for a New Single-Family Lower Quartile Price Home Would Be Affected by a Regulation-Induced Increase in Housing Prices, by State

State	Option 1		Option 2		Option 3	
	Number	Percent	Number	Percent	Number	Percent
Alabama	4	0.01%	86	0.10%	227	0.27%
Arkansas	0	0.00%	67	0.15%	124	0.28%
Arizona	0	0.00%	11	0.01%	21	0.02%
California	0	0.00%	60	0.02%	112	0.05%
Colorado	4	0.01%	16	0.02%	42	0.06%
Connecticut	0	0.00%	30	0.08%	55	0.16%
District of Columbia	0	0.00%	0	0.00%	5	0.08%
Delaware	0	0.00%	14	0.10%	27	0.18%
Florida	0	0.00%	484	0.17%	901	0.33%
Georgia	7	0.00%	127	0.08%	335	0.22%
Iowa	0	0.00%	33	0.09%	61	0.17%
Idaho	0	0.00%	0	0.00%	7	0.04%
Illinois	0	0.00%	106	0.06%	197	0.11%
Indiana	6	0.01%	81	0.07%	213	0.19%
Kansas	0	0.00%	44	0.10%	82	0.19%
Kentucky	0	0.00%	60	0.10%	112	0.18%
Louisiana	0	0.00%	145	0.18%	270	0.34%
Massachusetts	0	0.00%	39	0.05%	72	0.09%
Maryland	0	0.00%	65	0.08%	120	0.15%
Maine	0	0.00%	18	0.11%	34	0.21%
Michigan	0	0.00%	97	0.06%	181	0.11%
Minnesota	0	0.00%	34	0.04%	63	0.08%
Missouri	0	0.00%	102	0.10%	191	0.19%
Mississippi	0	0.00%	60	0.15%	112	0.28%
Montana	0	0.00%	2	0.02%	4	0.04%
North Carolina	10	0.01%	141	0.08%	369	0.22%
North Dakota	0	0.00%	2	0.03%	4	0.06%
Nebraska	1	0.01%	12	0.06%	32	0.16%
New Hampshire	0	0.00%	9	0.06%	17	0.11%
New Jersey	4	0.00%	59	0.07%	156	0.18%
New Mexico	0	0.00%	7	0.03%	13	0.05%
Nevada	0	0.00%	0	0.00%	4	0.01%
New York	0	0.00%	168	0.08%	313	0.14%
Ohio	12	0.01%	138	0.07%	363	0.18%
Oklahoma	0	0.00%	32	0.06%	60	0.11%
Oregon	0	0.00%	49	0.09%	92	0.18%
Pennsylvania	0	0.00%	204	0.10%	380	0.18%
Rhode Island	1	0.01%	9	0.07%	25	0.19%
South Carolina	0	0.00%	63	0.08%	118	0.14%
South Dakota	0	0.00%	3	0.04%	5	0.07%
Tennessee	0	0.00%	83	0.08%	155	0.14%
Texas	0	0.00%	266	0.06%	495	0.12%
Utah	0	0.00%	0	0.00%	15	0.04%
Virginia	0	0.00%	85	0.08%	159	0.16%
Vermont	0	0.01%	3	0.06%	8	0.16%
Washington	0	0.00%	50	0.05%	92	0.10%
Wisconsin	3	0.00%	51	0.07%	133	0.18%
West Virginia	0	0.00%	29	0.09%	54	0.17%
Wyoming	0	0.00%	1	0.02%	2	0.06%
U.S. Total	**53**	**0.00%**	**3,243**	**0.08%**	**6,633**	**0.16%**

EPA Estimates

Table 5-32: Number of Households Whose Purchasing Decision for a New Single-Family Median Price Home Would Be Affected by a Regulation-Induced Increase in Housing Prices, Top 15 MSAs Affected (2006$)

MSA	State	Price Change per New Single-Family Home	Percent Change	Number	Percent
Option 1					
North Wilkesboro, NC	NC	$356	0.52%	<1	<1%
Ashtabula, OH	OH	$356	0.29%	<1	<1%
New Philadelphia-Dover, OH	OH	$356	0.91%	<1	<1%
Dalton, GA	GA	$356	0.30%	<1	<1%
Albertville, AL	AL	$356	0.32%	<1	<1%
Dunn, NC	NC	$356	0.30%	<1	<1%
Wooster, OH	OH	$356	0.25%	<1	<1%
Anderson, IN	IN	$356	0.26%	<1	<1%
Parkersburg-Marietta-Vienna, WV-OH	OH	$356	0.28%	<1	<1%
Huntington-Ashland, WV-KY-OH	OH	$356	0.32%	<1	<1%
Michigan City-La Porte, IN	IN	$356	0.21%	<1	<1%
Enterprise-Ozark, AL	AL	$356	0.29%	<1	<1%
Marion, IN	IN	$356	0.20%	<1	<1%
Albany, GA	GA	$356	0.29%	<1	<1%
Jacksonville, NC	NC	$356	0.21%	<1	<1%
Option 2					
Lake Charles, LA	LA	$4,975	8.56%	11	<1%
Laurel, MS	MS	$4,007	5.42%	5	<1%
New Iberia, LA	LA	$4,975	3.25%	3	<1%
Monroe, LA	LA	$4,975	5.81%	8	<1%
Hattiesburg, MS	MS	$4,007	3.45%	5	<1%
Pascagoula, MS	MS	$4,007	6.11%	6	<1%
Russellville, AR	AR	$3,601	3.18%	3	<1%
New Orleans-Metairie-Kenner, LA	LA	$4,975	2.87%	35	<1%
Gulfport-Biloxi, MS	MS	$4,007	2.84%	8	<1%
DuBois, PA	PA	$2,381	3.01%	3	<1%
Hammond, LA	LA	$4,975	3.78%	4	<1%
Fort Smith, AR-OK	AR	$3,601	3.26%	7	<1%
Pine Bluff, AR	AR	$3,601	3.59%	3	<1%
Searcy, AR	AR	$3,601	2.96%	3	<1%
Alexandria, LA	LA	$4,975	3.04%	5	<1%
Option 3					
Lake Charles, LA	LA	$4,975	8.56%	21	<1%
Laurel, MS	MS	$4,007	5.42%	9	<1%
New Iberia, LA	LA	$4,975	3.25%	6	<1%
Monroe, LA	LA	$4,975	5.81%	15	<1%
Albertville, AL	AL	$4,142	3.74%	7	<1%
Hattiesburg, MS	MS	$4,007	3.45%	10	<1%
Dalton, GA	GA	$3,672	3.13%	9	<1%
Pascagoula, MS	MS	$4,007	6.11%	11	<1%
North Wilkesboro, NC	NC	$3,110	4.55%	5	<1%
Russellville, AR	AR	$3,601	3.18%	6	<1%
Enterprise-Ozark, AL	AL	$4,142	3.42%	7	<1%
New Orleans-Metairie-Kenner, LA	LA	$4,975	2.87%	64	<1%
Gulfport-Biloxi, MS	MS	$4,007	2.84%	16	<1%
DuBois, PA	PA	$2,381	3.01%	6	<1%
Hammond, LA	LA	$4,975	3.78%	7	<1%

EPA Estimates

Table 5-33: Number of Households Whose Purchasing Decision for a New Single-Family Lower Quartile Price Home Would Be Affected by a Regulation-Induced Increase in Housing Prices, Top 15 MSAs Affected (2006$)

MSA	State	Price Change per New Single-Family Home	Percent Change	Number	Percent
Option 1					
Mount Airy, NC	NC	$356	0.49%	<1	<1%
Jacksonville, NC	NC	$356	0.30%	<1	<1%
Albany, GA	GA	$356	0.43%	<1	<1%
New Bern, NC	NC	$356	0.41%	<1	<1%
Huntington-Ashland, WV-KY-OH	OH	$356	0.54%	<1	<1%
Cullman, AL	AL	$356	0.40%	<1	<1%
Parkersburg-Marietta-Vienna, WV-OH	OH	$356	0.41%	<1	<1%
Hickory-Lenoir-Morganton, NC	NC	$356	0.30%	<1	<1%
Hinesville-Fort Stewart, GA	GA	$356	0.20%	<1	<1%
Thomasville-Lexington, NC	NC	$356	0.33%	<1	<1%
Rocky Mount, NC	NC	$356	0.40%	<1	<1%
Roanoke Rapids, NC	NC	$356	0.37%	<1	<1%
Salisbury, NC	NC	$356	0.39%	<1	<1%
Anniston-Oxford, AL	AL	$356	0.33%	<1	<1%
Enterprise-Ozark, AL	AL	$356	0.46%	<1	<1%
Option 2					
Monroe, LA	LA	$4,975	10.59%	12	<1%
Laurel, MS	MS	$4,007	10.89%	5	<1%
Shreveport-Bossier City, LA	LA	$4,975	4.47%	21	<1%
Punta Gorda, FL	FL	$4,670	3.34%	10	<1%
Searcy, AR	AR	$3,601	4.44%	4	<1%
New Iberia, LA	LA	$4,975	6.95%	3	<1%
Lake Charles, LA	LA	$4,975	14.21%	10	<1%
Tupelo, MS	MS	$4,007	4.68%	6	<1%
Russellville, AR	AR	$3,601	4.78%	4	<1%
Lafayette, LA	LA	$4,975	5.33%	13	<1%
Alexandria, LA	LA	$4,975	4.88%	7	<1%
Hot Springs, AR	AR	$3,601	3.40%	5	<1%
Fort Smith, AR-OK	AR	$3,601	4.93%	9	<1%
Lake City, FL	FL	$4,670	4.87%	3	<1%
Hammond, LA	LA	$4,975	6.49%	5	<1%
Option 3					
Monroe, LA	LA	$4,975	10.59%	22	<1%
Laurel, MS	MS	$4,007	10.89%	10	<1%
Shreveport-Bossier City, LA	LA	$4,975	4.47%	38	<1%
Punta Gorda, FL	FL	$4,670	3.34%	18	<1%
Searcy, AR	AR	$3,601	4.44%	7	<1%
New Iberia, LA	LA	$4,975	6.95%	6	<1%
Lake Charles, LA	LA	$4,975	14.21%	18	<1%
Tupelo, MS	MS	$4,007	4.68%	12	<1%
Russellville, AR	AR	$3,601	4.78%	7	<1%
Lafayette, LA	LA	$4,975	5.33%	24	<1%
Alexandria, LA	LA	$4,975	4.88%	13	<1%
Cullman, AL	AL	$4,142	4.65%	7	<1%
Hot Springs, AR	AR	$3,601	3.40%	9	<1%
Fort Smith, AR-OK	AR	$3,601	4.93%	16	<1%
Albany, GA	GA	$3,672	4.46%	14	<1%

EPA Estimates

Appendix 5-4: State-Level Compliance Cost and Acreage

Table 5-34: Option 1 State-Level Compliance Cost and Acreage (millions of $2008)

State	Unadjusted Resource Cost of Compliance	Quantity-Effect Adjusted Resource Cost of Compliance	Dead Weight Loss in Producer and Consumer Surplus	Unadjusted Compliance Acreage	Quantity-Effect Adjusted Compliance Acreage
Alabama	$10	$10	$0.0	8,200	8,200
Arkansas	$0	$0	$0.0	0	0
Arizona	$0	$0	$0.0	0	0
California	$0	$0	$0.0	0	0
Colorado	$13	$13	$0.0	11,000	11,000
Connecticut	$0	$0	$0.0	0	0
District of Columbia	$0	$0	$0.0	0	0
Delaware	$0	$0	$0.0	0	0
Florida	$0	$0	$0.0	0	0
Georgia	$22	$22	$0.0	18,800	18,800
Iowa	$0	$0	$0.0	0	0
Idaho	$0	$0	$0.0	0	0
Illinois	$0	$0	$0.0	0	0
Indiana	$12	$12	$0.0	10,000	10,000
Kansas	$0	$0	$0.0	0	0
Kentucky	$0	$0	$0.0	0	0
Louisiana	$0	$0	$0.0	0	0
Massachusetts	$0	$0	$0.0	0	0
Maryland	$0	$0	$0.0	0	0
Maine	$0	$0	$0.0	0	0
Michigan	$0	$0	$0.0	0	0
Minnesota	$0	$0	$0.0	0	0
Missouri	$0	$0	$0.0	0	0
Mississippi	$0	$0	$0.0	0	0
Montana	$0	$0	$0.0	2,900	2,900
North Carolina	$21	$21	$0.0	17,800	17,800
North Dakota	$0	$0	$0.0	0	0
Nebraska	$4	$4	$0.0	3,600	3,600
New Hampshire	$0	$0	$0.0	0	0
New Jersey	$18	$18	$0.0	15,300	15,300
New Mexico	$0	$0	$0.0	0	0
Nevada	$0	$0	$0.0	0	0
New York	$0	$0	$0.0	0	0
Ohio	$21	$21	$0.0	17,500	17,500
Oklahoma	$0	$0	$0.0	0	0
Oregon	$0	$0	$0.0	0	0
Pennsylvania	$0	$0	$0.0	0	0
Rhode Island	$2	$2	$0.0	1,900	1,900
South Carolina	$0	$0	$0.0	0	0
South Dakota	$0	$0	$0.0	0	0
Tennessee	$0	$0	$0.0	0	0
Texas	$0	$0	$0.0	0	0
Utah	$0	$0	$0.0	0	0
Virginia	$0	$0	$0.0	0	0
Vermont	$2	$2	$0.0	1,400	1,400
Washington	$0	$0	$0.0	0	0
Wisconsin	$6	$6	$0.0	9,000	9,000
West Virginia	$0	$0	$0.0	0	0
Wyoming	$1	$1	$0.0	1,600	1,600
U.S. Total	**$132**	**$132**	**$0.0**	**119,000**	**119,000**

EPA Estimates

Table 5-35: Option 2 State-Level Compliance Cost and Acreage (millions of $2008)

State	Unadjusted Resource Cost of Compliance	Quantity-Effect Adjusted Resource Cost of Compliance	Dead Weight Loss in Producer and Consumer Surplus	Unadjusted Compliance Acreage	Quantity-Effect Adjusted Compliance Acreage
Alabama	$54	$53	$0.1	6,100	6,100
Arkansas	$32	$31	$0.1	2,600	2,600
Arizona	$5	$5	$0.0	4,700	4,700
California	$76	$76	$0.0	27,100	27,100
Colorado	$18	$18	$0.0	8,000	8,000
Connecticut	$22	$22	$0.0	2,500	2,500
District of Columbia	$0	$0	$0.0	0	0
Delaware	$6	$6	$0.0	700	700
Florida	$196	$195	$0.7	12,700	12,600
Georgia	$96	$96	$0.2	12,300	12,200
Iowa	$25	$25	$0.0	3,500	3,500
Idaho	$0	$0	$0.0	0	0
Illinois	$64	$64	$0.1	13,200	13,100
Indiana	$44	$44	$0.1	7,500	7,500
Kansas	$27	$27	$0.0	3,200	3,200
Kentucky	$33	$33	$0.1	3,800	3,800
Louisiana	$68	$67	$0.3	4,100	4,100
Massachusetts	$30	$30	$0.0	4,800	4,800
Maryland	$44	$44	$0.1	5,100	5,100
Maine	$14	$14	$0.0	1,700	1,700
Michigan	$59	$59	$0.1	11,600	11,600
Minnesota	$31	$31	$0.0	7,300	7,300
Missouri	$57	$57	$0.1	6,600	6,600
Mississippi	$42	$42	$0.1	2,700	2,600
Montana	$2	$2	$0.0	2,200	2,200
North Carolina	$76	$75	$0.2	11,400	11,300
North Dakota	$2	$2	$0.0	900	900
Nebraska	$12	$12	$0.0	2,700	2,700
New Hampshire	$8	$8	$0.0	1,400	1,400
New Jersey	$73	$73	$0.1	11,500	11,400
New Mexico	$5	$5	$0.0	2,100	2,100
Nevada	$0	$0	$0.0	0	0
New York	$132	$132	$0.1	16,200	16,200
Ohio	$71	$71	$0.1	13,000	13,000
Oklahoma	$16	$16	$0.0	3,400	3,400
Oregon	$43	$43	$0.1	5,900	5,900
Pennsylvania	$73	$73	$0.1	9,300	9,200
Rhode Island	$9	$9	$0.0	1,400	1,400
South Carolina	$32	$31	$0.1	4,700	4,700
South Dakota	$5	$5	$0.0	1,500	1,500
Tennessee	$38	$38	$0.1	5,600	5,600
Texas	$75	$75	$0.1	15,800	15,700
Utah	$0	$0	$0.0	0	0
Virginia	$70	$70	$0.1	8,500	8,500
Vermont	$5	$5	$0.0	1,000	1,000
Washington	$48	$48	$0.0	9,400	9,400
Wisconsin	$28	$28	$0.0	6,700	6,700
West Virginia	$19	$19	$0.0	2,300	2,300
Wyoming	$2	$2	$0.0	1,000	1,000
U.S. Total	**$1,890**	**$1,883**	**$3.5**	**289,700**	**288,900**

EPA Estimates

Table 5-36: Option 3 State-Level Compliance Cost and Acreage (millions of $2008)

State	Unadjusted Resource Cost of Compliance	Quantity-Effect Adjusted Resource Cost of Compliance	Dead Weight Loss in Producer and Consumer Surplus	Unadjusted Compliance Acreage	Quantity-Effect Adjusted Compliance Acreage
Alabama	$125	$124	$0.5	9,100	9,000
Arkansas	$54	$54	$0.2	4,500	4,500
Arizona	$10	$10	$0.0	8,400	8,400
California	$137	$137	$0.0	48,600	48,600
Colorado	$39	$39	$0.0	12,200	12,200
Connecticut	$48	$48	$0.1	5,500	5,500
District of Columbia	$1	$1	$0.0	200	200
Delaware	$14	$14	$0.0	1,600	1,600
Florida	$407	$404	$1.3	26,200	26,000
Georgia	$256	$254	$0.9	21,000	20,800
Iowa	$43	$43	$0.1	5,900	5,900
Idaho	$8	$8	$0.0	4,700	4,700
Illinois	$109	$109	$0.1	22,600	22,500
Indiana	$103	$103	$0.3	11,200	11,100
Kansas	$44	$43	$0.1	5,100	5,100
Kentucky	$57	$57	$0.1	6,500	6,400
Louisiana	$119	$117	$0.6	7,200	7,100
Massachusetts	$63	$63	$0.0	10,100	10,100
Maryland	$92	$91	$0.1	10,600	10,500
Maine	$24	$24	$0.1	3,000	3,000
Michigan	$103	$103	$0.1	20,400	20,300
Minnesota	$52	$52	$0.1	12,400	12,400
Missouri	$100	$99	$0.3	11,600	11,500
Mississippi	$57	$56	$0.2	4,200	4,200
Montana	$6	$6	$0.0	3,300	3,200
North Carolina	$206	$205	$0.7	20,000	19,800
North Dakota	$5	$5	$0.0	1,900	1,900
Nebraska	$26	$26	$0.0	3,900	3,900
New Hampshire	$17	$17	$0.0	2,900	2,900
New Jersey	$185	$184	$0.2	17,000	16,900
New Mexico	$10	$10	$0.0	4,400	4,400
Nevada	$2	$2	$0.0	4,100	4,100
New York	$212	$212	$0.2	28,300	28,300
Ohio	$164	$163	$0.4	19,400	19,300
Oklahoma	$29	$29	$0.0	6,000	6,000
Oregon	$74	$74	$0.1	10,300	10,300
Pennsylvania	$151	$151	$0.3	19,100	19,000
Rhode Island	$24	$24	$0.0	2,300	2,300
South Carolina	$56	$55	$0.1	8,300	8,300
South Dakota	$8	$8	$0.0	2,500	2,500
Tennessee	$66	$65	$0.1	9,700	9,700
Texas	$156	$156	$0.2	32,700	32,600
Utah	$14	$14	$0.0	6,600	6,600
Virginia	$121	$120	$0.2	14,600	14,600
Vermont	$11	$11	$0.0	1,600	1,600
Washington	$85	$85	$0.1	16,500	16,400
Wisconsin	$68	$68	$0.1	10,100	10,000
West Virginia	$31	$31	$0.1	4,000	4,000
Wyoming	$5	$5	$0.0	1,800	1,800
U.S. Total	**$3,797**	**$3,780**	**$8.2**	**524,100**	**522,000**

EPA Estimates

6 Benefits Assessment Methodology and Results

This chapter provides an overview of the potential benefits to society related to reduced sediment discharges from construction sites that will result from the C&D regulation. A more detailed discussion of EPA's methodology and results from the benefits assessment can be found in the *Environmental Impact and Benefits Assessment for Proposed Effluent Guidelines and Standards for the Construction and Development Category* (USEPA 2008b), hereafter referred to as the *Environmental Assessment Document*.

Sediments and other pollutants from construction sites may have a wide range of effects on water resources located in the vicinity of construction sites. These environmental changes affect economic productivity (e.g., navigation, water storage, and water treatment) as well as environmental services valued by humans (e.g., recreation, public and private property ownership, existence services such as aquatic life, wildlife, and habitat designated uses). Related market benefits (e.g., avoided costs of producing various market goods and services) and non-market benefits are additive (Freeman 2003). In all cases, benefits are conceptualized and estimated based on established welfare theoretic models (Freeman 2003; Just et al. 2004).

EPA considered four categories of quantifiable monetary benefits from the C&D Regulation:

- *Benefits to Navigation (Section 6.1)* – Navigable waterways are often dredged to maintain their navigable depth and width. Reduced sediment settling in navigable channels is expected to reduce the cost of dredging in these channels, as it is related to the amount of sediment dredged;
- *Benefits to Water Storage (Section 6.2)* – Water storage facilities (reservoirs) may also be dredged in order to regain capacity lost to sediment build-up. Reduced sediment settling in reservoirs is expected to reduce the cost of dredging in reservoirs that are dredged;
- *Benefits to Drinking Water Treatment (Section 6.3)* – Drinking water must be treated for sediment and turbidity, among other things, and the treatment costs are related to the sediment and turbidity levels of the influent water. Reducing sediment and subsequently the turbidity that must be treated by drinking water treatment plants reduces the amount of chemicals needed for treatment, and also the amount of sludge generated from this treatment that must be disposed, lowering the cost of drinking water treatment; and,
- *Water Quality Benefits (Section 6.4)* – Reducing sediment levels in U.S. waterways has the general effect of improving water quality, as suspended sediment is one of the determinants of water quality. Increased water quality has both explicit and implicit value to users of water bodies, which was quantified using willingness-to-pay estimates based on a meta-analysis of existing willingness-to-pay studies for water quality.

The total benefits resulting from the reduced sediment and turbidity levels in U.S. waters induced by this regulation is estimated as the sum of these four categories of monetary benefits. Total benefits are summarized in *Section 6.5*. Lastly, *Section 6.6* summarizes the key uncertainties and limitations underlying the analyses.

More details of the conceptual framework underlying this benefits assessment and a discussion of additional benefits categories not monetized can be found in *Chapter 4* of the *Environmental Assessment Document*. EPA used the SPARROW (**SPA**tially **R**eferenced **R**egressions **O**n **W**atershed attributes) model (USGS 2008) to predict changes in sediment loadings and concentrations resulting from expected reductions in construction site sediment discharges brought about by this regulation. Details of SPARROW can be found in *Chapter 6* and *Appendix A* of the *Environmental Assessment Document*.

6.1 Analysis of Benefits to Navigation

This section presents a summary of EPA's analysis of the navigable waterway maintenance costs that would be avoided by implementation of the C&D regulation. Further details of this analysis and an expanded discussion of its results can be found in *Chapter 7* of the *Environmental Assessment Document*.

The analysis of benefits to navigation includes four primary steps:

- Identify navigable waterways that are regularly dredged and estimate the frequency of dredging in each waterway;
- Estimate the navigable waterway maintenance cost per cubic yard of sediment dredged;
- Estimate the total cost of navigable waterway maintenance under the baseline and post-compliance scenarios and,
- Estimate cost savings from decreased dredging of navigable waterways due to the reduction in sediment discharged from construction sites.

This analysis presents low, mid, and high estimates for dredging, the cost of dredging, and reductions in these two areas in order to provide a range of benefits values. This range of values was determined by varying certain assumptions made about current and future dredging activity in U.S. navigable waterways. The details of the assumptions made for each range are summarized in *Chapter 7* of the *Environmental Assessment Document*.

The cost savings for each post-compliance scenario is calculated as the difference in total annualized dredging costs between the baseline and each post-compliance scenario, and will be considered as the benefits to navigation resulting from the C&D regulation. *Table 6-1, Table 6-2,* and *Table 6-3* present annualized avoided cost estimates for navigable waterway dredging for each of The Agency's regulatory options, including low, midpoint, and high estimates for cost reductions under each of these scenarios. Each of these estimates was calculated using both 3 and 7 percent annual discount rates to discount and annualize costs.

Annualized savings from reduced dredging activity range from $690,000 to $49.2 million, varying based on the regulatory option and estimate range. EPA estimates that Region 4 will benefit from the most substantial reductions in dredging costs under all regulatory options. This is due to a large amount of dredging activity in this region and a large percentage reduction in sediment discharges expected as a result of the C&D regulation. Region 6, though it does account for a large portion of dredging activity, does not represent as large a portion of the cost savings due to its substantially lower cost per unit of dredged material ($1.79, compared to $5.39 in Region 4) and a larger number of construction sites exempted by rainfall and soil type waivers. Due to the lack of significant dredging activity in Region 8, no benefits are expected in this region.

Option 1, a construction general permit requiring sedimentation basins on all sites larger than 10 acres and the implementation of best management practices on smaller sites, is EPA's least stringent regulatory option. It is predicted to produce a range of cost savings between $690,000 and $1.8 million. Under this regulatory option, Region 4 will have the most significant savings, accounting for almost all of the benefits under this option. This option does not predict any savings in Regions 7, 8, or 9.

Option 2 imposes a turbidity standard on construction sites larger than 30 acres in areas that have an "R-factor" (see *Chapter 3* and the USEPA 2008a for more details) of greater than 50 and with soils containing greater than 10 percent small particles, and requires a construction general permit for all other sites. This option will prevent an estimated 3.3 million cubic yards of sediment from entering navigable water bodies and requiring dredging. The midpoint estimate for cost savings under this option is between $12.6 and $12.9 million per year, ranging from $8.9 million to $23.8 million between the low and high estimates. EPA expects more than 99 percent of these benefits to accrue to Regions 1 through 6, as many areas in Regions 7 through 10 are exempt through soil

type or rainfall waivers provided by this option. Region 4 again represents a significant portion of savings, though Region 6 is also expected to benefit from a reduction of more than $1.6 million per year in dredging costs.

Option 3, which imposes a turbidity standard on all sites larger than 10 acres (in addition to the requirements of Option 1) and requires a construction general permit for others, is EPA's most stringent regulatory option. This option would require on-site treatment of stormwater, substantially reducing its contribution to in-stream TSS and turbidity. Cost savings from this action range between $18.7 and $49.2 million, with a midpoint estimate of $26.5 to $27.2 million. Region 4 is again the largest beneficiary from this regulation, with $21.3 to $21.9 million in savings for the midpoint estimate, and Regions 3 and 6 also benefit from $1.0 to $1.1 million and $2.4 to $2.5 million in cost savings, respectively, under this option. The largest changes from Option 2 come in Region 9, which had many areas exempt due to rainfall under Option 2. Region 10 also sees a substantial increase in its benefits under this option, with the midpoint estimates rising from just over $157,200 and $161,900 (7 percent and 3 percent discount rates, respectively) under Option 2 to $602,200 and $620,100, respectively, under Option 3.

Overall, Regions 4 and 6 are the largest beneficiaries of reduced dredging costs from this action, both in terms of cost savings and the amount of sediment prevented from entering and settling in navigable waterways. This is likely an effect of the large portion of coastline located in these regions and their large proportion of dredging activity.

Table 6-1: Annualized Reductions in Dredging and Costs Under Option 1

EPA Region	Reduction in Sediment Dredged (thousands of yd^3)			Avoided Costs Using 3% Discount Rate (thousands of 2008$)			Avoided Costs Using 7% Discount Rate (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
1[1]	0.0	0.0	0.0	$0.1	$0.4	$1.8	$0.1	$0.4	$2.0
2	0.2	0.3	0.5	$1.2	$2.2	$4.5	$1.1	$2.2	$4.8
3	0.2	0.3	0.4	$0.7	$1.3	$2.5	$0.7	$1.3	$2.7
4	169.3	204.0	302.3	$686.6	$962.8	$1,615.8	$676.7	$937.2	$1,741.7
5	0.2	0.2	0.3	$0.7	$0.9	$1.5	$0.7	$0.9	$1.6
6	1.1	1.3	1.8	$1.3	$2.0	$3.6	$1.3	$2.0	$3.8
7[a]	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
8	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9[a]	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**171.0**	**206.1**	**305.4**	**$690.6**	**$969.8**	**$1,629.7**	**$680.7**	**$943.9**	**$1,756.6**

a Reductions in dredged sediment and costs in these regions are not zero, but not sufficiently large to show at this level of significant digits

EPA Estimates

Table 6-2: Annualized Reductions in Dredging and Costs Under Option 2

EPA Region	Reduction in Sediment Dredged (thousands of yd^3)			Avoided Costs Using 3% Discount Rate (thousands of 2008$)			Avoided Costs Using 7% Discount Rate (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	0.2	0.8	1.2	$1.3	$9.3	$39.0	$1.3	$8.8	$44.5
2	29.6	53.6	98.9	$214.1	$408.1	$816.1	$210.2	$395.0	$878.6
3	79.8	112.6	162.1	$519.5	$720.5	$1,172.9	$512.0	$700.7	$1,276.4
4	1,744.6	2,125.3	3,136.1	$6,851.2	$9,759.3	$16,889.0	$6,758.1	$9,505.3	$18,161.5
5	30.0	39.9	47.2	$109.6	$145.2	$206.9	$107.7	$141.0	$222.9
6	744.7	951.3	1,314.2	$1,104.8	$1,669.5	$2,682.8	$1,093.2	$1,632.0	$2,846.0
7	0.7	4.0	4.8	$0.5	$7.9	$11.7	$0.5	$7.3	$13.9
8	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
9	2.7	3.2	4.8	$17.8	$21.2	$31.1	$17.5	$20.7	$33.0
10	35.4	52.9	84.5	$95.5	$161.9	$283.8	$94.7	$157.2	$304.5
Total	**2,667.8**	**3,343.6**	**4,853.9**	**$8,914.4**	**$12,903.0**	**$22,133.3**	**$8,795.3**	**$12,568.1**	**$23,781.3**

EPA Estimates

Table 6-3: Annualized Reductions in Dredging and Costs Under Option 3

EPA Region	Reduction in Sediment Dredged (thousands of yd^3)			Avoided Costs Using 3% Discount Rate (thousands of 2008$)			Avoided Costs Using 7% Discount Rate (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	0.6	1.9	3.0	$3.2	$22.9	$97.7	$3.2	$21.7	$111.1
2	45.5	82.5	153.1	$330.5	$628.1	$1,255.1	$324.5	$607.8	$1,352.0
3	118.7	167.9	241.6	$764.8	$1,066.6	$1,740.5	$753.8	$1,037.0	$1,894.3
4	3,586.9	4,401.9	6,741.2	$15,463.9	$21,927.8	$36,849.6	$15,248.8	$21,345.9	$39,776.9
5	49.7	65.5	77.4	$215.9	$280.1	$396.2	$212.5	$272.7	$425.4
6	1,100.1	1,411.8	1,949.1	$1,649.5	$2,494.1	$3,985.9	$1,631.9	$2,437.2	$4,232.8
7	1.0	5.9	7.2	$0.8	$11.7	$17.4	$0.8	$10.9	$20.7
8	0.0	0.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.1
9	22.7	26.7	39.6	$147.2	$175.3	$257.5	$145.1	$171.7	$273.1
10	137.9	203.8	319.6	$367.3	$620.1	$1,069.6	$364.2	$602.2	$1,147.5
Total	**5,063.0**	**6,368.0**	**9,531.7**	**$18,943.2**	**$27,226.8**	**$45,669.6**	**$18,684.7**	**$26,507.1**	**$49,233.9**

EPA Estimates

6.2 Analysis of Benefits to Water Storage

This section provides a summary of EPA's analysis to estimate the benefits to water storage facilities from reduced sediment discharge. A more detailed description of this analysis can be found in *Chapter 8* of the *Environmental Assessment Document*.

The analysis of these benefits includes the following steps:

- Estimating the unit cost of sediment removal from reservoirs assumed to be dredged;
- Estimating the sediment accumulation in reservoirs under the baseline scenario and the post-compliance regulatory scenarios and the amount expected to be dredged; and,
- Estimating the cost savings from decreased dredging of reservoirs due to the reduction in sediment discharged from construction sites.

Due to a lack of data on the frequency of reservoir dredging, EPA varied the assumed frequency of dredging between 2, 6, and 10 years to produce a range of avoided cost estimates. More details of this sensitivity analysis can be found in *Chapter 8* of the *Environmental Assessment Document*.

The difference between the anticipated dredging costs under the baseline and a particular post-compliance scenario represents the cost savings of that particular scenario. *Table 6-4*, *Table 6-5*, and *Table 6-6* present reductions in sedimentation and subsequent avoided costs from reduced reservoir dredging for the three post-compliance regulatory scenarios, including low, midpoint, and high estimates under each of these scenarios.

Cost savings from a reduction in reservoir sedimentation range from $470,000 to $32 million, with EPA's Option 2 representing a savings of $17.6 million the midpoint estimate assuming a 3% discount rate, $15.9 million at a 7% rate. The largest savings are predicted in Region 4 under all options, as SPARROW predicts the largest overall reductions in sediment accumulation in this region. Region 4 accounts for nearly 98% of all savings under Option 1, and more than 50% in both Options 2 and 3. Region 6 is also anticipated to benefit from savings between $4.3 and $4.8 million under Option 2, and by between $6.5 and $7.4 million under Option 3.

Option 1, a construction general permit requiring sedimentation basins on all sites larger than 10 acres and the implementation of best management practices on smaller sites, is EPA's least stringent regulatory option. As noted above, Region 4 is the only region to benefit significantly from this regulatory option, and accounts for $593,000 of the $606,000 in cost savings for the midpoint estimate of this option assuming a 3% discount rate, and $536,000 out of $548,000 at a 7% rate.

Option 2 imposes a turbidity standard on construction sites larger than 30 acres in areas that have an "R-factor" (see *Chapter 3* and the *Technical Development Document* for more details) of greater than 50 and have soils containing greater than10 percent small particles, and requires a construction general permit for all other sites. Cost savings under this option range between $13.7 and $18.7 million, with an expected value of $17.6 million assuming a 3% discount rate ($15.9 million at 7%). This option greatly increases expected savings for all regions, reducing reservoir sedimentation rates by more than 5 million kilograms per year in eight regions, and by more than 100,000 cubic yards per year in five of these regions. Region 4 is predicted to have a large portion of the savings, though Region 6 is also expected to benefit from $3.6 to $4.8 million dollars of reduced dredging costs each year. Region 7 has the next largest portion of savings, benefiting by at least $1.2 million in the midpoint estimate. The Agency expects the smallest reductions in reservoir sedimentation in Regions 8 and 9, where many sites will be exempt due to rainfall or soil type waivers. Both of these regions will experience a decline of 10,000 cubic yards or less per year in the midpoint estimate of reservoir sedimentation.

Option 3, which imposes a turbidity standard on all sites larger than 10 acres (in addition to the requirements of Option 1) and requires a construction general permit for others, is EPA's most stringent regulatory option. This option would require on-site treatment of stormwater, substantially reducing its contribution to in-stream TSS and turbidity. Expected cost savings from this action range between $23.8 and $32.5 million, with midpoint estimates of $30.6 million at 3% and $27.6 million at 7%. Region 4 is again the largest beneficiary from this regulation, with around $16.4 million in savings for the midpoint estimate assuming a 3% discount rate, and $14.8 million assuming a 7% discount rate. Region 6 is also estimated to benefit substantially from this regulation, with a reduction between $5.4 and $7.4 million. The drier Regions 8 and 9, which have many areas exempt under Option 2, are expected to benefit much more substantially under Option 3, with expected savings in Region 9 more than ten times greater under Option 3 than under Option 2 and more than seven times greater in Region 8. Overall cost savings under this regulatory option nearly double for all estimate ranges.

Overall, Regions 4 and 6 are the largest beneficiaries of reduced dredging costs from this action, with substantial cost and sedimentation reductions also occurring in Regions 7 and 10 under Options 2 and 3. These two options are expected to result in significantly higher savings than Option 1, and are also anticipated to provide a more even distribution of these avoided cost benefits among regions.

Table 6-4: Reduction in Reservoir Dredging and Costs Under Option 1

EPA Region	Reduction in Sediment (yd^3)	Avoided Costs (thousand 2008$)					
		3% Discount Rate			7% Discount Rate		
		Low	Mid	High	Low	Mid	High
1	81	$0.8	$0.8	$0.9	$0.6	$0.8	$0.9
2	122	$0.8	$0.8	$0.9	$0.6	$0.7	$0.8
3	236	$1.4	$1.5	$1.6	$1.2	$1.3	$1.5
4	118,525	$557.3	$592.6	$629.4	$462.4	$535.9	$617.3
5	1,343	$5.3	$5.6	$5.9	$4.4	$5.0	$5.8
6	175	$0.3	$0.3	$0.3	$0.2	$0.3	$0.3
7	256	$0.5	$0.6	$0.6	$0.4	$0.5	$0.6
8	641	$2.5	$2.7	$2.8	$2.1	$2.4	$2.8
9	120	$0.7	$0.7	$0.8	$0.6	$0.7	$0.8
10	5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	**121,504**	**$569.5**	**$605.6**	**$643.2**	**$472.5**	**$547.6**	**$630.8**

EPA Estimates

Table 6-5: Reduction in Reservoir Dredging and Costs Under Option 2

EPA Region	Reduction in Sediment (yd^3)	Avoided Costs (thousand 2008$)					
		3% Discount Rate			7% Discount Rate		
		Low	Mid	High	Low	Mid	High
1	9,405	$91.1	$96.9	$102.9	$75.6	$87.6	$101.0
2	11,408	$70.4	$74.8	$79.5	$58.4	$67.7	$78.0
3	77,481	$458.2	$487.3	$517.6	$380.2	$440.6	$507.6
4	1,894,111	$8,906.1	$9,470.5	$10,059.0	$7,389.6	$8,563.8	$9,864.6
5	151,379	$591.7	$629.2	$668.3	$491.0	$569.0	$655.4
6	2,754,706	$4,293.8	$4,565.9	$4,849.6	$3,562.7	$4,128.7	$4,755.9
7	701,561	$1,465.4	$1,558.3	$1,655.1	$1,215.9	$1,409.1	$1,623.1
8	8,869	$34.7	$36.9	$39.2	$28.8	$33.4	$38.5
9	3,541	$20.3	$21.6	$22.9	$16.8	$19.5	$22.5
10	182,545	$589.0	$626.3	$665.2	$488.7	$566.3	$652.3
Total	**5,795,007**	**$16,520.7**	**$17,567.7**	**$18,659.3**	**$13,707.7**	**$15,885.7**	**$18,298.7**

EPA Estimates

Table 6-6: Reduction in Reservoir Dredging and Costs Under Option 3

EPA Region	Reduction in Sediment (yd3)	Avoided Costs (thousand 2008$)					
		3% Discount Rate			7% Discount Rate		
		Low	Mid	High	Low	Mid	High
1	19,967	$193.5	$205.8	$218.5	$160.5	$186.1	$214.3
2	20,009	$123.4	$131.3	$139.4	$102.4	$118.7	$136.7
3	113,358	$670.4	$712.9	$757.2	$556.3	$644.7	$742.6
4	3,282,768	$15,435.5	$16,413.7	$17,433.6	$12,807.3	$14,842.2	$17,096.7
5	236,195	$923.3	$981.8	$1,042.8	$766.1	$887.8	$1,022.6
6	4,197,561	$6,542.8	$6,957.4	$7,389.7	$5,428.7	$6,291.3	$7,246.9
7	980,419	$2,047.9	$2,177.6	$2,313.0	$1,699.2	$1,969.1	$2,268.3
8	64,591	$252.9	$268.9	$285.6	$209.8	$243.2	$280.1
9	44,456	$254.6	$270.7	$287.5	$211.2	$244.8	$282.0
10	710,277	$2,291.6	$2,436.8	$2,588.3	$1,901.4	$2,203.5	$2,538.3
Total	**9,669,601**	**$28,735.9**	**$30,556.9**	**$32,455.6**	**$23,842.9**	**$27,631.3**	**$31,828.5**

EPA Estimates

6.3 Analysis of Benefits to Drinking Water Treatment

This section summarizes the estimation of the total expenditures to remove sediments from drinking water and the cost savings expected with the reduction of sediment discharges anticipated from the C&D regulation. Further details of this analysis and an expanded discussion of its results can be found in *Chapter 9* of the *Environmental Assessment Document.* The cost of drinking water treatment followed the following steps:

- Identifying RF1 reaches modeled by SPARROW that are sources for drinking water treatment plants;
- Determining TSS reductions in these reaches;
- Estimating the chemical cost of treating the turbidity caused by TSS in these reaches;
- Estimating the cost of disposing of the sludge generated from this turbidity treatment;
- Estimating the total costs of drinking water treatment under the baseline and post-compliance scenarios; and,
- Estimating the cost savings from decreased drinking water treatment costs due to the reduction in sediment discharged from construction sites.

To address uncertainty in its assumptions, EPA conducted a sensitivity analysis that varies assumptions about the treatment of highly turbid influent water and the cost of chemical inputs, and the results of the following analyses present low, midpoint, and high benefits estimates (see *Chapter 9* of the *Environmental Assessment Document* for details).

The total cost savings from lowered turbidity resulting from lower TSS concentrations in drinking water influent was estimated as the difference between drinking water turbidity treatment under the baseline and post-compliance scenarios. Reductions in drinking water treatment costs for the three post-compliance regulatory scenarios are presented in *Table 6-7*, *Table 6-8*, and *Table 6-9*.

The anticipated savings from reduced TSS and turbidity treatment at drinking water facilities are between $181,900 and $14.5 million, varying substantially between the least and most stringent regulatory options and also less dramatically between the low and high estimates. EPA's Option 2 is expected to reduce TSS and turbidity treatment costs for drinking water facilities by between $2.9 and $8.0 million. As is the case with navigable waterway and reservoir dredging, Region 4 benefits most significantly and consistently from the TSS

reductions expected from this regulatory action. The avoided costs in Region 4 under Regulatory Option 1 account for more than 90 percent of the total national savings. Other regions receive a larger portion of benefits under Regulatory Options 2 and 3, though Region 4 still accounts for the greatest proportion of the cost reductions. Regions 6 and 10 also show significant savings under Options 2 and 3, with savings in these regions between greater than $1 million in all estimates for these two options.

Option 1, a construction general permit requiring sedimentation basins on all sites larger than 10 acres and the implementation of best management practices on smaller sites, is EPA's least stringent regulatory option. Region 4 receives the only considerable cost savings under this option, between $170,500 and $200,00. Savings in Regions 2, 5, and 8 are between $1,000 and $10,000, and in all other regions, expected cost reductions are less than $1,000.

Option 2, imposes a turbidity standard on construction sites larger than 10 acres in areas that have an "R-factor" (see *Chapter 3* and the *Technical Development Document* for more details) of greater than 50 and with soils containing greater than 10 percent small particles, and requires a construction general permit for all other sites. For the midpoint estimate of EPA's Option 2, the national average reduction in treated turbidity is 1.7 NTU, though in Region 4 (where many of the benefits are expected) the reduction is more than 6 NTU. Region 10 is expected to benefit from an average reduction of 15.9 NTU in influent water turbidity, though its expected savings are lower than those in Region 4 due to the lower number of affected facilities in Region 10. The expected value of avoided costs for this estimate is $7.4 million. Estimated savings exceed $1 million in Regions 4 and 6, and 10. These savings are much greater than the near-zero savings expected under Option 1 for Regions 6 and 10. Regions 8 and 9 do not benefit as substantially as other regions, likely due to a large number of sites being exempted from the turbidity standard, which would otherwise shift turbidity treatment costs from the drinking water treatment facility to the construction site.

Option 3, which imposes a turbidity standard on all sites larger than 10 acres (in addition to the requirements of Option 1) and requires a construction general permit for others, is EPA's most stringent regulatory option. This option would require on-site treatment of storm water, substantially reducing its contribution to in-stream TSS and turbidity. Total avoided costs for this option are between $10.4 and $14.5 million, with a midpoint estimate around $13.1 million. The drier Regions 8 and 9, which have many areas exempt under Option 2, are expected to benefit much more substantially under Option 3. Estimated avoided costs in these regions are six to eleven times larger under this option, though still much lower than in other regions.

As construction site discharges are more likely to contain smaller particles that contribute less to TSS and more to turbidity, the high estimates for Options 2 and 3 may be more relevant because EPA uses a conversion factor between TSS and turbidity that takes this into account. The high estimate for turbidity reductions under Option 2 is 7.2 NTU nationwide, with a reduction of nearly 13 NTU in Region 4, and nearly 12 NTU in Region 6. Under Option 3, the high estimate is on average around 11.2 NTU nationwide, 22.2 NTU in Region 4, and 16.7 NTU in Region 6.

Overall, Regions 4, 6, and 10 receive the largest proportion of the cost reductions from reduced turbidity in drinking water. Options 2 and 3 produce significantly larger cost savings than Option 1, which is expected to reduce treatment costs by only about $211,400 nationally (midpoint estimate). Midpoint estimates of avoided costs under Options 2 and 3 are $7.4 and $13.1 million, respectively, and are expected to distribute these savings more evenly among the 10 regions, though with the aforementioned regions benefiting most due to a more substantial effect of the C&D regulation in these regions.

Table 6-7: Reduction in Drinking Water Treatment Costs Under Option 1

EPA Region	Average Reduction in Treated Turbidity (NTU) [a]			Cost Savings (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High
1	0.0	0.0	0.0	$0.2	$0.2	$0.3
2	0.0	0.0	0.0	$4.2	$5.0	$5.0
3	0.0	0.0	0.0	$0.2	$0.2	$0.2
4	0.5	0.8	1.4	$170.5	$196.7	$200.5
5	0.0	0.0	0.1	$5.6	$7.8	$9.3
6	0.0	0.0	0.0	$0.1	$0.1	$0.1
7	0.0	0.0	0.0	$0.1	$0.1	$0.2
8	0.0	0.0	0.0	$1.1	$1.4	$1.5
9	0.0	0.0	0.0	$0.0	$0.0	$0.0
10	0.0	0.0	0.0	$0.0	$0.0	$0.0
Total	**0.1**	**0.1**	**0.2**	**$181.9**	**$211.4**	**$217.1**

a Average Turbidity reductions shown as 0.0 are not actually zero, but not sufficiently large to show at this level of significant digits

EPA Estimates

Table 6-8: Reduction in Drinking Water Treatment Costs Under Option 2

EPA Region	Average Reduction in Treated Turbidity (NTU) [a]			Cost Savings (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High
1	0.1	0.1	0.2	$11.5	$14.4	$15.9
2	0.3	0.5	1.0	$137.1	$179.4	$197.9
3	1.4	2.0	3.8	$567.0	$652.7	$653.3
4	4.6	6.7	12.7	$2,070.0	$2,474.5	$2,583.8
5	0.6	1.0	2.3	$192.4	$258.5	$301.6
6	2.1	3.7	8.0	$1,369.0	$1,662.9	$1,738.3
7	2.9	5.3	11.8	$322.0	$411.8	$468.7
8	0.0	0.1	0.1	$4.9	$6.1	$6.7
9	0.1	0.1	0.2	$7.3	$10.1	$12.0
10 [b]	4.9	15.9	46.2	$1,165.7	$1,750.6	$2,034.4
Total	**1.7**	**3.1**	**7.2**	**$5,846.9**	**$7,421.0**	**$8,012.6**

a Average Turbidity reductions shown as 0.0 are not actually zero, but not sufficiently large to show at this level of significant digits

b The estimated turbidity reductions for Region 10 are heavily influenced by 6 facilities on a reach for which the TSS concentration is greater than 5,000 mg/L in the baseline and is reduced significantly under this option.

EPA Estimates

Table 6-9: Reduction in Drinking Water Treatment Costs Under Option 3

EPA Region	Average Reduction in Treated Turbidity (NTU)			Cost Savings (thousands of 2008$)		
	Low	Mid	High	Low	Mid	High
1	0.4	0.6	1.1	$76.7	$93.1	$101.8
2	0.6	0.9	2.0	$279.0	$361.1	$394.5
3	2.0	2.9	5.5	$837.6	$964.8	$965.7
4	8.0	11.8	22.2	$4,398.0	$5,272.3	$5,422.2
5	1.0	1.8	4.0	$302.5	$407.6	$475.5
6	3.1	5.8	13.1	$2,161.7	$2,644.6	$2,772.5
7	4.1	7.5	16.7	$450.9	$581.7	$665.4
8	0.2	0.4	0.8	$29.9	$36.5	$39.1
9	0.6	1.0	2.1	$81.0	$112.2	$134.4
10 [a]	7.7	21.8	60.6	$1,751.7	$2,667.5	$3,488.6
Total	**2.8**	**5.0**	**11.2**	**$10,369.1**	**$13,141.5**	**$14,459.9**

a The estimated turbidity reductions for Region 10 are heavily influenced by 6 facilities on a reach for which the TSS concentration is greater than 5,000 mg/L in the baseline and is reduced significantly under this option.

EPA Estimates

6.4 Analyzing the Benefits of Water Quality Improvement

As discussed in the preceding sections of this chapter, sediments and other pollutants from construction sites may have a wide range of effects on water resources located in the vicinity of the construction sites. The environmental changes affecting environmental services valued by humans are monetized in the preceding sections. Non-market benefits or existence services such as aquatic life, wildlife, and habitat designated use (Freeman 2003) need to be considered in addition to market benefits (e.g., avoided costs of producing various market goods and services).

To link water quality changes from reduced sediment runoff to effects on human uses and support for aquatic and terrestrial species habitat, this analysis utilizes a water quality index (WQI) based on the one developed by McClelland (1974), which EPA has modified to rely on fewer parameters (U.S. EPA 2002, EPA 2004a). This index is linked to specific pollutant levels, which in turn are linked to the presence of aquatic species and suitability for particular recreational uses. The WQI allows the use of objective water quality parameters (e.g., dissolved oxygen concentrations) to characterize ecosystem services or uses provided by a given water body. The WQI is measured on a scale from 0 to 100, where 0 is poor quality and 100 is excellent. The complete description and associated equations and tables can be found in *Chapter 10* of the *Environmental Assessment Document*.

This section describes the use of meta-analysis of surface water valuation studies for estimating benefits of water quality improvements resulting from the C&D regulation. The technical details involved in the estimation of original meta-analyses are presented in *Chapter 10* and *Appendix A* of the *Environmental Assessment Document* as well as in sources such as Johnston et al. (2005; 2006), Bateman and Jones (2003), Shrestha et al. (2007), Rosenberger and Phipps (2007), and U.S. EPA (2004c).

6.4.1 Estimated Changes in Water Quality (ΔWQI) from the C&D Regulation

To estimate benefits of water quality improvements expected from the C&D regulation, EPA estimated WQI for each regulatory option. In calculating the post-compliance WQI, the Agency used option-specific TSS concentrations from the SPARROW output. The sediment loading estimates for each regulatory option reflect the expected reduction in sediment runoff under the regulatory options. The other contributing parameters to the WQI were held constant for all regulatory options.

Each RF1 reach that has an improved WQI value from the baseline scenario to a regulatory option contributes to the estimated economic benefits. Based on the estimated WQI value under the baseline scenario, EPA categorized each RF1 reach using four WQI ranges (WQI < 25, 25≤WQI<50, 50≤WQI<70, and 70≤WQI). WQI values of less than 25 indicate that water is not even suitable for boating (the recreational use with the lowest required WQI), whereas WQI values greater than 70 indicate that waters are swimmable (the recreational use with the highest required WQI). For each WQI category under the baseline scenario and regulatory options in a given state, EPA estimated weighted average WQI using river miles as weights.

The difference in WQI between baseline conditions and a given rulemaking scenario is a measure of the change in water quality attributable to the regulatory option. To monetize benefits of the C&D regulation, EPA used three ranges of water quality improvements ΔWQI≤0.1, 0.1<ΔWQI≤0.5, 0.5< ΔWQI. For each combination, of the baseline water quality category and the improvement range, the Agency estimated average ΔWQI and the corresponding percentage of total river miles in the state.

Table 6-10, *Table 6-11*, and *Table 6-12* summarize changes in ambient water quality resulting from the C&D regulation. *Appendix D* of the *Environmental Assessment Document* provides more detail on water quality improvements by the baseline WQI range. EPA estimated that Option 1 is not expected to result in significant water quality improvements at the regional level with improvements in only 9,325 river miles or 1.6 percent of the 585,368 river miles included in the analysis. EPA Region 4 is essentially the only geographic region that

shows any significant water quality improvements with 9,177 RF1 miles (10.5 percent of indexed RF1 miles that recive C&D discharge) being affected. Region 5 is expected to have the next largest water quality improvement with 96 RF1 miles being affected under the post-compliance scenario.

EPA's Option 2 is estimated to improve ambient water quality in 111,418 (19.0 percent) RF1 miles nationwide. EPA's Regions 2, 3, and 4 are estimated to improve water quality in 35 percent or more of total RF1 miles. EPA's water quality analysis predicts that Regions 3 and 4 will experience most improvements in terms of both RF1 miles (18,844 and 48,229) and percent of total regional river length (64.6 percent and 55.2 percent). EPA's analysis also indicates that Region 4 would benefit the most in terms of the estimated magnitude of water quality improvements with 5.5 percent of indexed RF1 miles estimated to improve by greater than 0.5 WQI units. Conversely, EPA Region 8 is estimated to improve the least, with 0.3 percent of river miles benefiting from higher water quality.

Option 3 yields the most significant results overall in terms of RF1 miles expected to improve under the post-compliance scenario at136,488. The estimated scale of improvements range from 3.6 percent to 71.4 percent of RF1 miles that receive C&D discharge in EPA's Region 8 and 3, respectively. EPA estimated that Region 4 will experience the largest water quality improvement by river miles with 54,727 RF1 miles (62.7 percent of indexed RF1 miles) affected. EPA's analysis also shows that Region 4 will have the most RF1 miles (8,486) improving by greater than 0.5 WQI units. The Agency estimates that Region 9 will have the lowest water quality improvements with 2,193 miles showing any improvement under the post-compliance scenario. *Table 6-12* presents water quality improvements by river miles according to water quality under the baseline scenario for each of EPA's regulatory options. A more detailed table describing these changes by EPA region, as well as discussion of these results can be found in *Chapter 10* of the *Environmental Assessment Document.*

Table 6-10: Estimated Water Quality Improvements Under Option 1

EPA Region	Baseline Scenario		Water Quality Improvements by WQI Change											
			0.01 < ΔWQI < 0.1			0.1 < ΔWQI < 0.5			0.5 < ΔWQI			Total Improved Reaches		
	RFI Miles Receiving Construction Discharges	Miles of River in RF1 Network	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles
1	16,952	18,324	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
2	15,888	16,110	20	0.1%	0.1%	0	0.0%	0.0%	0	0.0%	0.0%	20	0.1%	0.1%
3	29,183	33,617	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
4	87,312	94,525	8,207	9.4%	8.7%	738	0.8%	0.8%	232	0.3%	0.2%	9,177	10.5%	9.7%
5	71,508	71,550	96	0.1%	0.1%	0	0.0%	0.0%	0	0.0%	0.0%	96	0.1%	0.1%
6	82,855	98,681	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
7	54,018	60,909	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
8	113,710	130,311	32	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	32	0.0%	0.0%
9	47,474	56,492	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
10	66,468	69,524	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%
National Total	**585,368**	**650,043**	**8,355**	**1.4%**	**1.3%**	**738**	**0.1%**	**0.1%**	**232**	**<0.0%**	**<0.0%**	**9,325**	**1.6%**	**1.4%**

Source: EPA Estimates

Table 6-11: Estimated Water Quality Improvements Under Option 2

EPA Region	Baseline Scenario		Water Quality Improvements by WQI Change											
			0.01 < ΔWQI < 0.1			0.1 < ΔWQI < 0.5			0.5 < ΔWQI			Total Improved Reaches		
	RFI Miles Receiving Construction Discharges	Miles of River in RF1 Network	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles
1	16,952	18,324	1,510	8.9%	8.2%	38	0.2%	0.2%	0	0.0%	0.0%	1,548	9.1%	8.5%
2	15,888	16,110	5,345	33.6%	33.2%	196	1.2%	1.2%	7	<0.0%	<0.0%	5,548	34.9%	34.4%
3	29,183	33,617	16,244	55.7%	48.3%	2,356	8.1%	7.0%	244	0.8%	0.7%	18,844	64.6%	56.1%
4	87,312	94,525	30,169	34.6%	31.9%	13,243	15.2%	14.0%	4,817	5.5%	5.1%	48,229	55.2%	51.0%
5	71,508	71,550	7,156	10.0%	10.0%	990	1.4%	1.4%	138	0.2%	0.2%	8,283	11.6%	11.6%
6	82,855	98,681	5,734	6.9%	5.8%	6,850	8.3%	6.9%	3,924	4.7%	4.0%	16,507	19.9%	16.7%
7	54,018	60,909	2,310	4.3%	3.8%	1,004	1.9%	1.6%	477	0.9%	0.8%	3,791	7.0%	6.2%
8	113,710	130,311	278	0.2%	0.2%	0	0.0%	0.0%	9	<0.0%	<0.0%	288	0.3%	0.2%
9	47,474	56,492	342	0.7%	0.6%	46	0.1%	0.1%	0	0.0%	0.0%	388	0.8%	0.7%
10	66,468	69,524	4,545	6.8%	6.5%	2,370	3.6%	3.4%	1,076	1.6%	1.5%	7,991	12.0%	11.5%
National Total	**585,368**	**650,043**	**73,632**	**12.6%**	**11.3%**	**27,093**	**4.6%**	**4.2%**	**10,693**	**1.8%**	**1.6%**	**111,418**	**19.0%**	**17.1%**

Source: EPA Estimates

Table 6-12: Estimated Water Quality Improvements Under Option 3

EPA Region	Baseline Scenario		Water Quality Improvements by WQI Change											
			0.01 < ΔWQI < 0.1			0.1 < ΔWQI < 0.5			0.5 < ΔWQI			Total Improved Reaches		
	RFI Miles Receiving Construction Discharges	Miles of River in RF1 Network	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles	River Miles	% of River Miles Receiving Construction Discharges	% of Total River Miles
1	16,952	18,324	2,754	16.2%	15.0%	192	1.1%	1.0%	9	0.1%	0.0%	2,956	17.4%	16.1%
2	15,888	16,110	6,864	43.2%	42.6%	621	3.9%	3.9%	30	0.2%	0.2%	7,514	47.3%	46.6%
3	29,183	33,617	16,843	57.7%	50.1%	3,631	12.4%	10.8%	355	1.2%	1.1%	20,830	71.4%	62.0%
4	87,312	94,525	26,844	30.7%	28.4%	19,397	22.2%	20.5%	8,486	9.7%	9.0%	54,727	62.7%	57.9%
5	71,508	71,550	9,310	13.0%	13.0%	1,883	2.6%	2.6%	414	0.6%	0.6%	11,606	16.2%	16.2%
6	82,855	98,681	5,212	6.3%	5.3%	7,095	8.6%	7.2%	5,395	6.5%	5.5%	17,702	21.4%	17.9%
7	54,018	60,909	2,973	5.5%	4.9%	1,041	1.9%	1.7%	735	1.4%	1.2%	4,749	8.8%	7.8%
8	113,710	130,311	3,603	3.2%	2.8%	362	0.3%	0.3%	128	0.1%	0.1%	4,092	3.6%	3.1%
9	47,474	56,492	1,786	3.8%	3.2%	306	0.6%	0.5%	101	0.2%	0.2%	2,193	4.6%	3.9%
10	66,468	69,524	4,489	6.8%	6.5%	3,367	5.1%	4.8%	2,261	3.4%	3.3%	10,118	15.2%	14.6%
National Total	**585,368**	**650,043**	**80,678**	**13.8%**	**12.4%**	**37,895**	**6.5%**	**5.8%**	**17,915**	**3.1%**	**2.8%**	**136,488**	**23.3%**	**21.0%**

Source: EPA Estimates

6.4.2 Benefits of Water Quality Improvements

To estimate non-market benefits of water quality improvements resulting from the C&D regulation, EPA used a benefits transfer function based on meta-analysis results presented in *Appendix D* of the *Environmental Assessment Document*. The general approach follows standard methods illustrated by Johnston et al. (2005) and Shrestha et al. (2007), among many others (see Rosenberger and Phipps 2007). This function allows the Agency to forecast WTP based on assigned values for model variables, chosen to represent a resource change in the C&D policy context.

Table 6-13 presents mean values and confidence interval boundaries of household WTP for water quality improvements resulting form reduced sediment discharges from construction sties by EPA region and regulatory option.

Table 6-13 :Average Household Willingness to Pay[a] for Water Quality Improvement by Region (2008$)

	Option 1			Option 2			Option 3		
EPA Region	Lower 10% Bound	Mean	Upper 90% Bound	Lower 10% Bound	Mean	Upper 90% Bound	Lower 10% Bound	Mean	Upper 90% Bound
1	$0.00	$0.00	$0.00	$0.06	$0.31	$0.67	$0.36	$1.84	$3.67
2	$0.00	$0.02	$0.04	$0.65	$3.11	$6.27	$1.02	$4.61	$9.07
3	$0.00	$0.00	$0.00	$1.47	$5.90	$12.24	$1.66	$6.59	$13.68
4	$0.21	$0.70	$1.54	$2.06	$5.12	$11.03	$3.19	$7.09	$15.51
5	$0.00	$0.01	$0.03	$0.32	$1.28	$2.64	$0.46	$1.68	$3.63
6	$0.00	$0.00	$0.00	$1.43	$2.28	$5.91	$1.74	$2.44	$6.71
7	$0.00	$0.00	$0.00	$0.54	$1.03	$2.40	$0.72	$1.22	$2.97
8	$0.00	$0.00	$0.01	$0.01	$0.04	$0.08	$0.16	$0.57	$1.15
9	$0.00	$0.00	$0.00	$0.03	$0.11	$0.23	$0.16	$0.62	$1.25
10	$0.00	$0.00	$0.00	$0.91	$2.37	$4.65	$1.42	$3.36	$6.50
National	**$0.04**	**$0.15**	**$0.32**	**$0.92**	**$2.59**	**$5.58**	**$1.33**	**$3.50**	**$7.59**

a EPA used the Krinsky and Robb (1986) procedure to estimate the lower and upper bound value of the non-use component of total WTP for each region, based on the results of the total WTP regression model. The Agency notes that this analysis provides confidence limits for WTP estimates related to the covariance matrix of meta-analysis parameter estimates.

EPA Estimates

As shown in *Table 6-13* the estimated national average household WTP for water quality improvements resulting from the regulation range from $0.15 to $3.50 per household.. The estimated WTP values vary greatly across EPA regions depending on the regulatory option and the level of construction activity in a given region. *Chapter 10, Section 10.1.3* of the *Environmental Assessment Document* provides detail on water quality improvements estimated to accrue from the C&D regulation.

EPA estimates that the least stringent regulatory option (Option 1) is not expected to result in significant water quality improvements across all EPA regions. Region 4 is the only geographic region that shows any significant water quality improvements. The estimated WTP per household in Region 4 has a 10 percent lower bound of $0.21 per household and a 90 percent upper bound of $1.54 per household, with an average WTP of $0.70. The estimated WTP for water quality improvements in Regions 1, 3, 6, 7, 9, and 10 is negligible. Nationwide, household WTP has a mean value of $0.15 and 90 percent confidence interval bounds ranging from $0.04 to $0.32.

Option 2 is estimated to improve ambient water quality in 19.0 percent RF1 river miles nationwide. The estimated national average WTP for water quality improvements resulting from the C&D regulation is $2.59 per household per year. Regions 3 and 4 are estimated to see improvements in water quality in more than 40 percent of their total RF1 river miles. EPA's analysis indicates that Region 3 households would be willing to pay the most ($5.90 per household per year) for water quality improvements resulting from the C&D regulation. Region 4 has the second

largest household WTP of, $5.12. Conversely, households located in Region 8 are estimated to have the lowest estimated WTP for water quality improvements from the C&D regulation, $0.04.

The most stringent option (Option 3) yields the most significant results overall in terms of RF1 miles expected to improve under the post-compliance scenario. The estimated scale of improvements ranges from 3.6 percent to 71.4 percent of total RF1 river miles in Region 8 and 3, respectively. Nationwide, the 90 percent confidence interval for the estimated per-household WTP has a 10 percent lower bound of $1.33 and a 90 percent upper bound of $7.59, with a mean value of $3.50.

6.4.3 Estimating Total WTP for Water Quality Improvements

For each regulatory option, EPA calculated state-level WTP as follows First EPA estimated mean state-level per-household WTP for each combination of the baseline water quality category ($WQI_{baseline}$) and the expected change in WQI (ΔWQI)). Then, the Agency assigned each reach in the analysis a mean household WTP value based on reach location, baseline water quality, and change in water quality. The WTP was then multiplied by the number of households in a given state in 2006 and the percentage of river miles in that state that comprise a given reach.The number of households per state was calculated by taking U.S. Census Bureau population estimates for 2006 for each state and dividing by average number of people per household for a given state as reported in U.S. Census Bureau (2006a, 2006b). The total WTP equation for each reach is provided below (Eq. 1):

$$TWTP_{reach} = WTP(WQI_{baseline}, \Delta WQI) \times StateHH \times PercentRiverMiles) \qquad \text{(Eq. 1)}$$

Where:

$TWTP_{reach}$ = the reach-level welfare change from improved water quality

WTP = the estimated state-level per-household WTP for water quality improvement for a given combination of the baseline water quality category ($WQI_{baseline}$) and the expected change in water quality under the post-compliance scenario (ΔWQI)

StateHH = the number of households in a given state

PercentRiverMiles = the percentage of total river miles that are comprised of a given reach

Finally, EPA aggregated reach-level benefits to the regional level. The regional benefits for the 10 EPA regions were then combined to calculate the national benefit of the regulation. *Table 6-14* presents estimated benefits of the C&D regulation by EPA region and regulatory option.

Table 6-14 :Regional Willingness to Pay for Water Quality Improvement (Millions 2008$)

	Option 1			Option 2			Option 3		
EPA Region	Lower 10% Bound	Mean	Upper 90% Bound	Lower 10% Bound	Mean	Upper 90% Bound	Lower 10% Bound	Mean	Upper 90% Bound
1	$0.00	$0.00	$0.00	$0.32	$1.76	$3.77	$2.04	$10.44	$20.76
2	$0.02	$0.18	$0.39	$6.81	$32.66	$65.72	$10.71	$48.32	$95.11
3	$0.00	$0.00	$0.00	$16.92	$67.86	$140.83	$19.14	$75.90	$157.42
4	$4.86	$16.10	$35.60	$47.57	$118.34	$254.72	$73.77	$163.74	$358.19
5	$0.04	$0.28	$0.61	$6.53	$25.98	$53.67	$9.37	$34.09	$73.78
6	$0.00	$0.00	$0.00	$18.89	$30.08	$77.78	$22.96	$32.16	$88.40
7	$0.00	$0.00	$0.00	$2.96	$5.62	$13.11	$3.92	$6.67	$16.22
8	<$0.00	$0.02	$0.04	$0.05	$0.17	$0.33	$0.64	$2.25	$4.53
9	$0.00	$0.00	$0.00	$0.39	$1.74	$3.59	$2.49	$9.63	$19.46
10	$0.00	$0.00	$0.00	$4.16	$10.82	$21.19	$6.49	$15.32	$29.62
National	**$4.93**	**$16.57**	**$36.63**	**$104.60**	**$295.01**	**$634.72**	**$151.53**	**$398.53**	**$863.49**

EPA Estimates

From this analysis, EPA estimates that the mean values for total annual benefits of water quality improvements range from $16.57 million under Option 1 to $398.53 million under Option 3. The estimated mean regional benefits vary from $0.00 to $163.74 million per year, depending on the level of construction activity and average rainfall in a given region and stringency of the regulatory option.

As shown in *Table 6-14*, the least stringent option (Option 1) is not expected to result in significant water quality improvements in many EPA regions. Thus, this option yields the smallest benefits at the regional and national levels. The national benefits of water quality improvements under this option have a 10 percent lower bound estimate of $4.93 million, a 90 percent upper bound estimate of $36.63 million, and a national average of $16.57 million. Region 4 gains the most benefit from water quality improvement, with a total value of $16.10 million (97 percent of the total national benefits). Region 5 has the second largest benefits ($0.28 million), Region 5 benefits account for 1.7 percent of the total national benefits.

Under Option 2, the average national benefits are $295.01 million. The 90 percent confidence interval has a 10 percent lower bound of $104.60 million and a 90 percent upper bound value of $634.72 million. Region 4 gains the most benefits from water quality improvements resulting from the C&D regulation ($118.34 million). EPA Region 8 receives the least amount of benfits, $0.17 million,

Under Option 3, the estimated mean national benefits of water quality improvement from the regulation are $398.53 million with a 10 percent lower bound of $151.53 and a 90 percent upper bound of $863.49 million. As with the other options, Region 4 receives the most benefit from water quality improvements, accounting for 41 percent ($163.74 million) of the total national benefits. Region 8 is anticipated to gain least under this Option 3, with the total regional benefits estimated at $2.25 million per year.

6.5 Estimating Total Monetized Benefits

EPA estimated the total benefits under each post-compliance regulatory scenario by summing the benefits estimated for each of the four categories above. *Table 6-15* presents low, midpoint, and high estimates of benefits under each regulatory option, consisting of benefits to navigation, to water storage, to drinking water treatment, and willingness to pay. It should be noted that these tables incorporate the confidence intervals of 10, 50, and 90 percent from the WTP analysis into the low, mid, and high sensitivity analyses performed for the avoided cost estimates. Though these are conceptually different, they are both intended to present a range of values to account for some of the uncertainty inherent in these estimates. The sensitivity analyses create a range by varying EPA's assumptions underlying the analysis, while the confidence interval presents high and low bounds from the meta-analysis regression.

Table 6-16, *Table 6-17*, and *Table 6-18* details total benefits by EPA region, regulatory option, and estimate range. These tables present benefits for navigable waterway dredging and water storage calculated using both 3 and 7 percent discount rates. Benefits for for drinking water and WTP were calculated using a single year timeframe and did not require annualizing. Total national benefits vary significantly among the three regulatory options: under Option 1, the estimated benefits range from approximately $6 million to about $39 million, while benefits under Option 3 are estimated to range from $209.6 million to $956.1 million ($204.4 million to $959 million using a 7 percent discount rate).

As shown in *Table 6-15*, under EPA's preferred regulatory option (Option 2), the estimated benefits range from around $133 and $136 million to between $684 and $685 million. The midpoint estimate is between $330.9 and $332.9 million, depending on the assumed discount rate. Non-market benefits estimated based on household WTP for surface water quality improvements account for the majority of total benefits from the C&D regulation. The estimated WTP for water quality improvements from reduced sediment discharges from construction sites under Option 2 ranges from $104.6 to $634.7 million with a mean value of $295.0 million. The estimated cost savings to industry and government through reduced costs of navigable waterway maintenance, reservoir dredging, and drinking water treatment ranges from $28.3 and $31.3 million to $48.8 and $50.1 million per year, with midpoint estimates of $35.9 to $37.9 million. Under Option 2, avoided cost benefits account for 7 to 23 percent of total benefits.

Under the most stringent option (Option 3), the expected cost savings are between $67.3 and $70.9 million per year; WTP also increases to a mean value of $398.5 million. The estimated midpoint total national benefits are between $465.8 and $469.5 million per year.

Table 6-15 Total National Benefits by Benefit Category (million 2008$)

Benefit Category	3% Discount Rate			7% Discount Rate		
	Low	Mid	High	Low	Mid	High
Option 1						
Navigation	$0.7	$1.0	$1.6	$0.7	$0.9	$1.8
Water Storage[a]	$0.6	$0.6	$0.6	$0.5	$0.5	$0.6
Drinking Water[a]	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Avoided Costs	*$1.4*	*$1.8*	*$2.5*	*$1.3*	*$1.7*	*$2.6*
WTP[a]	$4.9	$16.6	$36.6	$4.9	$16.6	$36.6
Total[b]	**$6.4**	**$18.4**	**$39.1**	**$6.3**	**$18.3**	**$39.2**
Option 2						
Navigation	$8.9	$12.9	$22.1	$8.8	$12.6	$23.8
Water Storage[a]	$16.5	$17.6	$18.7	$13.7	$15.9	$18.3
Drinking Water[a]	$5.8	$7.4	$8.0	$5.8	$7.4	$8.0
Avoided Costs	*$31.3*	*$37.9*	*$48.8*	*$28.3*	*$35.9*	*$50.1*
WTP[a]	$104.6	$295.0	$634.7	$104.6	$295.0	$634.7
Total[b]	**$135.9**	**$332.9**	**$683.5**	**$132.9**	**$330.9**	**$684.8**
Option 3						
Navigation	$18.9	$27.2	$45.7	$18.7	$26.5	$49.2
Water Storage[a]	$28.7	$30.6	$32.5	$23.8	$27.6	$31.8
Drinking Water[a]	$10.4	$13.1	$14.5	$10.4	$13.1	$14.5
Avoided Costs	*$58.0*	*$70.9*	*$92.6*	*$52.9*	*$67.3*	*$95.5*
WTP[a]	$151.5	$398.5	$863.5	$151.5	$398.5	$863.5
Total[b]	**$209.6**	**$469.5**	**$956.1**	**$204.4**	**$465.8**	**$959.0**

a These savings were calculated for a one-year timeframe and that did not require discounting, and are equal under both discount rates
b Totals may not equal sum of categories due to rounding

EPA Estimates

Table 6-16, *Table 6-17*, and *Table 6-18* detail total benefits by EPA region, regulatory option, and estimate range. Region 4 benefits the most from this regulation regardless of which regulatory option is chosen, as it experiences the largest reduction in sediment discharges which are expected to produce larger cost savings and water quality improvements.

Under Option 1, a CGP for all sites and sediment basin requirements for large sites, total benefits range between approximately $6 million in the low estimate and $39 million in the high estimate, with a midpoint estimate of approximately $18 million, regardless of the assumed discount rate. Region 4 is the sole region with expected benefits totaling more than $1 million, with estimates ranging from $6 to $38 million. The estimated benefits for other regions are modest at best, with midpoint estimates ranging from less than $500 to just under $291,000 annually. EPA's analysis shows that Option 1 would generate less than $500 in annual benefits in Region 10

Option 2, which adds a turbidity standard to the regulation for certain construction sites, is expected to result in significant benefits in all regions. EPA expects total benefits under this option to be approximately $333 million, with a range of $136 to $684 million. Under this regulatory option, Regions 2 through 6 benefit most substantially, with Region 4 alone accounting for more than 41 percent of the total national benefits anticipated under this option. Region 10 is also expected to benefit by about $13 million in the midpoint estimate. The Agency expects benefits for this option to be substantially larger than those under Option 1, because the turbidity standard will target construction site stormwater effluent that is likely to produce the highest benefits in terms of TSS and turbidity reductions. However, areas of the country with low rainfall or low percentage of clay in their soils, such as Regions 8 and 9, do not benefit as significantly because many sites in these areas are likely to qualify for waivers of the turbidity standard. Conversely, construction sites are not likely to affect sediment or turbidity pollution on a large scale in these regions.

The stringent Option 3, under which all large sites are required to meet an effluent turbidity standard, increases the midpoint estimate of total national benefits by 41 percent, and is expected to produce the most substantial increases over Option 2 in Regions 8 and 9, where many areas are exempt from the turbidity standard under that option. The Agency's midpoint estimates for benefits in these regions under Option 3 are approximately $2.6 million and $10.2 million, respectively. Option 3 is expected to generate benefits of $469 million, with a range of $210 to $956 million between the low and high estimates assuming a 3% discount rate; at a 7% discount rate benefits range between $204 and $960 million, with an expected value of $466 million.

Reductions in sediment pollution originating from construction site stormwater discharges are anticipated to reduce TSS and turbidity levels in waterbodies across the country, reducing costs of dredging navigable waterways and reservoirs and of drinking water treatment, as well as leading to improvements in water quality that benefit the general public. The value of these improvements derives directly from the magnitude of the sediment and turbidity reduction in waterbodies receiving construction site stormwater effluent.

Table 6-16 Total National Benefits Under Option 1 by EPA Region (thousand 2008$)

EPA	3% Discount Rate			7% Discount Rate		
Region	Low	Mid	High	Low	Mid	High
1	$1	$1	$3	$1	$1	$3
2	$31	$183	$396	$31	$183	$396
3	$2	$3	$4	$2	$3	$4
4	$6,273	$17,851	$38,044	$6,169	$17,769	$38,157
5	$52	$291	$626	$51	$290	$626
6	$2	$2	$4	$2	$2	$4
7	$1	$1	$1	$0	$1	$1
8	$7	$23	$46	$6	$23	$46
9	$1	$1	$1	$1	$1	$1
10	$0	$0	$0	$0	$0	$0
Total[a]	**$6,370**	**$18,357**	**$39,124**	**$6,263**	**$18,273**	**$39,239**

a Totals not equal to sum of regional data because the WTP model estimates the national values independently rather than summing regional values

EPA Estimates

Table 6-17: Total National Benefits Under Option 2 by EPA Region (thousand 2008$)

EPA Region	3% Discount Rate			7% Discount Rate		
	Low	Mid	High	Low	Mid	High
1	$425	$1,877	$3,932	$410	$1,867	$3,935
2	$7,230	$33,322	$66,814	$7,214	$33,302	$66,875
3	$18,463	$69,720	$143,177	$18,377	$69,654	$143,270
4	$65,399	$140,044	$284,250	$63,790	$138,884	$285,328
5	$7,421	$27,010	$54,847	$7,319	$26,946	$54,850
6	$25,659	$37,976	$87,051	$24,916	$37,501	$87,120
7	$4,745	$7,598	$15,247	$4,496	$7,448	$15,217
8	$88	$209	$373	$82	$205	$372
9	$440	$1,790	$3,661	$436	$1,788	$3,662
10	$6,007	$13,357	$24,178	$5,906	$13,292	$24,186
Total[a]	**$135,877**	**$332,903**	**$683,530**	**$132,945**	**$330,887**	**$684,817**

a Totals not equal to sum of regional data because the WTP model estimates the national values independently rather than summing regional values

EPA Estimates

Table 6-18: Total National Benefits Under Option 3 by EPA Region (thousand 2008$)

EPA Region	3% Discount Rate			7% Discount Rate		
	Low	Mid	High	Low	Mid	High
1	$2,315	$10,758	$21,178	$2,282	$10,737	$21,187
2	$11,442	$49,440	$96,897	$11,415	$49,407	$96,991
3	$21,410	$78,646	$160,880	$21,285	$78,549	$161,020
4	$109,071	$207,357	$417,892	$106,228	$205,203	$420,483
5	$10,812	$35,759	$75,696	$10,652	$35,657	$75,705
6	$33,319	$44,255	$102,551	$32,187	$43,532	$102,655
7	$6,415	$9,444	$19,215	$6,066	$9,234	$19,173
8	$924	$2,560	$4,852	$881	$2,534	$4,846
9	$2,968	$10,187	$20,143	$2,923	$10,158	$20,153
10	$10,901	$21,048	$36,769	$10,507	$20,797	$36,797
Total[a]	**$209,577**	**$469,455**	**$956,073**	**$204,425**	**$465,809**	**$959,010**

a Totals not equal to sum of regional data because the WTP model estimates the national values independently rather than summing regional values

EPA Estimates

6.6 Sources of Uncertainty and Limitations

Total national benefit estimates of the C&D regulation are subject to the limitations and uncertainties inherent in the valuation approaches used for assessing benefits to navigation, water storage, drinking water treatment, and non-market benefits of water quality improvement. Because the combined effect of these limitations and uncertainties is likely to underestimate national level of benefits of this regulation, the estimated benefits should be interpreted in the context of these limitations. Additional uncertainties and limitations specific to each category of monetized benefits are subsequently discussed.

6.6.1 Water Quality Model Limitations

To estimate benefits of reduced sediment loadings to surface water, EPA relied on SPARROW (**SPA**tially **R**eferenced **R**egressions **O**n **W**atershed attributes). The SPARROW model for suspended sediments has a number of limitations, some of which are inherent to the methodology and some the result of the particular model application. The key model limitations are:

- **Reliance on the Reach File 1 network**. While the RF1 network provides reasonably comprehensive national coverage of major rivers, streams and other surface water bodies, coverage is limited in certain important respects. RF1 network coverage is limited to the conterminous U.S., thus excluding Alaska and Hawaii. In addition, while RF1 1:500,000-scale network reaches have associated data or estimates of

stream discharge and velocity that are required to specify the SPARROW model; the network excludes the majority of the nation's total stream mileage, and smaller streams in particular. The linear coverage of the RF1 network is approximately 700,000 miles (www.epa.gov/waterscience/basins/metadata/rf1.htm). By contrast, coverage of the USGS National Hydrographic Dataset, at 1:24,000 - 1:100,000 scale, is currently over 7 million miles (USGS 2007). Given that RF1 accounts only for 10% of the total river miles, the impacts of construction-related sediment on smaller stream reaches are likely to be significantly understated. As construction activities may be concentrated along lower-order streams not included in the RF1 network, the relative share of total sediments contributed by construction activities may be high on these reaches during active construction phases. By contrast, the specific impacts of construction activities may diminish in importance relative to contributions from spatially extensive and diffuse land uses, including agriculture, at the level of RF1 reaches.

- **Omission of coastal waters from the analysis of monetized benefits**. The SPARROW model does not allow prediction of water quality changes in coastal waters. Therefore, all coastal waters in the U.S. (10,630 shoreline miles) are omitted from the analysis of monetized benefits.[56] Because the estimated willingness to pay for water quality improvements is a function of the total river and shoreline miles that are expected to improve from reduced sediment discharges, this omission is likely to lead to understatement of the estimated willingness to pay for water quality improvements resulting from the C&D rule.

- **Omission of all ponds and lakes and reservoirs located off RF1 network from water quality analysis.** All lakes, ponds, and reservoirs located off RF1 network are not included in the SPARROW model and thus are excluded from estimation of monetized benefits. The 2002 *National Water Quality Inventory: Report to Congress* (U.S. EPA 2007) reports 40.6 million acres of lakes and reservoirs in the conterminous U.S. The RF1 network includes approximately 3.9 million acres or 9.5 % of the total lakes and reservoir acres in the U.S.[57] (U.S. EPA 2007). Omission of these water body types from the analysis of monetized benefits is likely to lead to understatement of benefits in two benefit categories: (1) nonmarket benefits of water quality improvements resulting from the C&D regulation and (2) reservoir dredging.

- **Restriction of the water quality analysis to the description of long-term mean water quality conditions**. Construction activities are, by contrast, transient in nature, extending over weeks or months. Construction activities (unlike agricultural activities) are spatially compact, so they are sub-grid phenomenon with respect to the specification of the national scale of the sparrow model. The restriction to mean water quality conditions precludes an analysis of the frequency with which conditions of extreme sediment transport conditions (e.g., during an active construction period) occur. Although the predicted changes in average water quality conditions may be small, the expected changes in sediment concentrations under extreme sediment transport conditions may be significant. The analysis also predicts average water quality conditions in a reach that are representative of the center line of that reach. TSS concentrations near shore are likely to be higher and the expected changes in ambient water quality conditions near shore are likely to be greater.

- **Focus on one pollutant of concern (sediment)**. Existing case studies of environmental impacts associated with construction activities demonstrated that a number of pollutants are found in construction site discharges, including turbidity, nitrogen, phosphorus, BOD, metals, toxic organics, trash and debris, and as well as other miscellaneous pollutants (see *Chapter 3* of the *Environmental Assessment Document*

[56] EPA was able to estimate ambient concentrations of sediment [Total Suspended Solids (TSS)] within estuaries using SPARROW output in conjunction of the Dissolved Concentration Potential (DCP) approach (U.S. EPA 1997). However, estuarine reaches were not included in estimation of monetized benefits due to time constraint.

[57] The estimated total lake and reservoir acres do not include the Great Lakes.

for more details on other pollutant discharges from construction sites). However, EPA's analysis of benefits from reduced construction site discharges focuses on total suspended solids only. This is likely to result in underestimation of the expected water quality changes resulting from the C&D regulation because the combined impact of several pollutants on ambient water quality conditions is likely to be greater than a single pollutant impact. Moreover, EPA's analysis of willingness to pay for water quality improvements utilizes a water quality index (WQI) to link water quality changes from reduced sediment runoff to effects on human uses and support for aquatic and terrestrial species habitat. As described in *Chapter 10* of the *Environmental Assessment Document*, EPA estimated the WQI for a given reach using a weighted geometric mean function of six parameters: dissolved oxygen, BOD, nitrogen, phosphorus, fecal coliform, and total suspended solids. The weight assigned to TSS is 0.11, while the combined weight of BOD, nitrogen, and phosphorus is 0.43. Therefore, the expected change in WQI resulting from reduced discharges from construction sites is likely to be underestimated. Finally, the original WQI developed by McCleland (1974) was based on nine pollutants and included two sediment-related parameters: TSS and turbidity. Turbidity is excluded from the reduced version of WQI and the associated weight (0.08) is distributed among other parameters, which also diminishes the effect of reduced sediment discharges on ambient water quality conditions (as measured by WQI-6).

6.6.2 Benefits to Navigation

- The USACE dredging database identifies dredging jobs by name, which is usually the name of the water body dredged. However, the data lack standardized naming conventions, so it is possible that the same water body is dredged under different names. This may result in the exclusion of dredging job names that only appear once in the database, but in fact were carried out in the same water bodies as a differently named job, which would result in a downward bias in EPA's dredging frequency calculations and the project costs.
- The navigable waterway data provide latitude/longitude information for some dredging jobs, which are used to link dredging jobs to RF1 reaches, but these data are incomplete. In cases where latitude/longitude information was not available for a particular job, EPA matched it to an RF1 reach using the job name. This is a potential source of inaccuracy, as the job name is often the waterway name, and may not be very specific (in cases such as the Mississippi or Colorado rivers). It is unclear whether this would lead to an over- or underestimate of benefits.
- The cost per cubic yard and interval data obtained from the dredging database vary significantly, even for different occurrences of dredging in the same water body or within regions. Aggregating such highly varied data and using regional averages may bias the cost and interval estimates. The direction of this bias is, however, uncertain.

6.6.3 Benefits to Water Storage

- There is uncertainty as to the uniformity of sediment density, as it is related to the type of soil in the area. Using a single density to convert volume to weight for all sediment may reduce the accuracy of the resulting cost estimates. However, the direction of this potential bias is uncertain.
- The lack of data on reservoir dredging results in uncertainty as to the types of reservoirs that are dredged and the cost of this dredging.
- Though sediment pools are built to accumulate sediment and preserve the useful capacity of the reservoir, they may also fill up more rapidly than anticipated at their initial construction, increasing the sediment buildup in a reservoir and increasing the cost of dredging it. It is also possible that these sediment pools themselves may be dredged. This analysis assumes that to maintain the current water storage capacity in

the United States, all influent sediment will have to be removed in some manner, or replaced. Building replacement capacity is environmentally disruptive and may be more costly than sediment removal by dredging, therefore this analysis assumes that dredging will be used to maintain reservoir capacity.

6.6.4 Benefits to Drinking Water Treatment

- Sediment filtration systems and pre-sedimentation (allowing water to sit and sediment to filter out before treatment) at drinking water treatment facilities reduce the sediment concentration of the water before it enters chemical treatment, so that the turbidity level of the water entering the facility is not the turbidity level that is eventually treated with coagulants. Assuming that the differential between pre- and post-compliance sediment concentration is proportional to the differential between pre- and post-compliance turbidity treatment introduces uncertainty, as the lower sediment levels may be more or less affected by the pre-sedimentation and filtration processes. EPA's analysis attempts to account for this uncertainty by varying the effectiveness of pre-sedimentation basins, and thus amount of TSS and turbidity treated by a drinking water treatment facility.
- If a drinking water treatment facility produces sludge that is toxic (due to other pollutants in the water besides sediment), its disposal costs may be significantly higher because toxic sludge disposal is more restricted and costly. If the facility cannot separate the sludge generated by sediment treatment from the sludge generated by treatment of toxics (which is likely the case), then all of its sludge will be characterized as toxic. This analysis may understate the cost of disposal (and thus the cost savings of smaller quantities of sludge to be disposed of) for facilities that generate toxic sludge.

6.6.5 Willingness to Pay Estimate

A number of issues are common to all benefit transfers. Benefit transfer involves adapting research conducted for another purpose in the available literature to address the policy questions at hand. Because benefits analysis of environmental regulations rarely affords enough time to develop original stated preference surveys that are specific to the policy effects, benefit transfer is often the only option to inform a policy decision. As a result, they are nearly universal in benefit-cost analyses (Smith et al. 2002).

- Benefit transfers are by definition characterized by a difference between the context in which resource values are estimated and that in which benefit estimates are desired (Rosenberger and Phipps 2007). The ability of meta-analysis to adjust for the influence of study, economic, and resource characteristics on WTP can minimize, but not eliminate, potential biases (Rosenberger and Stanley 2006; Rosenberger and Phipps 2007; Smith et al. 2002). As is typical in applied benefit transfers, the meta-analysis model used in this analysis provides a close, but not perfect, match to the context in which values are desired. Some related and additional limitations inherent to the meta-analysis model and the subsequent benefit transfer include:
- It is difficult to identify accurately the beneficiary (human) population and characterize how household values attenuate with distance from the resource. The population considered in the benefits analysis of the C&D regulation does not represent all the households that are likely to hold values for water resources in a given state. Residents of other states may hold values for water resources outside of their home state, in particular if such resources have regional or national significance.
- The Agency notes, as detailed by Loomis (1996; Loomis et al. 2000) and Bateman et al. (2006), among others, that there are numerous uncertainties and associated assumptions required to aggregate WTP across spatial jurisdictions. While these uncertainties are well known, the literature does not agree on appropriate, standardized guidance for benefit aggregations, and applied benefit-cost analysis almost universally requires simplifying assumptions in order to generate defensible welfare aggregations. In an

ideal context, analysts would have information necessary to estimate spatially referenced distance decay relationships for all changes resulting from policies under consideration (cf. Bateman et al. 2006). However, the Agency notes that even the most advanced literature provides only simple illustrations of such issues, and none methodologically sufficient to support regulatory analysis. As a result, the population considered in the benefits analysis of the C&D regulation does not represent all the households that are likely to hold values for water resources in a given state. Residents of other states may hold values for water resources outside of their home state, in particular if such resources have personal, regional, or national significance.

- Some resource valuation studies have found that respondents in the typical contingent market situation may overstate their WTP compared to their likely behavior in a real-world situation. However, the magnitude of hypothetical bias on the estimated WTP is uncertain. Following standard benefit transfer approaches, including meta-analytic transfers, this analysis proceeds under the assumption that each source study provides a valid, unbiased estimate of the welfare measure under consideration (cf. Moeltner et al. 2006; Rosenberger and Phipps 2007). To minimize potential hypothetical bias EPA set independent variable values to reflect best benefit transfer practices.
- The estimation of WTP may be sensitive to differences in the environmental water quality measures. Studies that did not use the WQI were mapped to the WQI so a comparison could be made across studies. The dummy variable *(WQI)* captures the effect of a study using *(WQI*=1) or not using the WQI *(WQI*=0). It was found that studies that did not use the WQI had lower WTP values. This may indicate that there may have been some systematic biases in the mapping of studies that did not use the WQI. In analyzing, benefits of this regulation, EPA set WQI to one reduce uncertainty in WTP estimates associated with studies that did not include WQI as a native survey instrument. See Appendix C for a detailed discussion of water quality measures used in the original studies included in metadata.
- Transfer error may occur when benefit estimates from a study site are adopted to forecast the benefits of a policy site. Rosenberger and Stanley (2006) define transfer error as the difference between the transferred and actual, generally unknown, value. While meta-analysis is fairly accurate when estimating benefit function, transfer error may be a problem in cases where the sample size is small. While meta-analyses have been shown to outperform other function-based transfer methods in many cases, this result is not universal (Shrestha et al. 2007). This notwithstanding, results reviewed by Rosenberger and Phipps (2007) are “very promising” for the performance of meta-analytic benefit transfers relative to alternative transfer methods.

7 Social Costs and Benefits of the Proposed Rule

This chapter brings together the total social costs, discussed in *Chapter 5*, and total monetized benefits, discussed in *Chapter 6*, to directly compare the estimated costs and benefits of the regulatory options. All costs and monetized benefits are presented as annual values – representative of a typical year's expected impact – in 2008 dollars.

7.1 Summary of Social Cost

Total social costs include:

- The resource costs of compliance to the private sector and to governments;
- The deadweight loss to society; and,
- Administrative costs to federal, state, and local governments

The resource cost to society of each regulatory option refers to the compliance outlays required after adjusted for the expected C&D market contraction due to the proposed options. The proposed options may have the effect of reducing C&D market output because the incremental cost of compliance for each proposed option has the effect of increasing builders' costs and can cause an upward shift the market's supply curve. Part of the increased costs may raise the price of new housing, with the balance of increased costs being absorbed by the builder, depending on the relative elasticities of supply and demand. The resulting shift in market equilibrium may reduce the quantity of construction units produced in a given market. This quantity-adjusted measure of the resource cost of compliance is the primary contributor to total social cost for all three options. It encompasses the BMP and new technology requirements as specified by the regulatory options.

The C&D market adjustments that arise from incurring the resource cost of compliance have a number of implications for the welfare of society. When the supply curve shifts as a result of incremental compliance costs, consumers lose some of their benefits from the product in absorbing those compliance costs. The result is a change in consumer surplus, part of which eventually makes its way to the entities whose services are purchased to implement the requirements of the rule, and part of which becomes the consumer contribution to the dead weight loss of the proposed rule. There is also a change in producer surplus. Some producer surplus is similarly transferred to other producers whose services are purchased to implement the regulation due the partial absorption of compliance costs, and another portion of producer surplus is contributes the dead weight loss of the rule. Deadweight loss to society, another component of total social cost, therefore results from losses of both consumer and producer surplus.

The final component of total social cost includes the administrative costs associated with state and local governments' administration of federal rule requirements to regulated entities within their jurisdictions. EPA assumed for the current analysis that the NPDES Phase I and Phase II stormwater permit programs are fully implemented and that any new regulatory requirements would be superimposed on these programs. However, EPA does expect a small additional administrative burden to government entities under the proposed options. Federal and state and local governments will incur costs for processing and analyzing discharge monitoring reports (DMR's) for projects that incur cost under the proposed rule.

As shown in *Table 7-1*, these three elements of cost sum to the total social cost of each regulatory option.

7.2 Summary of Monetized Benefits

The reduction of sediment and other pollutants entering surface waters from construction sites as a result of the C&D regulation will have a wide range of market and nonmarket benefits, as described in *Chapter 6*. As noted previously in *Chapter 6* and emphasized here, EPA's estimate of total monetized benefits does not represent the full-range and magnitude of benefits expected from this rule because certain categories of benefits are not able to be monetized.

Total estimated monetized benefits include:

- Benefits to navigation;
- Benefits to water storage;
- Benefits to drinking water treatment; and,
- Benefits to water quality.

Benefits to navigation include reduced sediment settling in navigable channels, reducing the cost of dredging in these channels. Benefits to water storage include reduced sediment settling in reservoirs, reducing the cost of dredging in reservoirs that are currently dredged to recapture lost capacity. Benefits to drinking water treatment include reduced sediment, a reduction in the amount of chemicals needed for treatment, and a reduction in the amount of sludge generated from this treatment that must be disposed. Furthermore, reducing sediment levels in U.S. waterways has the general effect of improving water quality, as suspended sediment is one of the determinants of water quality. Increased water quality has both explicit and implicit value to users of water bodies, which was quantified using willingness-to-pay estimates based on a meta-analysis of existing WTP studies for water quality. The WTP estimate provides an estimate of the monetary value of recreational benefits of water quality improvements, including swimming, fishing, boating, and other outings. Property value increases stemming from water quality improvements and reduced flood risk due to decreased sediment are also implicit in the WTP estimate. However, all estimates of monetized benefits are subject to a degree of uncertainty resulting from limitations in the data EPA obtained on current dredging activity and drinking water treatment, as well as uncertainty inherent in WTP valuation. These uncertainties are described in detail in *Chapter 6, Section 6.6*. The estimates of monetized benefits presented in *Table 7-1*, below, are mid-point estimates from the ranges presented previously in *Table 6-15*.

EPA did not include benefits to commercial fishing and shell fishing or benefits to industrial and agricultural water use in its monetized benefits estimate due to insufficient available data, although these benefits may be substantial. Sediment runoff from construction sites has been documented to reduce standing fish crops and shellfish populations in receiving waterbodies, which may reduce the size of commercial harvest with negative market implications for both firms and consumers. Industries that use surface water for cooling and hydraulic purposes receive benefits from lower sediment levels in water, as high levels of sediment increase wear on equipment. High sediment concentrations in surface water used for agricultural irrigation can harm crops by reducing absorption, inhibiting soil aeration, and creating dried layers of silt that may prevent seedlings form emerging. Reductions in the risk and frequency of these negative effects of sediment in surface water are considered benefits of this regulation.

7.3 Comparison of Social Cost and Monetized Benefits

The elements of social cost and monetized benefits and the net monetized benefits are presented in *Table 7-1*.

Anticipated social costs are greater than the monetized benefits. It is important to emphasize once again that *Chapter 6* discusses several other classes of benefits that could not be monetized but are likely to provide real

social benefits, and therefore, the estimate of monetized benefits is not as complete an estimate as that of total social cost.

Table 7-1: Comparison of Social Costs and Benefits (millions of 2008$)[a]

	Option 1	Option 2	Option 3
Social Costs			
Resource Cost of Compliance (adjusted for market-effect in C&D industry)	$132.3	$1,882.6	$3,780.2
Government Administrative Cost	$0.0	$0.7	$1.2
Deadweight Loss to Society	$0.0	$3.5	$8.2
Total Social Cost of the Regulation	**$132.4**	**$1,886.8**	**$3,789.6**
Monetized Benefits[b]			
Benefits to Navigation	$1.0	$12.9	$27.2
Benefits to Water Storage	$0.6	$17.6	$30.6
Benefits to Drinking Water Treatment	$0.2	$7.4	$13.1
Avoided Cost	*$1.8*	*$37.9*	*$70.9*
Water Quality Benefits	$16.6	$295.0	$398.5
Total Monetized Benefits[b]	**$18.4**	**$332.9**	**$469.5**
Net Benefit (Benefits minus Cost)	**-$114**	**-$1,553.9**	**-$3,320.1**

[a] Totals may not sum due to rounding.

[b] Based on a 3% social discount rate, previously described in *Chapter 6*.

Source: EPA Estimates

8 Assessing the Impact of the C&D Regulatory Options on Small Entities – Regulatory Flexibility Act (RFA) Analysis

The Regulatory Flexibility Act (RFA, 5 U.S.C. et seq., Public Law 96-354), amended by the 1996 Small Business Regulatory Enforcement Fairness Act (SBREFA), requires EPA to consider the economic impact that a new rule will have on small entities. The purpose of the RFA is to ensure that, in developing rules, agencies identify and consider ways to avoid undue impacts on small entities that will be affected by the regulation, whether as small entities that will be subject to regulatory requirements or as small governments that will be responsible for administering the regulation.[58] While the RFA does not require an agency to minimize a rule's impact on small entities if there are legal, policy, factual, or other reasons for not doing so, it does require that agencies:

- Determine, to the extent feasible, the economic impact on small entities subject to the rule;
- Explore regulatory options for reducing any significant economic impact on a substantial number of such entities; and,
- Explain the ultimate choice of regulatory approach.

For any notice-and-comment rule it promulgates, EPA must either certify that the rule "will not, if promulgated, have a significant economic impact on a substantial number of small entities" ("SISNOSE") or prepare a Regulatory Flexibility Analysis if the Agency cannot make this certification. Small entities include small businesses, small organizations as defined by SBA, and governmental jurisdictions with populations of less than 50,000.

To evaluate the potential impact of the proposed rule on small entities, EPA conducted an RFA/SBREFA Screening Analysis, which includes:

- Determining the number of C&D firms subject to the rule within each NAICS industry and associated revenue range.
- Estimating the potential economic impacts on small entities based on a cost-to-revenue analysis.

Appendix 8-1 presents a sensitivity analysis that illustrates how a typical small C&D firm could be affected by the regulation under alternative assumptions about the *magnitude of per-acre compliance costs*, the *quantity of in-scope activity performed by a small builder*, and *cost pass-through from the small firm to the consumer* for any given project.

8.1 Definition of Affected Small Entities

The RFA defines a "small entity" as a small business (which is defined at the parent firm level, not at the establishment level), small not-for-profit organization, or small governmental jurisdiction. EPA expects that the principal impact of the C&D options on small entities will fall on small businesses that undertake C&D activities and small governmental units involved in permitting C&D activities.

The RFA provides that EPA generally define small businesses according to the size standards established by SBA. SBA establishes criteria for identifying small businesses based on either the number of employees or annual revenues (13 CFR 121). These size standards vary by NAICS (North American Industrial Classification System)

[58] Impacts on small governments are detailed in the UMRA analysis, Chapter 10 in this document.

code, and previously by Standard Industrial Classification (SIC) codes. Qualifying revenue levels differ among NAICS industries, and within the C&D industry are as follows:

- NAICS 236 (*Construction of Buildings*): $33.5 million
- NAICS 237 (*Heavy and Civil Engineering Construction*), except 2372: $33.5 million
- NAICS 2372 (*Land Subdivision* of NAICS 237): $7.0 million

8.2 Determining the Number of In-Scope Small C&D Firms

SUSB 2002 data provide the primary basis for estimating the number of small businesses potentially subject to the rule. As described in the industry profile (*Chapter 2*), a number of adjustments and exclusions were performed to determine the baseline universe of firms, revenue, employees, and average firm revenue for the C&D sectors that EPA estimates will be affected by the proposed regulation. The analysis baseline only reflects those sectors that can perform activities that result in land disturbance that are NPDES permitees and those with sufficient data for analysis. *Table 4-3* in *Chapter 4, Developing the Analysis Baseline*, reflects the baseline industry "snapshot" prior to determining the breakout of small and large firms. Based on the estimates of the number of firms by revenue size range within each of the relevant NAICS sectors, EPA used the small business revenue-size standards to estimate the number of small firms that could be within the scope of the C&D rule. The reported estimates of small business firms by NAICS sector are "best reasonable approximations" accounting for two considerations:

1. As described in *Chapter 4*, for the firm- and industry-level analysis, EPA allocated the Land Subdivision sector (NAICS 23721) among the four primary building construction sectors: NAICS 236115 – New single-family housing construction (except operative builders); NAICS 236116 – New multifamily housing construction (except operative builders); NAICS 236210 – Industrial building construction; and NAICS 236220 – Commercial and institutional building construction. As a result, this sector, which has a lower small business size criterion of $7.0 million, is blended in with sectors with a higher small business size criterion of $31 million. For the estimation of number of small entities potentially affected by the regulation and the assessment of potential impacts on those entities, EPA used the $31 million cut-off for separating small businesses and large businesses. As a result, EPA's implicit estimate of the number of small businesses in the Land Subdivision will likely overstate the actual number of small businesses in this sector, by including firms with revenue greater than $7.0 million in the small business count.
2. The small business size criterion used in this analysis ($31.0 million) lies within the SUSB/Economic Census revenue range of $10 to $50 million. As a result, it is not possible to estimate precisely from the SUSB firm data the number of those firms that are small businesses, according to the SBA business size criterion. Including *all* of the relevant revenue size range in the small firm count will likely overstate the number of small firms while including *none* of the relevant revenue size range in the small firm count will likely understate the small firm count. If firms were distributed uniformly by revenue size within this revenue range, then approximately 59 percent of the firms would qualify as small business.[59] However, based on the distribution of the *reported* numbers of firms by the *reported* revenue ranges for these industries – in which the larger numbers of firms lie in the lower revenue ranges – EPA expects that firms will not be uniformly distributed by revenue in this revenue range, and instead that firms will be disproportionately concentrated at the lower end of the range. Based on this expectation, for this analysis, EPA assumed that 75 percent of the firms in the $10 to $50 million revenue range would be small businesses.

As described in *Chapter 2*, a very large share of total C&D industry firms and a large absolute number of firms are likely to be defined as small businesses and will likely undertake activities within the scope of the C&D rule.

[59] ($33.5 million -$10 million) ÷ ($50 million - $10 million) = 0.5875.

Overall, EPA estimates that a total of 152,300 firms are in the C&D industry sectors of concern for this regulation. Of this total, EPA estimates that approximately 148,800 firms, or about 98 percent, are defined as small businesses (see *Table 8-1*, below).

Although a large percentage of C&D industry businesses are defined as small business, many of these firms are not likely to complete projects that fall within the coverage size thresholds of the regulatory options considered in this analysis. EPA assessed whether small businesses would likely perform projects of sufficient size to be within the scope of the C&D regulation using the acreage intensity concept described in *Chapter 3*. EPA considers firms that are capable of starting annually a single project of at least one acre to be within the potential scope of a C&D regulation. In addition to listing total firms and small firms by sector, *Table 8-1* also identified the number of firms by sector and size classification that EPA estimates are capable of starting annually a single project of at least one acre. As shown in *Table 8-1*, EPA estimates that a much smaller number of small businesses – approximately 78,200 firms – are capable of performing in-scope projects than the total of small businesses, approximately 148,800, in the total C&D industry. From this analysis, 70,600, or 47 percent, of the small businesses in the C&D industry sectors of concern are estimated *not* to be capable of performing in-scope projects.

In assessing the potential impact of specific regulatory options on small businesses, EPA considered whether small firms would be capable of performing projects within the acreage size ranges for which a regulatory option is estimated to require compliance outlays (e.g., at least 10 acres, at least 20 acres, etc.). This assessment leads to further reductions in the number and percentage of small businesses that will be affected by the C&D regulation. *Table 8-2* reports the number of small firms that are expected to incur costs under each of the regulatory options.

Table 8-1: Total Number of Small and Large Firms in the C&D Industry

NAICS Code	Sector[a]	Small		Large		Total
		Number	Percent	Number	Percent	
All Firms in Potentially Affected C&D Sectors						
236115	New single-family housing construction (except operative builders)	65,075	99.7%	216	0.3%	65,291
236116	New multifamily housing construction (except operative builders)	4,716	97.6%	117	2.4%	4,833
236117	New housing operative builders	24,653	97.6%	612	2.4%	25,265
236210	Industrial building construction	2,638	94.0%	168	6.0%	2,806
236220	Commercial and institutional building construction	41,129	95.9%	1,765	4.1%	42,893
237310	Highway, street, and bridge construction	10,548	94.1%	662	5.9%	11,210
Total		**148,759**	**97.7%**	**3,539**	**2.3%**	**152,298**
In-Scope Firms – Firms Estimated Capable of Starting Annually a Single Project of at Least One Acre Size						
236115	New single-family housing construction (except operative builders)	33,393	99.4%	216	0.6%	33,609
236116	New multifamily housing construction (except operative builders)	2,504	95.5%	117	4.5%	2,620
236117	New housing operative builders	16,682	96.5%	612	3.5%	17,295
236210	Industrial building construction	1,520	90.0%	168	10.0%	1,688
236220	Commercial and institutional building construction	19,034	91.5%	1,765	8.5%	20,797
237310	Highway, street, and bridge construction	5,035	88.4%	662	11.6%	5,696
Total		**78,168**	**95.7%**	**3,539**	**4.3%**	**81,706**

a Firms within NAICS 237210 – Land Subdivision – are allocated over the NAICS 236115, 236116, 236210, and 236220 building construction categories.
b Does not include firms in Alaska or Hawaii.
Note: Numbers do not necessarily add to totals due to rounding.
Source: U.S. SBA (2004), U.S. SBA (2008), U.S. Census Bureau's Economic Census (2005a), and EPA Analysis

8.3 Estimating Economic Impacts on Small C&D Firms

EPA assessed the impacts on small businesses by examining the ratio of estimated compliance costs to firm-level revenues based on model firm-based analysis of firm- and industry-level impacts. Impacts are determined by the number and percentage of businesses incurring costs that exceed 1 percent and 3 percent of revenue. EPA believes that, for the C&D industry, a SISNOSE determination should not be based primarily on the absolute number of

small entities affected due to the nature of the firms that comprise this industry. This judgment is based on the facts that (1) this industry is comprised of a very large number of firms *and* (2) virtually all of these firms (98 percent) are small firms, according to SBA size criteria. Rather than rely on the absolute number of affected small firms, EPA believes the *percentage* of impacted small entities provides a better basis for determining whether a given regulatory option can meet the criteria for a *no*-SISNOSE determination.

The potential for impacts to small businesses was an important consideration for EPA in developing and analyzing regulatory options for the C&D rule. In the end, the regulatory options that EPA focused on as the principal candidates for proposal are all expected to exclude the majority of C&D industry small entities from direct regulatory requirements and incurrence of costs to comply with the rule. For all three of the options presented in this analysis, fewer than 15 percent of the estimated 78,168 in-scope small businesses are expected to incur costs, and, for Option 2, approximately 5 percent of in-scope small businesses are expected to incur compliance costs.

Finally, EPA emphasizes that the proposed regulation includes no requirements – in terms either of regulatory coverage or of the technical requirements for compliance – that would affect small firms more adversely than large firms: that is, the proposed regulation does not confer a competitive advantage to large firms.

In the firm- and industry-level analysis, compliance costs are assigned to model firms by revenue range based on an estimate of the quantity of acreage subject to compliance requirements that firms in a given revenue range are able to perform. As described in *Chapter 3*, the percentages of firms within each revenue range that are estimated to incur compliance costs exceeding one or three percent of revenue are calculated using the construction category-specific acreage intensity distributions previously developed and described in *Chapter 4*. Specifically, for each model firm by sector and revenue range, the calculation first determines the levels of compliance cost that would exceed one and three percent of revenue – these are referred to as *critical compliance cost* levels. The analysis then calculates the acreage intensity that would yield the critical compliance cost, given the relationships for determining compliance cost by model firm. Finally, the analysis looks to the distributions of acreage intensity by construction activity to estimate the percentage of firms within the revenue range for which compliance cost would exceed the indicated critical compliance cost values (see *Chapter 3*).

The cost-to-revenue calculation is performed in two ways:

1. Using the unadjusted compliance cost. This metric indicates the potential burden of compliance costs in relation to revenue, without accounting for EPA's assessment that some of the compliance cost will be offset by increased revenue.
2. Using the compliance cost adjusted by the increase in revenue that is estimated to occur from passing on a part of the compliance cost increase to customers as a price increase. This measure may provide a more meaningful measure of potential compliance cost burden. In this calculation, the total compliance cost is reduced by the increase in revenue resulting from cost pass-through. The resulting comparison is of *net compliance cost burden* (i.e., after the offsetting revenue increase) to baseline revenue.

In both instances, the analysis assumes that some of the compliance cost will be passed through to consumers and thus offset by increased revenue. However in the first instance, the calculation of the cost-to-revenue ratio does not account for this effect; in the second instance, the calculation does account for the estimated revenue increase as an offset to compliance cost.

Table 8-2, following page, presents the findings from the small business impact assessment for the primary regulatory options considered in this analysis. In addition to presenting the results from the cost-to-revenue analysis, *Table 8-2,* also presents results for two other measures of firm-level effects: (1) the number and percent of small firms potentially incurring "financial stress" because of compliance requirements and (2) the number and

percent of small firms whose business value is expected to become negative because of the regulation (i.e., potential closures).

As reported in *Table 8-2,* the cost to small business of the C&D options is less than the total cost of the regulatory options as reported in the preceding chapter. As reported in *Table 5-1* (*Chapter 5*), total annual costs for all firms are approximately $132 million for Option 1, $1.9 billion for Option 2, and $3.8 billion for Option 3. In comparison, the total estimated costs for small businesses are less than one-third of these values: approximately $41 million (31 percent of the all-firms total) for Option 1, approximately $0.35 billion (18 percent of all-firms total) for Option 2, and $1.2 billion (32 percent of all-firms total) for Option 3.

The impacts of these regulatory options on small businesses by regulatory option are as follows:

- For *Option 1,* EPA estimates that approximately 2,300 small businesses will incur costs. These 2,300 firms represent about 1.5 percent of all estimated small businesses in the affected C&D sectors and 3 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. EPA estimates that none of these small businesses incur costs exceeding 1 or 3 percent of revenue, regardless of whether the expected increased revenue offset to compliance costs is accounted for in the cost-to-revenue comparison. In these 2,300 firms, EPA estimates that 12 will potentially incur financial stress as a result of the regulatory option and 14 would potentially incur negative net business value – an indicator of potential closure. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive. The number of small businesses estimated to incur financial stress or potential closure, represent approximately 0.01 percent of the total small businesses in the C&D sectors and about 0.02 percent of those estimated potentially in-scope small businesses.
- For *Option 2,* EPA estimates that approximately 3,700 small businesses will incur costs. These 3,700 firms represent about 2.5 percent of all estimated small businesses in the affected C&D sectors and 5 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. For this option, EPA estimates that about 395 small businesses would incur costs exceeding 1 percent of revenue and 17 small businesses would incur costs exceeding 3 percent of revenue – without accounting for the expected cost pass-through offset to compliance costs. Both numbers represent very small percentages of the small firm universes. The 395 firms estimated to incur costs exceeding 1 percent of revenue represent about 0.2 percent of all small C&D sector firms and 0.5 percent of estimated potentially in-scope small businesses. The 17 firms estimated to incur costs exceeding 3 percent of revenue are less than one-tenth of a percent of both small business counts. If the expected cost pass-through offset to compliance costs is accounted for in the cost-to-revenue calculation, 7 small businesses are estimated to incur costs exceeding 1 percent of revenue and none are estimated to incur costs exceeding 3 percent of revenue. EPA estimates that 81 small businesses will potentially incur financial stress and 56 are potential closures. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive. Although these impact values are higher than the numbers for Option 1, the Option 2 estimates remain small percentages of the small firm counts.
- *Option 3* imposes a higher economic/financial burden on small businesses than Option 2, although the impact values, when considered as percentages of total and in-scope small businesses, remain small. For Option 3, EPA estimates that approximately 10,200 small businesses will incur costs. These 10,200 firms represent about 7 percent of all estimated small businesses in the affected C&D sectors and 13 percent of those small businesses estimated capable of performing projects potentially within the scope of a C&D regulation. For this option, EPA estimates that 1,868 small businesses would incur costs exceeding 1 percent of revenue and 111 small businesses would incur costs exceeding 3 percent of revenue – again, without accounting for the expected cost pass-through offset to compliance costs. The 1,868 firms

estimated to incur costs exceeding 1 percent of revenue represent about 1 percent of all small C&D sector firms and 2 percent of estimated potentially in-scope small businesses. The 111 firms estimated to incur costs exceeding 3 percent of revenue are 0.1 percent of the small in-scope firms. If the expected cost pass-through offset to compliance costs is accounted for in the cost-to-revenue calculation, 28 small businesses are estimated to incur costs exceeding 1 percent of revenue and no small businesses are estimated to incur costs exceeding 3 percent of revenue. EPA estimates that 318 small businesses will potentially incur financial stress and 295 are potential closures. Some of the firms estimated to incur financial stress may also be estimated to experience negative business value, and as a result, these two measures of financial impact may not be additive.

Overall, EPA estimates the small business impacts of all three of the primary options are not substantial on the basis of the small percentages of total small businesses and estimated small businesses that would potentially be adversely affected by the C&D regulatory options. Although EPA estimates that Option 2 would potentially cause approximately 395 firms to incur costs exceeding 1 percent of revenue, EPA does not judge this impact to be so substantial or so significant as to warrant a SISNOSE finding. The number of affected firms represents a small percentage of all small businesses (0.2 percent) and all small in-scope businesses (0.5 percent) in the C&D industry sectors of concern. The estimated effects relative to the 3 percent of revenue threshold are even smaller, at only 17 firms. Thus, EPA does not judge the number of adversely affected small businesses to be *substantial*. Moreover, if the expected pass-through of these compliance costs is accounted for in the cost-to-revenue analysis, then the number of adversely affected firms falls to zero under both cost-to-revenue impact thresholds. On this basis, EPA further concludes that the adverse impact is *not significant*.

Table 8-2: Summary of Small Business Cost and Impact Analysis for C&D Rule Options

Impact Analysis Concept		Option 1	Option 2	Option 3
Resource Cost of Compliance and Affected Acreage and Firms				
Total Costs in Small Businesses ($000,000; $2008)		$41	$350	$1,213
Total Small Business Activity Acreage Incurring Cost[a]		36,808	60,318	167,566
Number of Small Firms	All Small Firms	148,760	148,760	148,760
	Small Firms In-Scope	78,090	78,090	78,090
	Small Firms Incurring Cost	2,337	3,660	10,227
Small Firms with Compliance Cost Exceeding Percentages of Revenue Judged Potentially Indicative of Adverse Impact				
Costs Unadjusted for Effect of Cost Pass-Through				
Small Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	395	1,868
	% of All Small Firms	0.0%	0.3%	1.3%
	% of Small Firms In-Scope	0.0%	0.5%	2.4%
Small Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	17	111
	% of All Small Firms	0.0%	0.0%	0.1%
	% of Small Firms In-Scope	0.0%	0.0%	0.1%
Costs Adjusted for Effect of Cost Pass-Through[b]				
Small Firms with Costs Exceeding 1% of Revenue	Number Incurring Effect	0	7	28
	% of All Small Firms	0.0%	0.0%	0.0%
	% of Small Firms In-Scope	0.0%	0.0%	0.0%
Small Firms with Costs Exceeding 3% of Revenue	Number Incurring Effect	0	0	0
	% of All Small Firms	0.0%	0.0%	0.0%
	% of Small Firms In-Scope	0.0%	0.0%	0.0%
Small Firms Estimated to Incur Financial Stress From Deterioration in Measures of Financial Performance				
Small Firms Incurring Financial Stress	Number Incurring Effect	12	81	318
	% of All Small Firms	0.0%	0.1%	0.2%
	% of Small Firms In-Scope	0.0%	0.1%	0.4%
Small Firms whose Net Business Value Becomes Negative as a Result of Compliance (Potential Closures)				
Small Firms with Negative Business Value	Number Incurring Effect	14	56	295
Because of Regulation (Potential Closures)	% of All Small Firms	0.0%	0.0%	0.2%
	% of Small Firms In-Scope	0.0%	0.1%	0.4%

[a] Option costs for the economic impact analysis vary slightly from the engineering compliance cost estimates due to the reconciliation process described in Chapter 5.

b Assumes cost pass-through rate of 85% for residential sectors and 71% for non-residential and non-building sectors.

EPA Estimates

8.4 Consideration of Small Entity Impacts in Regulatory Option Selection

As described at page 8-3, above, EPA considered carefully the potential impact of the regulation on small businesses in developing and analyzing regulatory options. In particular, EPA set aside from consideration those regulatory options that would have extended regulatory coverage to project sizes that would more likely be within the performance capability of small businesses. The result of this effort are proposed options that EPA judges will have a small effect, overall, on small businesses based on any of the relevant measures of small business impact assessment. For example, the results for Option 2 indicate the following:

- Number and percentage of small businesses estimated to incur compliance costs out of the total of small businesses in the C&D industry and potential in-scope small businesses:
  - Approximately 3,700 small businesses are estimated to incur costs, which represent about 2.5 percent of all estimated small businesses in the affected C&D sectors and 5 percent of potentially in-scope small businesses.
- Number and percentage of small businesses estimated to incur compliance costs exceeding cost-to-revenue impact thresholds out of the total of potential in-scope small businesses and of the total of small businesses estimated potentially to be within the scope of the regulation:

- 395 small businesses are estimated to incur costs exceeding 1 percent of revenue, or only 0.2 percent of all small C&D sector firms and 0.5 percent of estimated potentially in-scope small businesses
- 17 small businesses are estimated to costs exceeding 3 percent of revenue, or less than one-tenth of a percent of both small business counts.

➢ Number and percentage of small businesses estimated to incur other measures of adverse economic impact – financial stress and/or potential business closure – again out of the total of potential in-scope small businesses and of the total of small businesses estimated to incur compliance costs from the regulation:

- 81 small businesses are estimated to potentially incur financial stress, or fewer than 0.1 percent of both small C&D sector firms and estimated potentially in-scope small businesses
- 56 small businesses are assessed as potential closures, or again less than 0.1 percent of both small C&D sector firms and estimated potentially in-scope small businesses.

Appendix 8-1: Economic Impacts on Small Model C&D Firms Under Different In-Scope Activity Cases

In the firm-level analysis, firms that are not of sufficient size (i.e., revenue) to perform an in-scope project *on their own* do not incur direct compliance cost under the regulation. However, large construction projects, in particular, could be completed by multiple firms who otherwise would not be able to complete an in-scope project on their own given the size of their business. For example, a single developer can sell "pieces" of a project to small independent firms. Under this configuration, the initial developer could incur the direct costs of the regulation but then pass those costs – in whole or in part – on to other project participants, including small businesses.[60] We will call this the *Large Developer-Small Builder* configuration. The purpose of this sensitivity test is to examine the impact of the regulation on small firms who *may* incur costs under this kind of business configuration, and who otherwise would not be in-scope of the regulation.

The analysis illustrates how a typical small C&D firm *could* be affected by the regulation by assuming that *all* of the firm's new construction activity incurs compliance costs, and then testing cost-to-revenue impacts across a wide range of assumptions about *revenue per acre, compliance cost per-acre, and rate of cost pass-through* for any given project.

This illustrative sensitivity analysis is structured as follows:

- The analysis is performed for a *small model C&D firm* that would otherwise incur no compliance costs under Option 2 of the proposed C&D regulation. We have selected the model firm that represents *Revenue Range 2* ($1M - $3M) in the *New Single-Family Residential Construction* (NAICS 236115) sector for this analysis.
- For the analysis of this model firm, we estimate a 3x4 matrix of cost-to-revenue impacts. The matrix of impacts is defined by three "in-scope activity cases" and four acreage intensity cases.

  In-Scope Activity Cases. The three in-scope activity cases are included to establish a range of per-acre compliance costs that the model firm may incur depending on the kind of project in which the firm typically engages:

  - Assume the model firm performs in-scope activity in a 10-30 acre project (i.e. pond cost)
  - Assume the model firm performs in-scope activity in a 30+ acre project (i.e. treatment cost)
  - Assume the model firm performs in-scope activity in a mix of projects proportional to the national mix of projects incurring cost under Option 2 (i.e. blended pond & treatment cost)

  Acreage Intensity Cases. The four acreage intensity assumptions (e.g., acres developed per million dollars of revenue) are included to establish a range for the quantity of acreage, based on in-scope revenue, performed by the model firm under each activity case.[61] For each activity case, we look at four acreage intensity assumptions: the 25th, 50th, 75th, and 90th percentile acreage intensity values for the single-family construction sector.

[60] Or, a configuration could exist where several small firms combine their resources to undertake a project, where all of the firms "share" the *direct* cost of the regulation in some way. This configuration is not addressed in the sensitivity analysis outlined here.

[61] In other words, the acreage-intensity assumptions help to account for the potentially great variability in the *kind* of construction activity that could be performed by the model firm.

- Before estimating the 3x4 matrix of model firm impacts, we must establish the quantity of *in-scope* model firm revenue.[62] We establish the *in-scope* model firm revenue using two assumptions about the *total* model firm revenue: [63]
  - We assume approximately 94% of the model firm's revenue is associated with *new* single-family construction, and is therefore potentially in-scope. This assumption is based on the Census' NAICS sector firm specialization data.[64]
  - We assume that *all* of the firm's *potentially* in-scope revenue (e.g., 94%) is actually derived from in-scope projects. This conservative assumption belies the reasonable expectation that, in all likelihood, only some of a firm's activity will actually be performed in in-scope projects. For example, under the proposed Option 2, only about 51% of all new residential acreage developed is expected to incur costs under the regulation.
- We begin to estimate the matrix of impacts by first estimating the quantity of in-scope acreage performed by the model firm for each acreage intensity case using the estimate of in-scope model firm revenue and the acreage intensity value (e.g., in-scope revenue * acres/revenue = in-scope acres). The *total* compliance cost associated with that acreage is then estimated for each in-scope activity case in the matrix using the per-acre compliance costs (e.g., in-scope acres * cost/acre = total cost).
- We then assumed that the developer passes through 100% of the compliance cost to the small builder.
- Lastly, cost-to-revenue impacts for the small model firm are estimated for each matrix option using two different assumptions (0% and 85%) about cost pass-through from the small builder to the consumer.

Table 8-3 summarizes the revenue characteristics of the model C&D firm in this analysis. The table shows that this model firm has approximately $1.47 million of in-scope revenue; that is, revenue generated from construction activity that is performed on in-scope acreage and therefore incurs a compliance cost.

Table 8-3: Small Model C&D Firm In-Scope Revenue

Model Firm Revenue Range	$1,000,000 - $3,000,000
Total Model Firm Revenue	$1,554,883
Percent of Revenue from New Construction	94%
Percent of New Construction Revenue In-Scope	100%
Model Firm Revenue/Activity Incurring Cost	*$1,467,810*

Source: EPA Analysis

Table 8-4 presents the results of this analysis for Option 2. Cost-to-revenue impacts on the small C&D firm increase as you move down the acreage intensity cases in any column, or as you move across the in-scope activity cases for any acreage intensity case. The greatest impact on the small model firm is therefore observed for the 30+ acre in-scope activity case (column 3) and the 90th percentile acreage intensity case. For the highest impact case, costs absorbed by the model firm represent 0.22% – 1.45% of firm revenues, depending on the cost pass-through assumption. One could reasonably expect impacts to be *even less* if one relaxes the conservative assumption that *all* of the firms *new* construction activity occurs in in-scope projects. The results for potential compliance costs incurred under Options 1 and 3 are presented in *Table 8-5*.

[62] In-scope model firm revenue, when combined with acreage intensity, determines the quantity of model firm acreage that incurs costs. That quantity of acreage is then assigned costs based on the in-scope activity case

[63] Although model firm compliance cost is determined by *in-scope* revenue, the cost-to-revenue results are still based on *total* firm revenue.

[64] It would be preferable to have this information by revenue range, however is not readily available from the Census.

Table 8-4: Small Model C&D Firm Sensitivity Impact Analysis Results: Option 2 (RR2, 236115)

	In-Scope Activity Cases		
	All In-Scope Activity in a 10 - 30 Acre Project (pond cost)	**All In-Scope Activity in Proportion to National Blend (blended cost)**	**All In-Scope Activity in a 30+ Acre Project (treatment cost)**
Compliance Cost per Acre	**$842**	**$5,626**	**$6,288**
25th Percentile Acreage Intensity			
Acreage Intensity ($millions of revenue/acre)	**1.35**	**1.35**	**1.35**
Model firm *total feasible* acreage	1.15	1.15	1.15
Model firm *in-scope* acreage	1.09	1.09	1.09
Compliance Cost Incurred by Model Firm			
Total compliance cost for in-scope acreage	$916	$6,119	$6,839
CPT from developer to builder	100%	100%	100%
Total compliance cost passed to the builder	$916	$6,119	$6,839
Compliance Cost Incurred as a Percent of Model Firm Revenue			
Accounting for 85% CPT to Customer	0.01%	0.06%	0.07%
Accounting for 0% CPT to Customer	0.06%	0.39%	0.44%
50th Percentile Acreage Intensity			
Acreage Intensity ($millions of revenue/acre)	**0.96**	**0.96**	**0.96**
Model firm *total feasible* acreage	1.61	1.61	1.61
Model firm *in-scope* acreage	1.52	1.52	1.52
Compliance Cost Incurred by Model Firm			
Total compliance cost for in-scope acreage	$1,283	$8,572	$9,580
CPT from developer to builder	100%	100%	100%
Total compliance cost passed to the builder	$1,283	$8,572	$9,580
Compliance Cost Incurred as a Percent of Model Firm Revenue			
Accounting for 85% CPT to Customer	0.01%	0.08%	0.09%
Accounting for 0% CPT to Customer	0.08%	0.55%	0.62%
75th Percentile Acreage Intensity			
Acreage Intensity ($millions of revenue/acre)	**0.66**	**0.66**	**0.66**
Model firm *total feasible* acreage	2.35	2.35	2.35
Model firm *in-scope* acreage	2.21	2.21	2.21
Compliance Cost Incurred by Model Firm			
Total compliance cost for in-scope acreage	$1,865	$12,461	$13,927
CPT from developer to builder	100%	100%	100%
Total compliance cost passed to the builder	$1,865	$12,461	$13,927
Compliance Cost Incurred as a Percent of Model Firm Revenue			
Accounting for 85% CPT to Customer	0.02%	0.12%	0.13%
Accounting for 0% CPT to Customer	0.12%	0.80%	0.90%
90th Percentile Acreage Intensity			
Acreage Intensity ($millions of revenue/acre)	**0.41**	**0.41**	**0.41**
Model firm *total feasible* acreage	3.80	3.80	3.80
Model firm *in-scope* acreage	3.59	3.59	3.59
Compliance Cost Incurred by Model Firm			
Total compliance cost for in-scope acreage	$3,023	$20,199	$22,574
CPT from developer to builder	100%	100%	100%
Total compliance cost passed to the builder	$3,023	$20,199	$22,574
Compliance Cost Incurred as a Percent of Model Firm Revenue			
Accounting for 85% CPT to Customer	0.03%	0.19%	0.22%
Accounting for 0% CPT to Customer	0.19%	1.30%	1.45%

Source: EPA Analysis

Table 8-5: Small Model C&D Firm Sensitivity Impact Analysis Results: Options 1 & 3 (RR2, 236115)

	Option 1	Option 3
	All In-Scope Activity in a 10+ Acre Project	All In-Scope Activity in a 10+ Acre Project
Compliance Cost per Acre	**$883**	**$6,008**
25th Percentile Acreage Intensity		
Acreage Intensity ($millions of revenue/acre)	**1.35**	**1.35**
Model firm *total feasible* acreage	1.15	1.15
Model firm *in-scope* acreage	1.09	1.09
Compliance Cost Incurred by Model Firm		
Total compliance cost for in-scope acreage	$960	$6,535
CPT from developer to builder	100%	100%
Total compliance cost passed to the builder	$960	$6,535
Compliance Cost Incurred as a Percent of Model Firm Revenue		
Accounting for 85% CPT to Customer	0.01%	0.06%
Accounting for 0% CPT to Customer	0.06%	0.42%
50th Percentile Acreage Intensity		
Acreage Intensity ($millions of revenue/acre)	**0.96**	**0.96**
Model firm *total feasible* acreage	1.61	1.61
Model firm *in-scope* acreage	1.52	1.52
Compliance Cost Incurred by Model Firm		
Total compliance cost for in-scope acreage	$1,345	$9,154
CPT from developer to builder	100%	100%
Total compliance cost passed to the builder	$1,345	$9,154
Compliance Cost Incurred as a Percent of Model Firm Revenue		
Accounting for 85% CPT to Customer	0.01%	0.09%
Accounting for 0% CPT to Customer	0.09%	0.59%
75th Percentile Acreage Intensity		
Acreage Intensity ($millions of revenue/acre)	**0.66**	**0.66**
Model firm *total feasible* acreage	2.35	2.35
Model firm *in-scope* acreage	2.21	2.21
Compliance Cost Incurred by Model Firm		
Total compliance cost for in-scope acreage	$1,956	$13,308
CPT from developer to builder	100%	100%
Total compliance cost passed to the builder	$1,956	$13,308
Compliance Cost Incurred as a Percent of Model Firm Revenue		
Accounting for 85% CPT to Customer	0.02%	0.13%
Accounting for 0% CPT to Customer	0.13%	0.86%
90th Percentile Acreage Intensity		
Acreage Intensity ($millions of revenue/acre)	**0.41**	**0.41**
Model firm *total feasible* acreage	3.80	3.80
Model firm *in-scope* acreage	3.59	3.59
Compliance Cost Incurred by Model Firm		
Total compliance cost for in-scope acreage	$3,170	$21,571
CPT from developer to builder	100%	100%
Total compliance cost passed to the builder	$3,170	$21,571
Compliance Cost Incurred as a Percent of Model Firm Revenue		
Accounting for 85% CPT to Customer	0.03%	0.21%
Accounting for 0% CPT to Customer	0.20%	1.39%

Source: EPA Analysis

9 Assessing the C&D Regulatory Options in Accordance with Unfunded Mandates Reform Act (UMRA) Requirements

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104-4, requires federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of UMRA, EPA generally prepares a written statement, including a cost-benefit analysis, for proposed and final rules with "federal mandates" that may result in expenditures by state, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year.

Before EPA promulgates a rule for which a written statement is needed, section 205 of UMRA directs EPA to consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the proposed rule an explanation of why that alternative was not adopted.

In addition, before EPA establishes any regulatory requirements that might significantly or uniquely affect small governments, including tribal governments, the Agency is to develop a small government agency plan pursuant to section 203 of UMRA. The purpose of the plan is to provide for notifying potentially affected small governments, thus enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant federal mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

Lastly, UMRA requires the statutory authority for the rule to be cited. A detailed discussion of the objectives and legal basis for the proposed rule will be presented in the Federal Register preamble a proposed regulation.

In accordance with these UMRA requirements, EPA evaluated the impact of the C&D regulatory options on (1) government entities, (2) small governments, and (3) private entities.

9.1 Assessing Costs to Government Entities

The purpose of this part of the UMRA analysis is to estimate the potential regulatory burden of the C&D regulatory options on State, Local, and Tribal governments. For this assessment, EPA considered two concepts of potential government burden:

- **Administrative Costs.** Administrative costs are those costs associated with state and local governments' administration of federal rule requirements to regulated entities within their jurisdictions.
- **Compliance Costs.** Governments build or hire contractors to perform construction and development activities on a material quantity of developed space in any given year. These government projects will need to comply with the proposed rule just as private sector projects will, and therefore, governments are assumed to incur some incremental compliance costs.

The total of the administrative costs for permitting and related activities and the compliance costs estimated to apply to government are the total costs to government.

The following sections discuss EPA's proposed methodology for assessing these costs to governments.

9.1.1.1 Administrative Costs

EPA assumed for the current analysis that the NPDES Phase I and Phase II stormwater permit programs are fully implemented and that any new regulatory requirements would be superimposed on these programs. However, EPA expects a small additional administrative burden to government entities under the proposed options. Federal and state and local governments will incur costs for processing and analyzing discharge monitoring reports (DMR's) for projects that incur cost under the proposed rule. EPA has estimated preliminary results of the additional administrative cost to governments for administering the DMR's.[65]

The cost to federal and state and local governments for processing and analyzing DMR's is a function of (1) the number of DMR's received by the permitting authority, (2) the labor hour requirement to process and analyze the DMR, and (3) the labor rate and associated overhead costs of the federal and state and local employees who process DMR's. EPA assumed that one DMR will be required for each project that incurs cost under *Option 2* and *Option 3*. EPA engineering analysis estimates 60,411 projects under *Option 2* and 119,356 projects under *Option 3* will require the submittal of a DMR. Furthermore, depending on the project location, the DMR will either be received by the federal or the state or local authority.[66] The breakout of projects into the federal and the state and local DMR jurisdiction is determined from the option specific turbidity requirement acreage by state. For both *Option 2* and *Option 3*, the percent of total acreage subject to the turbidity monitoring requirement is determined for the five states that will file their DMR's to the federal authority. This percentage is applied to the total number of projects to determine the number of projects covered by the federal and the state and local DMR jurisdictions.

The labor hour requirement for the processing and review of the DMR is from the Information Collection Request (ICR) for National Pollution Discharge Elimination System (NPDES) and Sewage Sludge Monitoring Reports. The ICR estimates that an average of 10 minutes (0.17 hrs) is required to review and process the DMR. Furthermore, 20 percent of the DMR's submitted will require some form of follow-up action due to non-compliance. The follow-up action requires an average of 30 minutes (0.5 hrs) per DMR (U.S. EPA, 2005). Therefore, EPA has assumed that 80 percent of projects will require 0.17 labor hours whereas the other 20 percent will require 0.67 labor hours.

Labor rates for federal government employees are based on the Base General Schedule Pay Scale from a federal employment website. The GS-12, Step 5 estimated hourly rate, including a 1.6 multiplier accounting for overhead and fringe benefits[67], is $50.31 in 2008 dollars (FedJobs, 2008). Labor rates for state and local government employees are based on the Department of Labor's Bureau of Labor Statistics *Employer Costs for Employee Compensation.* The state and local employer cost-per-hour for employee compensation (including benefits) is $37.73 in December 2007 dollars (U.S. DOL, 2007).

Table 9-1 details the calculation of the government administrative costs. Total costs are provided for both the federal and state and local governments.

[65] Processing and reviewing DMR's is only required under *Option 2* and *Option 3*. *Option 1* does not have any turbidity monitoring requirements.

[66] Alaska, District of Columbia, Idaho, Massachusetts, New Hampshire, and New Mexico do not have approved NPDES programs. Therefore, the administrative cost for their project DMR's is attributed to the federal government.

[67] The 1.6 overhead and fringe benefits multiplier is assumed according to the EPA ICR Handbook.

Table 9-1: Government Administrative Costs: DMR (2008$)

	Option 1	Option 2	Option 3
Number of Projects[a]			
Incurring Federal Administrative Cost	N/A	124	3,014
Incurring State or Local Administrative Cost	N/A	68,008	112,522
Government Administrative Costs			
Federal	$0	$1,660	$40,433
State and Local	$0	$684,254	$1,132,124
Total	**$0**	**$685,914**	**$1,172,557**

a Allocated to federal or state and local administration based upon the option specific percent of acres incurring turbidity costs by state. Those states that do not have a certified NPDES program are assumed to file their DMR with the federal government.

Source: U.S. EPA (2005), U.S. DOL (2007), FedJobs (2008), and EPA Estimates

9.1.1.2 Compliance Costs

Governments will likely bear some of the compliance costs associated with the regulatory options, assuming that these costs are passed on from developers and builders. EPA estimated the compliance costs potentially incurred by government entities, based on the value of construction work done by government agencies (federal, state, and local) as a percentage of the total value of construction, as reported in the U.S. Census publication, *Construction Spending* for 2002. *Table 9-2* shows, for each regulatory option, total compliance costs by general construction activity category, and broken between the private sector and various public sectors. *Table 9-3* provides the same breakout of total *acreage* incurring costs.

Table 9-2: Total Compliance Costs[a] (millions of $2008)

	Option 1	Option 2	Option 3
Total Compliance Costs by Government Unit and by General Industry Sector			
Residential Sector			
Private	$64.0	$890.3	$1,846.9
Public	$1.0	$13.4	$27.9
Federal	$0.3	$3.8	$7.8
State and Local	$0.7	$9.7	$20.1
Total	**$65.0**	**$903.7**	**$1,874.8**
Non-Residential Sector			
Private	$34.4	$482.0	$969.2
Public	$19.8	$276.9	$556.9
Federal	$1.7	$24.3	$48.8
State and Local	$18.1	$252.7	$508.1
Total	**$54.2**	**$758.9**	**$1,526.1**
Transportation Sector			
Private	$1.1	$17.8	$30.7
Public	$12.1	$202.2	$348.7
Federal	$0.4	$5.9	$10.2
State and Local	$11.7	$196.3	$338.5
Total	**$13.1**	**$220.0**	**$379.4**
Total Compliance Costs by Government Unit and Across All Industry Sectors			
Private	$99.5	$1,390.1	$2,846.8
Public	$32.9	$492.5	$933.5
Federal	$2.4	$34.0	$66.8
State and Local	$30.5	$458.7	$866.7
Total	**$132.4**	**$1,882.6**	**$3,780.3**

a Based on the value of construction work done by government entity

Source: U.S. Census (2008a), U.S. Census Bureau's Government Organization (2002), EPA Estimates

Table 9-3: Total Acreage Incurring Cost[a]

	Option 1	Option 2	Option 3
Total Acreage by Government Unit and by General Industry Sector			
Residential Sector			
Private	57,964	135,749	252,745
Public	875	2,049	3,815
Federal	245	574	1,068
State and Local	630	1,475	2,747
Total	**58,838**	**137,798**	**256,560**
Non-Residential Sector			
Private	30,619	74,196	135,920
Public	17,592	42,629	78,093
Federal	1,541	3,734	6,840
State and Local	16,051	38,895	71,253
Total	**48,211**	**116,825**	**214,014**
Transportation Sector			
Private	974	2,765	4,191
Public	11,047	31,368	47,536
Federal	322	915	1,386
State and Local	10,725	30,453	46,150
Total	**12,021**	**34,133**	**51,727**
Total Acreage by Government Unit and Across All Industry Sectors			
All Industry Sectors			
Private	89,557	212,711	392,856
Public	29,514	76,046	129,444
Federal	2,108	5,222	9,295
State and Local	27,406	70,824	120,149
TOTAL	**119,071**	**288,757**	**522,300**

a Based on the value of construction work done by government entity

Source: U.S. Census (2008a), U.S. Census Bureau's Government Organization (2002), EPA Estimates

9.1.1.3 Total Government Costs and Impacts

Table 9-4 reports total compliance and administrative costs estimated to be incurred by Federal, State and Local government entities for each regulatory option. *Table 9-5* reports the findings from comparing the total compliance and administrative costs with three baseline measures: total government revenue, capital outlay, and capital outlay for construction only.

Table 9-4: Total Government Compliance and Administrative Costs (millions of $2008)

	Option 1	Option 2	Option 3
Compliance Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.1	$128.6
Local[a]	$26.0	$390.6	$738.1
Administrative Costs			
Federal	$0.0	$0.0	$0.0
State[a]	$0.0	$0.1	$0.2
Local[a]	$0.0	$0.6	$1.0
Total Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.2	$128.8
Local[a]	$26.0	$391.2	$739.1

a State and Local compliance costs were split-out from the State and Local total based on the proportion of total project value in state and local governments from Reed Construction Data.

Source: Reed (2008), U.S. Census Bureau's Government Organization (2002), EPA Estimates

Table 9-5: Impacts of Regulatory Option Compliance and Administrative Costs on State and Local Governments (millions of $2008)

	Option 1	Option 2	Option 3
State Governments Impact Analysis Concepts			
Total Revenues	1,097,829	1,097,829	1,097,829
Total Costs as % of Total Revenues	0.00%	0.01%	0.01%
Capital Outlay	89,919	89,919	89,919
Total Costs as % of Total Capital Outlay	0.01%	0.08%	0.14%
Construction Outlay Only	71,035	71,035	71,035
Total Costs as % of Total Construction Outlay	0.01%	0.10%	0.18%
Local Governments Impact Analysis Concepts			
Total Revenues	1,083,129	1,083,129	1,083,129
Total Costs as % of Total Revenues	0.00%	0.04%	0.07%
Capital Outlay	142,209	142,209	142,209
Total Costs as % of Total Capital Outlay	0.02%	0.28%	0.52%
Construction Outlay Only	107,588	107,588	107,588
Total Costs as % of Total Construction Outlay	0.02%	0.36%	0.69%

a State and Local compliance costs were split-out from the State and Local total based on the proportion of total project value in state and local governments from Reed Construction Data.

Source: Reed (2008), U.S. Census Bureau's Compendium of Government Finances (2005c), U.S. Census Bureau's Government Organization (2002), EPA Estimates

9.2 Assessing Costs and Impacts on Small Government Entities

In addition to looking at total outlays by governments for the C&D regulatory options, in accordance with UMRA requirements, EPA also considered the extent to which these outlays would fall specifically on small governmental entities, and the potential impact of these entities. The assessment of impacts on small governmental entities involved two steps: (1) identifying small government entities (i.e., those serving populations of less than 50,000, (5 USC 601[5])), (2) estimating the share of total government costs for the regulatory options incurred by small governments, and (3) estimating the potential impact from these costs based on comparison of small government outlays with small government revenue and outlays.

The smallest unit of government potentially affected by the rule is at the sub-county (i.e., municipal or township) government level. The evaluation of potential impact on these entities began by estimating the share of local-government compliance and administrative costs (as described in previous section) incurred by small governments, as follows:

- EPA identified the sub-set of local-government entities determined to be small government entities. The determination is based on a national estimate – from the U.S. Census – of the population served by local jurisdictions with fewer than 50,000 population (i.e., of the total population in local jurisdictions, the percentage of that population in local jurisdictions with fewer than 50,000 people);
- Based on the proportion of *population* served by small governments out of total population in local jurisdictions, EPA allocated local-government compliance and administrative costs to the sub-set of local-government entities determined to be small. This allocation assumes that government construction activity and incurrence of compliance and administrative costs are proportional to population;[68]
- EPA compared the local government share of compliance and administrative costs against several baseline indicators to assess the extent of potential impacts on small governmental entities. The indicators

[68] Approximately 92 percent of the total U.S. population in 2002 lived in areas governed by a municipality or town/township. Of those served by these sub-county governments, approximately 51 percent lived in areas served by municipal or town/township governments with populations of less than 50,000. Therefore, EPA estimated that 51 percent of local government compliance costs affect projects undertaken by small government entities.

include total government revenue, capital outlay, and capital outlay for construction only. The comparisons indicate the materiality of the compliance and administrative outlays in relation to the baseline government revenue and outlay levels.

Table 9-6 reports total compliance and administrative costs estimated to be incurred by small government entities and the findings from comparing these outlays with the three baseline measures.

Table 9-6: Impacts of Regulatory Option Compliance and Administrative Costs on Small Government Units (millions of $2008)

	Option 1	Option 2	Option 3
Compliance Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.1	$128.6
Local[a]	$26.0	$390.6	$738.1
Small Government Entities	$12.2	$183.6	$346.9
Administrative Costs			
Federal	$0.0	$0.0	$0.0
State[a]	$0.0	$0.1	$0.2
Local[a]	$0.0	$0.6	$1.0
Small Government Entities	$0.0	$0.3	$0.5
Total Costs			
Federal	$2.4	$34.0	$66.8
State[a]	$4.5	$68.2	$128.8
Local[a]	$26.0	$391.2	$739.1
Small Government Entities	$12.2	$183.9	$347.4
Small Government Impact Analysis Concepts			
Total Revenues	125,515	125,515	125,515
Total Costs as % of Total Revenues	0.01%	0.15%	0.28%
Capital Outlay	13,455	13,455	13,455
Total Costs as % of Total Capital Outlay	0.09%	1.37%	2.58%
Construction Outlay Only	8,529	8,529	8,529
Total Costs as % of Total Construction Outlay	0.14%	2.16%	4.07%

a State and Local compliance costs were broken out from the State and Local total based on the proportion of total project value in state and local governments from Reed Construction Data.

Source: Reed (2008), U.S. Census Bureau's Compendium of Government Finances (2005c), U.S. Census Bureau's Government Organization (2002), EPA Estimates

9.3 Assessing Costs and Impacts on Private Entities

The potential economic impacts for private entities that were analyzed were divided into two major groups:

- Impacts on the individual projects, establishments, and firms in the construction industries, and
- Impacts at the national level and on the national economy.

EPA's analysis of impacts on private entities was previously detailed in *Chapter 3: Economic Impact Analysis Methodology* and results were reported in *Chapter 5*: *Economic Impact Analysis Results*.

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