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

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The deposition of sediment from construction site runoff has contributed to the loss of capacity in small streams, lakes, and reservoirs, leading to the necessity for mitigation efforts such as dredging or replacement. In response, the U.S. Environmental Protection Agency (EPA) is proposing several options to address storm water discharges from construction sites. As one option, EPA would establish inspection and certification requirements that would be incorporated into the storm water permits issued by EPA and States, with other permit requirements based on the best professional judgement of the permit authority. As another option, EPA would establish technology-based effluent limitation guidelines and standards (ELGs) for storm water discharges from construction sites required to obtain National Pollutant Discharge Elimination System (NPDES) permits. The final option would involve no incremental regulation. EPA would allow technology-based permit requirements to continue to be established based upon the best professional judgment of the permit authority.

This Economic Analysis (EA) summarizes EPA's analysis of the estimated compliance costs and the economic impacts that may be incurred by regulated entities within the construction and development (C&D) industry as a result of the proposed regulations. The EA describes the proposed regulatory options considered by EPA. Financial impacts to establishments in the C&D industry, potential impacts on consumers of C&D industry output, and market and other secondary impacts such as industry employment are also covered here. This EA also responds to requirements for small business analyses under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) and for cost-benefit analyses under Executive Order 12866 and the Unfunded Mandates Reform Act (UMRA).

ES.2 INDUSTRY PROFILE

ES.2.1 Data Sources

EPA relied on existing data sources, including academic literature, industry trade associations, and government data such as that provided by the U.S. Census Bureau. Major data sources are discussed in more detail where they are used to support sections of this analysis.

Of primary importance in the early development of this EA was the 1997 Census of Construction, conducted by the U.S. Census Bureau. The Census provided information on the industry sectors potentially affected by the proposed rule, as well as characteristics of each sector such as employment and revenue levels. EPA used other reports from the Census Bureau, including:

- Report C25 – Characteristics of New Housing
- Report C40 – Building Permits
- Report C20 – Housing Starts
- Report C30 – Value Put in Place

These reports were used to develop and support the various economic models used in this analysis.

Other data sources used to create a profile of the C&D industry included focus group sessions with the National Association of Home Builders (NAHB) and various NAHB publications, the Economic Analysis for the Final Phase II NPDES Storm Water Regulations, and a report on the remodeling industry by the Joint Center for Housing Studies at Harvard University, in addition to a variety of academic literature.

ES.2.2 Industry Description

The construction industry plays an integral role in the nation's economy, contributing approximately five percent of the Gross Domestic Product. Establishments in this industry are involved in a wide variety of activities, from land development and subdivision to homebuilding, construction of nonresidential buildings and other structures, heavy construction work (including roadways and bridges), and a myriad of special trades such as plumbing, roofing, electrical, excavation, and demolition work. C&D activity affecting water quality typically involves site selection and planning, and land-disturbing tasks during construction such as clearing, excavating and grading. Disturbed soil, if not managed properly, can be easily washed off-site during storm events. Storm water discharges generated during construction activities can cause an array of physical, chemical and biological impacts.

Several characteristics of the construction industry affect the structure of this economic analysis:

- Individuals (e.g., homebuyers) are often the direct customers of the construction industry. With individuals as the direct consumer it is necessary to address issues such as cost pass through and the impacts of regulations on housing affordability.

- The construction industry is dominated by small businesses. As a result, EPA carefully considered the impacts on small businesses in accordance with the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA).

- There are complex and varying relationships between developers and builders, resulting in a variety of different business models. Developers may undertake all improvement and sell completed lots directly to builders, act as builders themselves and remain onsite to build out the development, or sell some lots and retain others to build on.

- Construction activities are highly localized. This suggests that a regional approach to analysis may be helpful in accounting for varying market conditions.

- The standard industry definitions include a large number of establishments primarily engaged in remodeling activities. Such establishments are less likely to be involved in land disturbing activities.

For the purposes of this economic analysis, the "C&D industries" are broadly defined to include those establishments within the construction sector (NAICS 23) that may be involved in activities that disturb the ground at construction sites. This includes site clearing or site preparation activities such as tree removal, excavation, blasting, scraping, grading, etc. EPA believes that many establishments in NAICS 233 (Building, developing, and general contracting) and NAICS 234 (Heavy construction) are likely to engage in such activities on a regular basis. Establishments within selected 5-digit industries that are part of NAICS 235 (Special trade contractors) may also engage in land-disturbing activities. These may include NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors). However, as discussed in Section VI.A in the preamble of the proposed rule, Special trade contractors are typically subcontractors and not identified as NPDES permittees. Table ES-1 identifies the industry sectors that may be covered by the proposed regulations.

Table ES-1. Industry Definitions for Construction and Development Industry Profile

NAICS Code	Industry	Relevant SIC Codes
233	**Building, developing, and general contracting**	
2331	Land subdivision and development	
23311	Land subdivision and development	6552 Land subdividers and developers, except cemeteries
2332	Residential building construction	
23321	Single-family housing construction	1521 General contractors–single-family houses 1531 Operative builders (partial) 8741 Management services (partial)
23322	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	
23331	Manufacturing and industrial building construction	1531 Operative builders (partial) 1541 General contractors–industrial buildings and warehouses (partial) 8741 Management services (partial)
23332	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	
23411	Highway and street construction	1611 Highway and street construction contractors, except elevated highways 8741 Management services (partial)
23412	Bridge and tunnel construction	1622 Bridge, tunnel, and elevated highway construction
2349	Other heavy construction	
23491	Water, sewer, and pipeline construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
23492	Power and communication transmission line construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
23493	Industrial nonbuilding structure construction	1629 Heavy construction, n.e.c. (partial) 8741 Management services (partial)
23499	All other heavy construction	1629 Heavy construction, n.e.c. (partial) 7353 Heavy construction equipment rental and leasing (partial) 8741 Management services (partial)
235	**Special trade contractors**	
23593	Excavation contractors	1794 Excavation work special trade contractors
23594	Wrecking and demolition contractors	1795 Wrecking and demolition work special trade contractors

Source: U.S. Census Bureau (2000).

ES.2.2.1 Number of Establishments

In 1997, there were a total of 261,617 establishments with payroll in the C&D industries. This represented 39.8 percent of all establishments in the construction sector (NAICS 23) and 4.1 percent of all U.S. business establishments. Between 1992 and 1997, the number of establishments with payroll in the C&D industries increased from 235,789 to 261,617, an increase of 11.0 percent (see Table ES-2). This overall modest increase masks some significant offsetting changes in establishment counts within individual industries, as defined under NAICS, i.e.,:

- The number of establishments in the land development sector (NAICS 2331) *decreased* by 46.6 percent;
- There was a 13.5 percent *increase* in the number of establishments in residential and nonresidential building construction (NAICS 233, except 2331);
- The number of establishments in heavy construction *increased* by 14.5 percent;
- There was a 33.0 percent *increase* in the number of special trades contractor establishments (NAICS 235), including a 31.2 percent increase among excavation contractors and a 59.6 percent increase among demolition contractors.

Table ES-2. Number of Establishments in Construction and Development Industries, 1997 vs 1992

NAICS	Industry	Number of Establishments 1992	1997	Pct. Change 1992-1997
233, exc. 2331	Building, developing, and general contracting, except land development and subdevelopment	168,407	191,101	13.5%
2331	Land development and subdevelopment	15,338	8,185	-46.6%
234	Heavy construction	37,180	42,557	14.5%
235[a]	Special trade contracting	14,864	19,771	33.0%
Subtotal		235,789	261,617	11.0%

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000).

ES.2.2.2 Employment

In 1997, employment in the C&D industries totaled nearly 2.4 million workers. This represented 41.6 percent of all construction sector employment (NAICS 23) and 2.3 percent of all employment in U.S. business establishments. Table ES-3 shows a distribution of employment by NAICS industry. NAICS 2331 (Land subdivision and land development) accounts for 41,827 employees (1.8 percent of the total), the rest of NAICS 233 (Building, developing, and general contracting) accounts for 1.3 million employees, or 55.2 percent of the total. A total of 880,400 or 37.3 percent of the total are employed in NAICS 234 (Heavy construction), and NAICS 23593 and 23594 (Excavation contractors and Wrecking and demolition contractors) employ 135,057 (5.7 percent of the total).[1]

Table ES-3. Number of Employees in the Construction and Development Industries, Establishments With Payroll, 1997

NAICS	Industry	Number of Employees	Percent of Total
233, except 23311	Building, developing, and general contracting, except land subdivision and land development	1,301,126	55.2%
23311	Land subdivision and land development	41,827	1.8%
234	Heavy construction	880,400	37.3%
235[a]	Special trade contractors	135,057	5.7%
TOTALS		**2,358,410**	**100.0%**

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000).

Construction is a seasonal activity in many parts of the country, and employment data from the industry bear this out. In 1997 employment of construction workers was lowest in March at 1.59 million and highest in August at 1.83 million.

[1] A comparison to 1992 employment levels (comparable to that shown in Table ES-2) is not easily made because of the change from SIC to NAICS basis between the 1992 and 1997 Census periods.

ES.2.2.3 Revenues

Overall, the *value of construction work* completed in the C&D industries was $525.3 billion in 1997. This represents an increase of 58.8 percent over the $330.6 billion in (nominal) value recorded in 1992. NAICS 233 (Building and developing) accounted for $368.0 billion or 70.0 percent of the total overall value in 1997. Value of work for heavy construction contractors (NAICS 234) was $127.8 billion or 24.4 percent of the total, while special trade contractors (NAICS 23593 and 23594) completed work valued at $15.9 billion, representing 3.0 percent of total revenues. The average value of construction work done per establishment ranges from $0.8 million per year for special trades to $3.0 million per year for heavy construction.

Table ES-4. Value of Construction Work (Thousands of 1997 Dollars)

NAICS	Description	Value of Construction Work[a] ($1,000)	
		Total	Per Establishment
233, except 2331	Building, developing, and general contracting, except land development and subdivision	$368,006,098	$1,926
2331	Land subdivision and land development	$13,635,521	$1,666
234	Heavy construction	$127,841,600	$3,004
235[b]	Special trade contractors	$15,910,770	$805
TOTAL		**$525,393,989**	**$2,008**

[a] Value of construction work includes all value of construction work done during 1997 for construction work performed by general contractors and special trade contractors. Included is new construction, additions and alterations or reconstruction, and maintenance and repair construction work. Also included is the value of any construction work done by reporting establishments for themselves.
[b] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000).

ES.2.2.4 Number of Potentially Regulated Businesses

EPA took several steps to define the number of C&D establishments that may be affected by the proposed regulations. The analysis began with all C&D establishments as defined in Table ES-1, using data from the 1997 Census of Construction. EPA next estimated the number of C&D establishments primarily engaged in remodeling work, using data from the National Association of Home Builders (NAHB) and the Joint Center for Housing Studies at Harvard University (Joint Center). These were excluded because they were judged unlikely to engage in land disturbing activities. The final step was to estimate the number of C&D establishments who are unlikely to disturb more than one acre of land. This was done to exclude establishments that fall below the regulatory coverage of the proposed rule.[2]

A number of establishments classified in the C&D industries are primarily engaged in remodeling activities. These establishments are not expected to be affected under the proposed rule because they are unlikely to engage in any land-disturbing activities. The Joint Center (2001) recently published a report focused solely on the remodeling industry. This report classified establishments that derive *at least half* of their revenues from remodeling activities as remodelers. When defined in this manner, the study found that 62,400 establishments classified as general contractors/builders in 1997 were actually remodelers. The study goes further to identify establishments classified in various special trades (e.g., carpentry, plumbing) that are primarily engaged in remodeling, but provides no estimates for the special trades industries that form part of the C&D industries as defined for this proposed rule (i.e.,in NAICS 23593 Excavation contractors and 23594 Wrecking and demolition contractors).[3] The report does not address remodeling activities conducted by establishments in NAICS 234 (Heavy construction), however, EPA does not believe that many establishments in this sector are principally engaged in remodeling activities.

EPA believes that builders who construct only a few houses per year are also unlikely to be affected by the proposed rule, because such builders are unlikely to build on sites over one acre in size. A special report on the homebuilding industry, published by the Census Bureau (Rappaport and Cole, 2000), estimates the number of establishments according to the number of housing units started each year. In

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[2] An additional step used in the analysis of Option 2 was to estimate the number of C&D establishments that disturb only 5 acres of land or more. Option 2 would not apply to sites below 5 acres in size.

[3] The Joint Center study does provide an estimate for the number of remodelers classified in "miscellaneous special trades" (NAICS 2359), which includes NAICS 23593 and 23594, but several other industries as well. The number of remodelers classified primarily in NAICS 23593 and 23594 may not be large, however, since the total number in NAICS 2359 is only 6,600.

1997, the number of establishments that built between one and four houses (the smallest builder size category) was 50,661.

From Table ES-2, EPA estimates that the total number of establishments in the C&D industry is 261,617. Subtracting the 62,400 remodeling establishments and the 50,661 establishments that start between one and four houses per year leaves 148,556 establishments potentially affected by the proposed rule. Table ES-5, below, shows the number of establishments in the C&D industry, adjusted for the number of remodelers and small-scale builders.[4]

Table ES-5. Number of Establishments Potentially Affected by the Proposed Rule

NAICS	Industry	Establishments With Payroll: Number	Establishments With Payroll: Percent of Total
2331	Land development and subdivision	8,185	3.1%
23321	Single-family residential building construction	138,849	53.1%
23322	Multi-family residential building construction	7,543	2.9%
2333	Nonresidential construction	44,710	17.1%
234	Heavy construction	42,557	16.3%
235[a]	Special trade contracting	19,771	7.6%
SUBTOTAL		**261,617**	**100.0%**
Minus Remodeling Establishments		***62,400***	--
Minus Establishments Starting 1 - 4 Houses per Year		***50,661***	--
Number of Potentially Affected Establishments		**148,556**	--

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Figures may not add to totals due to rounding. See also the footnote below.
Source: U.S. Census Bureau (2000); Rappaport and Cole (2000); Joint Center (2001).

[4] EPA believes, in addition, that a majority of establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) will not be affected by the proposed rule because they act as subcontractors to the actual NPDES storm water permittee, who will most often be a developer or general contractor. EPA has included these establishments in the universe of potentially affected establishments shown in Table ES-5, but has excluded them from the economic impact analysis summarized below. For further details, see Section 2.3.4.

ES.2.2.5 Small Entities

Small entities are defined by the Small Business Administration (SBA) according to size standards based on either number of employees or annual revenue (13 CFR 121). For all of the C&D industries, the size standards are based on annual revenues. The SBA revenue thresholds for the C&D industry range from $5.0 million for NAICS 233110 (Land subdivision and land development) to $27.5 million for the majority of NAICS 233 (Building, developing, and general contracting) and NAICS 234 (Heavy construction).[5] As shown in Table ES-6, 95,753 potentially affected C&D businesses, representing 98.6 percent of all potentially affected businesses in the C&D industry, fall below the SBA-defined revenue thresholds for this industry and therefore may be qualified as small businesses.

Note that for this analysis, due to data limitations for the land development industry (NAICS 23311) EPA accounted for these establishments by assigning them to the four building construction industries (single-family residential, multifamily residential, commercial[6], and industrial) based on the share of affected establishments represented by each sector.[7] EPA likewise lacked financial data for establishments in the special trades industries (NAICS 235) but decided to exclude these establishments from the small entity analysis rather than have them represented by model firms that are dissimilar in their characteristics. In general, EPA believes establishments in NAICS 235 will not be affected by the proposed rule. Chapter Six of this report provide further detail on EPA's approach to the small entity analysis.

[5] For those industries with a $27.5 million SBA cutoff, the table shows the number of firms and establishments with revenues below $25.0 million (the next closest SBA data break point). For industries with a $11.5 million SBA cutoff, figures shown are for firms and establishments with revenues below $7.5 million.

[6] See section ES.4.1 for a description of the commercial construction industry.

[7] Implicitly, this means that establishments in the land development industry are represented by model facilities in each of the four building construction industries. Prior to doing this, EPA compared industry characteristics such as average employment, revenues, and assets across industries and found them to be similar.

Table ES-6. Estimated Number of Small Businesses Potentially Affected by the Proposed Rule.

NAICS	Potentially Affected Establishments	Potentially Affected Businesses	Potentially Affected Small Businesses		Small Businesses as a Percent of Total for Individual Industry
			Number	Percent of total	
233210: Single-family housing construction	34,070	34,041	34,004	35.5%	99.9%
233220: Multifamily housing construction	4,603	4,597	4,571	4.8%	99.4%
233310: Manufacturing and industrial building construction	7,742	7,719	7,498	7.8%	97.1%
233320: Commercial and institutional building construction	39,810	39,587	39,013	40.7%	98.6%
23411 Heavy Construction	11,270	11,141	10,667	11.1%	95.7%
Total	**97,495**	**97,085**	**95,753**	**100.0%**	**98.6%**

Source: EPA estimates (see Chapter Six).

ES.2.3 Industry Dynamics

For purposes of the economic analysis, EPA has selected 1997 as the baseline year. In part this reflects the availability of data from the 1997 Census of Construction, but in addition EPA believes 1997 to be reasonably representative year for the affected industries. Before reaching this conclusion, EPA examined historical activity data for the construction industry, reviewed analyses of recent trends, and looked at projections for the future. As a result of this review, EPA concluded the following:

- Historically, construction activity has been highly cyclical. Data from 1959 through 2001 for new housing units authorized by building permit show an overall growth trend that is punctuated by cyclical swings (see Figure ES-1). These reach highs in 1972, 1978, and 1986 and lows in 1974, 1982, and 1991.

- Since 1991, the industry has been on a fairly continuous growth trend. Single-family housing, for example, grew from an annual level of 0.7 million new units in 1991 to 1.2 million new units in 1999, which represents an average annual growth rate of 8.2 percent.

During this same period, real GDP grew by an average of 4.1 percent per year (BEA, 2002).

- Structural changes in the market have made construction less cyclical than before. In a recent analysis, the NAHB identifies several factors that have contributed to reducing the cyclicality of housing market activity. These include the easing of rules on credit availability, the subsequent development of adjustable-rate mortgage instruments, and the maturation of the secondary market for mortgage-backed securities (NAHB, no date).

- An NAHB report called *The Next Decade for Housing* predicts that over the 2001-2010 period the nation will build an average of 1.82 million new homes per year, up from an average of 1.66 million per year over the 1991-2000 (see Table ES-7).

- A surprising feature of the most recent economic slowdown is that it has had almost a negligible effect on construction activity, and new home construction in particular. As NAHB's chief economist wrote in early 2002, "Believe it or not, 2001 turned out to be a record year for sales of both new and existing homes, despite three quarters of economic recession and the shock of the terrorist attacks." (Seiders, 2002).

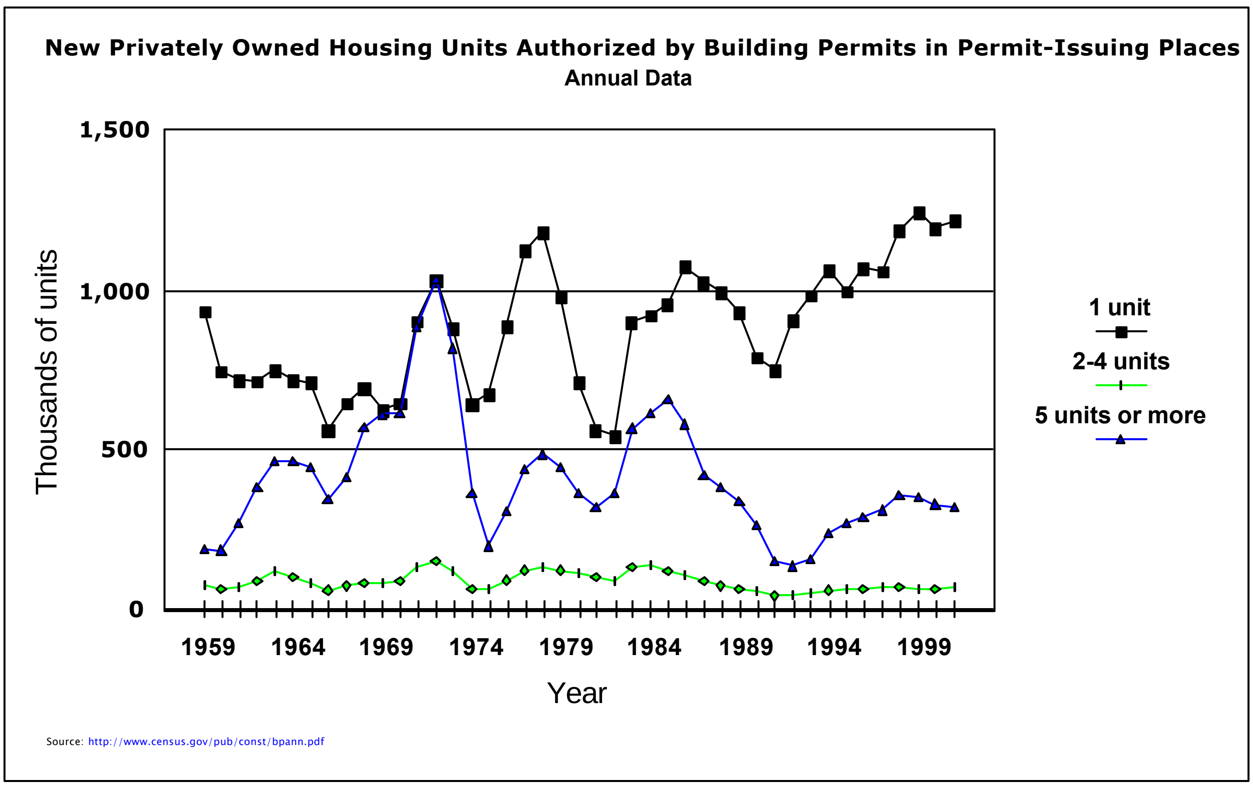

Figure ES-1. Historical data on housing construction.

Table ES-7. Housing Supply and Demand - Historical Data and Projections for 2001-2010 (all data are in thousands and represent annual changes)

	1971-1980	1981-1990	1991-2000	2001-2010 *proj.*
Change in households	1,578	1,281	1,137	1,255
Change in vacancies	151	219	184	223
Net removals	333	214	343	344
Total Demand	**2,062**	**1,714**	**1,664**	**1,822**
New single-family housing units	1,110	979	1,108	1,203
New multifamily housing units	602	491	257	343
Mobile homes	349	244	298	276
Total Supply	**2,062**	**1,714**	**1,664**	**1,822**

Source: NAHB (no date); based on Bureau of the Census data and NAHB forecasts.

Based on this review, EPA concluded that data from the year 1997 provide a reasonable basis for characterizing the industries likely to be affected by the proposed ELG. In particular, EPA concluded that there is nothing to suggest that 1997 represents a particularly robust year, or that during the coming years in which the industry will have to adapt to the requirements of the ELG it will be in a relatively weak position, compared to the profile presented here.

ES.3 REGULATORY OPTIONS

ES.3.1 Current Regulatory Status of the C&D Industry

The Construction General Permit (CGP), published in 1992 and revised in 1998, directs those seeking an NPDES permit from EPA to prepare a storm water pollution prevention plan (SWPPP) for certain construction activities. The CGP also calls for installation of temporary sediment basins for construction sites with disturbed area of 10 acres or more. The permit lists a variety of options and goals for other erosion and sediment controls (ESCs), but none are required. A description of ESCs is to be contained in the SWPPP. Options and goals for post-construction storm water best management practices (BMPs) are also contained in the CGP, but none are required. As with ESCs, selected BMPs are to be described in the SWPPP. Further discussion of current storm water regulations affecting construction activities can be found in Chapter One.

The C&D industry ELG would complement the existing NPDES permitting program by setting minimum technology-based national standards for active construction ESCs and requiring inspection and certification of ESC practices. The proposed regulatory options considered by EPA are described below.

ES.3.2 Summary of Proposed Regulatory Options

EPA is proposing BAT/BPT/BCT/NSPS guidelines and standards for active construction phase erosion and sediment control under the proposed ELG. The specific options under consideration are summarized in Table ES-8 and described in detail in Chapter Three of this EA. All three options are co-proposed, none is identified as "preferred."

Table ES-8. Summary of Regulatory Options Proposed by EPA

Option	Description	Regulatory Mechanism	Applicability
Option 1	Inspection and Certification of Construction Site Erosion and Sediment Controls	Amendment to NPDES storm water permitting regulations	Construction sites disturbing 1 acre or more
Option 2	"Codification" of the Construction General Permit (CGP) plus Inspection and Certification Requirements	Effluent limitation guidelines	Construction sites disturbing 5 acres or more
Option 3	No Additional Regulation (Baseline)	N/A	All sites

EPA has defined the baseline for the proposed rule as full compliance with the construction requirements of the final Phase I and Phase II NPDES storm water regulations. EPA also conducted a supplemental analysis that takes into account the fact that some states have not fully implemented the construction permitting requirements of the final Phase II NPDES storm water rule. The deadline for compliance with these requirements is March 10, 2003. The alternative baseline scenario considers the combined impact of the Phase II NPDES storm water rule and ELG regulations. Since EPA does not have current information on the extent of implementation of the construction permitting requirements of the Phase II NPDES storm water rule, the supplemental analysis assumes that all affected activities incur the combined cost of the Phase II NPDES storm water rule and ELG requirements.

ES.4 ECONOMIC IMPACT ANALYSIS

The economic impact analysis models the economic impacts of the proposed rule from several different perspectives. EPA has developed a series of *model projects* to analyze the economic achievability of regulatory alternatives at the project level. These models are based on representative project characteristics for single-family residential, multifamily residential, commercial, and industrial projects of various sizes. For example, the single-family residential model project reflects national averages for typical lot size, number of housing units built, size of housing units, etc. as well as project financial characteristics such as lot prices, development costs, permitting costs, construction costs, and project financing alternatives. A second type of modeling simulates the impacts of the regulatory options at the *establishment and/or firm level* (most construction firms operate only a single establishment). These models build on the project-level models to account for the level of activity (number and mix of projects) a typical firm is involved with in a typical year. EPA assesses the potential for business closure and employment losses using the firm-level model analysis. The third level of analysis focuses on the impacts of the regulatory options on the *national markets* affected by regulations on construction and development activities. The primary focus of this analysis is on the residential sector in terms of changes in house sales prices due to the proposed regulations, but EPA has also analyzed the effects of the regulations on the commercial and industrial sectors. These models are described in detail in Chapter Four of this report. In that chapter EPA provides a detailed discussion of the data sources and methodologies used for each type of model (project-, firm-, and market-level). Chapter Five contains the results of these analyses.[8]

[8] The model projects were developed with input from industry representatives and from literature sources to ensure they are representative of projects undertaken by firms likely to be affected by the proposed ELG. The model firms are developed using mean or median values for firm characteristics as reported in the 1997 Census of Construction. See Chapter Four for more extensive discussion of the modeling methodologies.

ES.4.1 Impacts on Model Construction Projects

Section ES.3 described the approach used by EPA to develop model projects that assess the impact of the various regulatory options on the financial performance of the project and to determine the incremental project-level costs that would result. EPA developed models for the following four project types:

- Single-family residential
- Multifamily residential
- Commercial[9]
- Industrial

EPA prepared multiple versions of each project type to reflect a range of project sizes–1, 3, 7.5, 25, 70, and 200 acres. EPA also analyzed each model project under two cost pass through (CPT) scenarios. In the 100 percent CPT scenario the developer/builder passes on 100 percent of the regulatory cost to the buyer or consumer. The impacts are felt by consumers in the form of changes in the sales prices of the building or housing unit. In the zero CPT scenario the developer/builder absorbs all of the regulatory costs and the impact is reflected in a change in pre-tax profits. The baseline project sales price is calculated in the models and varies according to project type and size. The baseline pre-tax profit is set at 10 percent of building sales price based on input from industry. Tables ES-9a and ES-9b present the weighted average changes in price to consumers and in pre-tax developer/builder profit for all regulatory options. Values in Table ES-9 are weighted based on the distribution of acreage by project type and size.

Changes in project cost to buyers under 100 percent cost pass through range from 0.04 percent to 0.07 percent (single family) for Option 2 (Table ES-9), and are below 0.1 percent for Option 1. Changes in builder profit under zero cost pass through range from -0.35 percent (commercial) to -0.65 percent (single family) for Option 2. Builder impacts are no worse than -0.13 percent for Option 1. More complete comparisons appear in Chapter Five, Table 5-2.

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[9] For the purposes of this analysis, the commercial construction industry included hotels/motels, amusement, religious, parking garages, service stations, hospitals, offices, public works (including roads and highways), educational, stores, and other nonresidential buildings.

Table ES-9a. Weighted Average Change in Sales Price to Buyer (All Site Sizes)
100 Percent Cost Pass Through

Option	Percent Change in Project Price to Buyer			
	Single-family	Multifamily	Commercial	Industrial
1	0.01%	0.01%	0.01%	0.01%
2	0.07%	0.04%	0.04%	0.06%
3	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates (see Chapter Five).

Table ES-9b. Weighted Average Change in Builder-Developer Profit (All Site Sizes)
Zero Cost Pass Through

Option	Percent Change in Developer/Builder Profit			
	Single	Multi	Commercial	Industrial
1	-0.12%	-0.07%	-0.07%	-0.13%
2	-0.65%	-0.38%	-0.35%	-0.54%
3	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates (see Chapter Five).

ES.4.2 Impacts on Model Construction Firms

ES.4.2.1 Impacts on Model Firm Financial Ratios

To analyze impacts of the proposed rule at the level of the facility, EPA developed model facilities based on 1997 Census of Construction data, Census special studies on the housing industry, and Dun & Bradstreet financial data. EPA constructed income statements and balance sheets for each model facility by scaling D&B data to represent different sized facilities based on Census revenue figures. EPA calculated incremental compliance costs per establishment, then used these model establishment income statements and balance sheets to estimate the post regulatory value of the following financial ratios considered especially significant to the construction industry:

- Gross Profit Ratio
- Return on Net Worth
- Current Ratio
- Debt to Equity Ratio

EPA expressed impacts to the model establishments engaged in the model construction projects in terms of the percent change from baseline value to post-regulatory value for each financial ratio.

Table ES-10 shows changes in the financial ratios under each regulatory option, with the range in outcomes reflecting simulations run using varying assumptions of model firm size and average project size (see Chapter Four for further details).[10] Return on net worth is the most sensitive ratio and shows the largest change in value, followed in descending order by the gross profit, debt to equity, and current ratios. Also, with the exception of the return on net worth ratio, the multifamily model establishment tends to incur larger impacts to its financial ratios than do the other industry sectors.

Under the more costly Option 2, return on net worth is projected to decrease as much as 5.85 percent in the single-family sector and 3.0 percent in the multifamily sector, but less than 1.5 percent in the commercial and industrial sectors. The gross profit ratio is projected to decrease by as much as 1 percent in the multifamily sector, and from about 0.3 to 0.5 percent in the remaining sectors. The debt to equity ratio is projected to worsen by as much as 0.6 percent for multifamily sector establishments; changes in this ratio range from 0.21 percent (single-family) to 0.31 percent (commercial) for the remaining sectors. The largest impact on the current ratio again occurs in the multifamily sector (a decrease of 0.16 percent), with changes of 0.05 in the other three sectors. Note that the figures presented in this table assume zero CPT.

[10] The table shows results for the four building construction industries (single-family residential, multifamily residential, commercial, and industrial). EPA conducted a separate analysis for the heavy construction industry, which found similar (i.e., very small) impacts. See Table 5-6.

Table ES-10. Impact of Compliance Costs on Model Firm Financials -- Zero Cost Pass Through

Construction Industry and Regulatory Option	Percent Change in Financial Ratios, From Baseline[a]							
	Gross Profit		Return on Net Worth		Current Ratio		Debt to Equity	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Single-family residential								
Option 1	0.000%	-0.230%	0.000%	-2.540%	0.000%	-0.020%	0.000%	0.900%
Option 2	0.000%	-0.520%	0.000%	-5.850%	0.000%	-0.050%	0.000%	0.210%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Multifamily residential								
Option 1	0.000%	-0.310%	0.000%	-0.990%	0.000%	-0.050%	0.000%	0.200%
Option 2	0.000%	-0.950%	0.000%	-3.070%	0.000%	-0.160%	0.000%	0.640%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Commercial								
Option 1	0.000%	-0.170%	0.000%	-0.530%	0.000%	-0.020%	0.000%	0.130%
Option 2	0.000%	-0.400%	0.000%	-1.250%	0.000%	-0.050%	0.000%	0.310%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Industrial								
Option 1	0.000%	-0.140%	0.000%	-0.430%	0.000%	-0.020%	0.000%	0.120%
Option 2	0.000%	-0.320%	0.000%	-1.020%	0.000%	-0.050%	0.000%	0.280%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%

a Ranges (minimum and maximum) reflect results across model firms of varying sizes.
Source: EPA estimates (see Chapter Five).

ES.4.2.2 Closures and Employment Losses

To estimate facility closures, EPA generalized its model facility analysis above by constructing a cumulative distribution function for the return on net worth, current, and debt to equity ratios using the quartile values found in D&B. EPA assumed financial distress occurs if the post regulatory value of an individual ratio falls below the lowest quartile benchmark. EPA used a weighted average of financial distress indicators under the three financial ratios as its estimate of the incremental probability of closure due to the proposed rule. Multiplying this probability by the number of establishments represented by the model results in the projected number of closures. Multiplying the projected number of closures by average facility employment results in estimated direct employment impacts.

Under Option 2, the largest number of establishment closures is projected to occur in the commercial sector (43 closures), followed by the single-family residential sector (13 closures). Closures as a percent of total establishments in the sector are largest in the commercial sector where about 0.1 percent of the total are estimated to close. Employment impacts as a percent of each sector's total employment are roughly proportional to closure impacts. Adjusting for CPT, as in Table ES-12, decreases the projected closure impacts significantly.

Table ES-11. Estimated Facility Closures
Zero Cost Pass Through

Option	Single-Family		Multifamily		Commercial	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	4	0.005%	1	0.022%	11	0.028%
2	13	0.015%	3	0.065%	43	0.108%
3	0	0.000%	0	0.000%	0	0.000%
Option	Industrial		Heavy		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	2	0.026%	0	0.000%	18	0.012%
2	7	0.090%	26	0.230%	92	0.063%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates (see Chapter Five).

Table ES-12. Estimated Facility Closures
Estimated Cost Pass Through

Option	Single-Family		Multifamily		Commercial	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	1	0.001%	0	0.000%	1	0.003%
2	2	0.002%	0	0.000%	4	0.010%
3	0	0.000%	0	0.000%	0	0.000%
Option	Industrial		Heavy		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	0	0.000%	0	0.000%	2	0.001%
2	1	0.013%	3	0.027%	10	0.007%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates (see Chapter Five).

ES.4.2.3 Barriers to Entry

The proposed rule should not present a barrier to new establishments entering the construction industry. This proposal does not generate additional costs to start a new construction company, nor does it create a difference in project costs between existing firms and new entrants (such as development fees or input prices). Such cost differentials, if they existed, would represent a barrier to new industry entrants.

The impact of the proposed rule will essentially be felt through increased borrowing requirements to finance construction projects. On the surface this should affect both existing and new firms equally. New entrants may be affected indirectly, however, in that the requirements may marginally increase their start up capital needs, in order to qualify for the somewhat larger short term construction loans required to undertake a project. EPA examined the ratio of compliance costs to current and total assets to determine if new market entrants would need a significant amount of additional capital to obtain construction loans to start a project. Note that existing firms would face the same burden — this does not represent a cost differential between new and existing firms.

EPA's analysis indicates that compliance costs would represent a maximum of 0.82 percent of model establishments' current assets (0.6 percent of total assets) under Option 2. As above, the maximum projected impact occurs in the multifamily sector. For the other sectors, compliance costs represent less than 0.3 percent of current assets. This methodology is conservative because it does not account for the fact that a firm would typically be expected to finance 20 percent of the incremental compliance costs from their own financial resource to obtain the loan — not the full amount as assumed here.[11]

Table ES-13. Barrier to Entry Analysis -- Zero Cost Pass Through

	Compliance Costs Divided by:			
	Current Assets		Total Assets	
Option Comb.	Min	Max	Min	Max
Single-family Residential				
1	0.000%	0.100%	0.000%	0.070%
2	0.000%	0.230%	0.000%	0.170%
3	0.000%	0.000%	0.000%	0.000%
Multifamily Residential				
1	0.000%	0.260%	0.000%	0.190%
2	0.000%	0.820%	0.000%	0.600%
3	0.000%	0.000%	0.000%	0.000%
Commercial				
1	0.000%	0.120%	0.000%	0.090%
2	0.000%	0.270%	0.000%	0.220%
3	0.000%	0.000%	0.000%	0.000%
Industrial				
1	0.000%	0.110%	0.000%	0.080%
2	0.000%	0.250%	0.000%	0.190%
3	0.000%	0.000%	0.000%	0.000%

Source: EPA estimates (see Chapter Five).

[11] The table shows results for the four building construction industries (single-family residential, multifamily residential, commercial, and industrial). EPA conducted a separate analysis for the heavy construction industry, which found similar (i.e., very small) impacts. See Table 5-10.

ES.4.3 Impacts on National Construction Markets and the National Economy

EPA developed a series of regional market models to estimate the impact of compliance costs of the proposed regulation on markets for new construction. In addition, a national partial equilibrium model estimated changes in the national market for new single-family homes. The results of these models were aggregated to estimate the national impacts of the regulation.

Table ES-14 summarizes the annual national costs to builders of each option in terms of the incremental cost ESC management over the cost under the baseline conditions.

Table ES-14. Estimated National Costs of ESC Controls
All dollar values in constant, pre-tax, 1997 dollars

Option	National Costs by Type of Construction ($millions)				Total ($millions)
	Single-family	Multifamily	Commercial	Industrial	
1	$24.1	$11.9	$78.4	$3.7	$118.1
2	$121.5	$59.4	$277.3	$11.0	$469.2
3	$0.0	$0.0	$0.0	$0.0	$0.0
	National Costs per Unit by Type of Construction				
	$/house	$/sq ft	$/sq ft	$/sq ft	
1	$16.91	$0.003	$0.007	$0.008	
2	$90.79	$0.019	$0.031	$0.030	
3	$0.00	$0.000	$0.000	$0.000	

Source: EPA estimates (see Chapter Five).

EPA's literature review (Chapter Four) suggests the long-run supply of housing is considered highly elastic while demand for new housing construction is relatively inelastic. Under these conditions, changes in costs are passed through to home buyers without a large loss in sales. Non-residential consumers are more price sensitive and passed through costs contribute to a larger reduction in construction in many markets. The decrease in number of units sold varied by option combination from:

- 0.0 to 0.02 percent for single-family housing
- 0.0 to 0.01 percent for multifamily housing
- 0.0 to 0.07 percent for commercial construction and
- 0.0 to 0.32 percent for industrial construction

Additional analyses of the single-family housing market assessed the impact of the regulation on the affordability of newly constructed homes. One measure was the number of households that would no longer qualify for a mortgage to buy the model median priced new home. In the most costly option combination, 29,100 households that would have qualified for a mortgage in the baseline would no longer qualify when all of the compliance costs were included in the home price. As a percent of households that qualified in the baseline the percentage no longer qualifying ranged from 0 to 0.15%.

Another measure of affordability is the Housing Opportunity Index (HOI) which measures the proportion of households in a housing market that can afford the median priced home. Across more than 200 metropolitan areas modeled, HOI changed by a maximum of 0.02 percent for Option 1 and 0.11 percent for Option 2.

The model firm analysis showed the number of jobs that may be lost in the construction industry. These losses have effects throughout the economy as laid off workers consume less and fewer projects are undertaken. The market model generated estimates of these indirect employment losses. The reduction in construction activity generates national employment losses in all industries of 6,000 jobs under Option 2. These losses are offset, however, by spending to implement the program which creates new jobs. EPA's analysis indicates that this stimulus effect is larger than the loss of activity and produces a net increase of 7,200 new jobs under Option 2. Compliance costs passed on to consumers reduce the resources consumers have for other goods and services as they spend more on storm water management. This again creates a drag on employment. The net loss in jobs in the national economy is 280 for Option 1 and 1,400 for Option 2.

Finally, the market models also estimate the social cost of the regulation. Given the relatively small shifts in supply and inelastic demand the social cost, or deadweight loss, of the regulation is only $200,000 for the most costly option.

ES.5 SMALL ENTITY IMPACT ANALYSIS

In accordance with the Regulatory Flexibility Act (RFA, 5 U.S.C. et seq., Public Law 96-354) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, EPA has considered the effects that the proposed C&D regulations may have on small entities. The RFA generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a "significant impact on a substantial number of small entities."[12]

For this proposed rulemaking, EPA could not conclude that costs are sufficiently low to justify such "certification." Instead, EPA conducted outreach to small businesses, convened a Small Business Advocacy Review (SBAR) panel, and prepared an Initial Regulatory Flexibility Analysis (IRFA). Chapter Six details the IRFA and presents EPA's assessment of the impacts of the proposed regulations on small businesses in the C&D industry.

ES.5.1 Definition of Affected Small Entities

The RFA defines a "small entity" as a small not-for-profit organization, small governmental jurisdiction, or small business. EPA expects that the principal impact of the proposed C&D regulations on small entities will fall on (1) small businesses that undertake C&D activities and (2) small governmental units involved in permitting C&D activities.

Small businesses are defined (with some exception) according to the size standards established by the Small Business Administration (SBA). SBA establishes criteria for identifying small businesses based on either the number of employees or annual revenues (13 CFR 121).[13] Qualifying revenue levels vary

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[12] The preparation of an IRFA for a proposed rule does not foreclose certifying no significant impact for the final rule (USEPA, 1999).

[13] Employees counted in determining size includes all individuals employed on a full-time, part-time, temporary or other basis. Employment is measured as the average number of employees for each pay period over the previous 12 months. For standards based on revenues, SBA uses the average revenues over the last three completed fiscal years.

by NAICS code and differ among NAICS industries. Within the C&D industry there is a range of qualifying revenue levels, from $5.0 million for NAICS 23311 (Land subdivision and development), to $27.5 million for the majority of industries within NAICS 233 and 234. For businesses in the special trades sector (as defined for this proposed rule), the small business revenue threshold is $11.5 million. See Table ES-6 above for the number of establishments in the C&D industry that fall below these revenue thresholds.

ES.5.2 Small Entity Impacts

EPA has conducted an IRFA for the proposed rule. The IRFA includes a description and estimates of the following:

- Number of small businesses that will be affected;
- The reporting, recordkeeping, and other compliance requirements of the proposed rule;
- Any Federal rules that may duplicate, overlap, or conflict with the proposed rule;
- Any significant regulatory alternatives to the proposed rule that would accomplish the stated objectives of the applicable statutes and which minimize impacts to small businesses.

As presented in Table ES-6, approximately 97,085 businesses are potentially affected by the proposed rule; over 98 percent of these businesses (95,753) may be classified as small businesses. EPA assessed the impacts to small businesses by examining the ratio of estimated compliance costs to firm revenues. Impacts are determined by the number and percentage of firms incurring costs that exceed one percent and three percent of revenues. EPA relied on the model facility approach to assess the impacts of the proposed rule on small businesses. Each model facility actually represents a set of approximately similar firms (e.g., similar levels of employment within some bounded range) with revenues that form a statistical distribution around the model facility's revenue figure. These distributions were used to estimate the number and percentage of small business-owned establishments in each industry sector that incur compliance costs exceeding one and three percent of revenues. The results are presented as ranges that represent the lower and upper bounds of the impacts calculated by EPA.

Additional detail on EPA's methods may be found in Chapter Six, Section 6.4. Table ES-15a presents the results of the one percent revenue test and Table ES-15b presents the results for the three percent test.

Table ES-15a. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 1 Percent of Revenues Zero Percent Cost Pass Through

	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	47	0.000%	0.138%	0	5	0.000%	0.110%	0	62	0.000%	0.159%
2	40	140	0.118%	0.412%	8	18	0.175%	0.395%	18	234	0.046%	0.599%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%
	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	12	0.000%	0.160%	0	0	0.000%	0.000%	0	126	0.000%	0.000%
2	2	36	0.270%	0.480%	36	199	1.863%	0.337%	104	627	0.109%	0.109%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates (see Chapter Six).

Table ES-15b. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 3 Percent of Revenues Zero Percent Cost Pass Through

Option	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	15	0.000%	0.044%	0	2	0.000%	0.044%	0	21	0.000%	0.054%
2	0	45	0.000%	0.133%	0	6	0.000%	0.132%	0	77	0.000%	0.197%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Option	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	4	0.000%	0.053%	0	0	0.000%	0.000%	0	42	0.000%	0.044%
2	0	12	0.000%	0.160%	0	65	0.000%	0.607%	0	205	0.000%	0.214%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates (see Chapter Six).

ES.6 BENEFITS ANALYSIS

The key categories of benefits examined for the proposed rule include decreased stream channel sedimentation and reduced in-stream total suspended solids (TSS) and sediment concentration.

ES.6.1 Benefits Methodology

EPA's Environmental Assessment estimates the impact of the proposed regulation on several measures of environmental quality with implications for social well-being. Sediment in waterways, for example, imposes costs on society through the degradation of water quality, and filling in of water storage impoundments and navigational channels. EPA estimated the monetary benefits of the regulation by connecting these environmental measures to the related costs they would continue to impose on society in the absence of the proposed regulations. Such avoided cost benefit valuation methods yield lower bound estimates of value. Since the methodology for assessing and quantifying each benefit category differs the sections below present only a summary of the benefits methodology. More complete details can be found in Chapter Seven.

ES.6.2 Environmental Assessment and Benefits Analysis

ES.6.2.1 Overview of Environmental Assessment and Benefits Analysis

The environmental effects of the options were measured in terms of reductions in discharge of sediment. Option 1 is expected to result in discharge of 2.6 to 7.9 million fewer tons of total solids annually. Option 2 is expected to result in discharge of 11.1 million fewer tons annually. These reductions contribute to savings in dredging costs for water storage impoundments and navigational channels. Table ES-16 summarizes the results of the environmental assessment. More complete results are shown in Table 8-2. These estimates are the starting point for benefit valuation.

Table ES-16. Environmental Measures (thousand tons per year)

	Option 1		
Decrease from baseline in:	**Low**	**High**	**Option 2**
Settleable solids	2,110	6,330	8,901
Turbidity producing solids	527	1,583	2,225
Total solids	**2,638**	**7,913**	**11,127**

Source: EPA estimates (See Chapter Eight).

ES.6.2.2 Avoided Water Treatment Costs

Turbid water requires pretreatment before it can be used in industrial or municipal water systems. By removing turbidity-producing solids from streams, the proposed regulation reduces the need for pretreatment, saving water users money. The total benefit shown in Table ES-17 is quite small, as storm water runoff is only one source of turbidity so its removal does not obviate the need for pretreatment entirely. The marginal costs of pretreatment are also quite low.

ES.6.2.3 Avoided Loss of Water Storage Capacity

Reservoirs and impoundments serve many purposes but generally cannot function if they fill with silt. This estimate of value for this benefit category is based on the costs of dredging sediment that settles in reservoirs. Only a small portion of sediment reaches water bodies that would be dredged if filled, so benefits for this category are relatively small.

ES.6.2.4 Avoided Navigational Dredging

Like water storage capacity, navigational channels must be dredged when they fill with sediment. Keeping sediment out of streams reduces the need for dredging. Only a small share of streams flow to commercial waterways and harbors so this benefit is also relatively small.

Table ES-17. Point Estimates of Benefits by Category ($1997 million per year)

	Benefit Category			
Option	**Water Treatment**	**Water Storage**	**Navig. Dredging**	**Total**
1	$0.1	$7.1	$2.6	$9.7
2	$0.2	$15.0	$5.4	$20.6
3	—	—	—	$0.0

Source: EPA estimates (see Chapter Eight).

ES.6.2.5 Non-quantified Benefits

Several categories of benefits discussed in other studies were considered for this benefit assessment. For the most part, the benefits expected to be derived from these categories are relatively small and difficult to quantify. Therefore, EPA discusses the following categories qualitatively, rather than attempting to quantify them:

- Water contact recreation
- Biodiversity effects
- Wetland preservation
- Other sources of benefits (decrease in clogged roadside and irrigation ditches)

Chapter Seven provides more detailed explanation and discussion of these qualitative benefits categories.

ES.7 SOCIAL COSTS AND BENEFITS

The social costs of the proposed regulation represent the real commitment of resources by society to administering, implementing, and enforcing the rule. Direct social costs include the compliance costs of construction firms, administration costs of governments, and operation and maintenance costs of home owners, municipalities, industrial and commercial property owners. This regulation is not expected to have substantial indirect social costs because it does not propose any radical changes in the production process or technology. The anatomy of the market for new construction also limits the loss of social welfare.

Table ES-18 compares the sum of these social costs with the benefits estimated in Chapter Eight and discussed above. The social costs are greater than the monetized benefits.

Table ES-18. Social Costs and Benefits of Options (1997 $Million per year)

Option	Installation, Design and Permitting	Operation and Maintenance	Government Costs	Deadweight Loss	Total Social Costs	Total Benefits
1	$118.1	$0.0	$0.0	$0.0	$118.2	$9.7
2	$421.2	$48.0	$0.3	$0.2	$469.6	$20.6
3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

Source: EPA estimates (see Chapter Nine).

ES.8 ANALYSIS OF OTHER IMPACTS

ES.8.1 Unfunded Mandates

EPA has determined that the proposed C&D regulations may contain a federal mandate that may result in expenditures of $100 million or more for the private sector in any one year. Accordingly, EPA has prepared a written statement in accordance with section 202 of the UMRA. In addition, EPA has determined that the proposed C&D regulations do not include a federal mandate that may result in estimated costs of $100 million or more to either state, local, or tribal governments in the aggregate. Nor do the proposed regulations contain regulatory requirements that might significantly or uniquely affect small governments. Therefore, this proposal is not subject to the requirement of section 203 of the UMRA.

ES.8.2 Environmental Justice

EPA has determined that the proposed C&D regulations will not disproportionately affect minority or low-income populations, nor will they have disproportionately high health or environmental effects.

ES.8.3 Children's Health

EPA has determined that the proposed C&D regulations do not have any significant implications in regard to children's health or safety.

ES.9 REFERENCES

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CHAPTER ONE

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is proposing some options to address storm water discharges from construction sites. As one option, EPA is proposing technology-based effluent limitation guidelines and standards (ELGs) for storm water discharges from construction sites required to obtain National Pollutant Discharge Elimination System (NPDES) permits. As another option, EPA is proposing not to establish ELGs for storm water discharges from those sites, but to allow technology-based permit requirements to continue to be established based upon the best professional judgment of the permit authority A third option would establish inspection and certification requirements that would be incorporated into the discharge permits issued by EPA and States, with other permit requirements based on the best professional judgement of the permit authority. The regulatory proposals, if implemented, are expected to significantly reduce the amount of sediment discharged from construction sites. The deposition of sediment originating from construction sites has contributed to the loss of capacity in small streams, lakes, and reservoirs, leading to the necessity for mitigation efforts such as dredging or replacement.

This Economic Analysis (EA) summarizes EPA's analysis of the incremental compliance costs and the economic impacts that may be incurred by regulated entities within the C&D industry. The EA details EPA's proposed regulation and the alternative regulatory options considered by EPA. The report covers financial impacts to establishments in the C&D industry, potential impacts on consumers of C&D industry output, and market and other secondary impacts on the national economy, such as employment and output. The EA also undertakes small business analyses under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), cost-benefit analyses under Executive Order 12866 and the Unfunded Mandates Reform Act (UMRA). EPA also addresses the issues of environmental justice and children's health.

This chapter begins with a discussion of the current regulatory environment in the C&D industry. Section 1.2 presents EPA's reasons for proposing this rule while Section 1.3 identifies the potentially affected sectors of the C&D industry. Section 1.4 provides an overview of key data sources used in the development of this EA, and Section 1.5 provides an outline for the remainder of this report.

1.1 EXISTING REGULATORY FRAMEWORK

The Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), was passed by Congress in 1972 to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" (33 U.S.C. § 1251 (a)), sometimes referred to as "fishable, swimmable" criteria. The CWA establishes a comprehensive program for protecting our nation's waters. Among its core provisions, the CWA prohibits the discharge of pollutants from a point source to waters of the U.S., except those authorized by a NPDES permit. Under Title III, the CWA also provides for the development of technology-based effluent limitations that are imposed through the NPDES permit framework to control direct discharges of pollutants.

The CWA was amended in 1987 to require implementation of a comprehensive national program for addressing municipal and industrial storm water discharges (Water Quality Act of 1987, Pub. L. 100-4, February 4, 1987). CWA Section 402(p) requires that industrial, municipal and other storm water dischargers designated by EPA obtain NPDES permits. In response to these amendments EPA has promulgated two rules that contain provisions affecting the C&D industry. These regulations, commonly referred to as the Phase I and Phase II storm water rules, require NPDES permits for construction activities disturbing more than one acre and discharging storm water. Phase I was promulgated on November 16, 1990 (55 FR 47990), with permit requirements taking effect in 1992. Phase II was promulgated on December 22, 1999 (64 FR 68722).

1.1.1 NPDES Permit Regulation of the C&D Industry

The C&D industry is currently regulated under NPDES permit requirements for construction activities disturbing more than one acre. Construction activities disturbing five acres or more are covered under the Phase I requirements while construction activities disturbing between one acre and five acres are covered under the Phase II requirements. (Applications for permits for storm water discharges associated with small construction activity under the Phase II rule, however, are not due until March 10, 2003.) The NPDES regulations affecting the construction and development industry are implemented through EPA's Construction General Permit (CGP) in states without their own authorized NPDES program.

The CGP requires permittees to prepare a storm water pollution prevention plan (SWPPP) for C&D activities. The permit lists options and goals for other erosion and sediment controls (ESCs), and the SWPP must contain a description of any ESCs used, but there are no *required* elements.[1] Options and goals for post-construction best management practices (BMPs) are also contained in the CGP, but none are specifically required. As with ESCs, those BMPs selected for use must be described in the SWPPP.

The Phase II regulations also provide waivers for construction activities disturbing between one and five acres of land in instances where:

- Activity occurs during a negligible rainfall period (rainfall erosivity factor of less than five), or
- A Total Maximum Daily Load (TMDL) or equivalent analysis addresses the pollutants of concern leading to a determination that storm water controls are not necessary for construction activity. (64 FR 68735).

These waivers acknowledge that variance in regional factors such as climate, annual rainfall patterns, and existing hydrology affect the incidence and magnitude of storm water runoff.

The CGP is the vehicle through which the NPDES storm water regulations are implemented for construction activities. There is a national CGP issued by EPA which applies in those areas where EPA Regions 1, 2, 3, 5, 7, 8, 9 and 10 are the NPDES permitting authorities. In addition, EPA Regions 4 and 6 have their own version of the CGP which applies only in those areas where the respective Region is the

[1] For sites with 10 acres or more of disturbed area, the CGP does require installation of temporary sediment basins.

NPDES permitting authority. Other NPDES programs also require permits, and as with most of these other programs, the NPDES storm water permits may be issued through one of EPA's ten regions (as described above) or through an authorized state/territory NPDES permitting authority. At this time 44 states have NPDES permitting authority.[2] EPA itself issues storm water permits in nondelegated states, on tribal lands, and in most territories.

EPA's CGP currently covers large (5 acres or larger) construction activities; NPDES permitting authorities are expected to develop and issue storm water permits for small (between 1 and 5 acres) construction activities by December 8, 2002. EPA expects that the national CGP and the general permits currently in use by NPDES permitting authorities will be used as templates for the small construction permits. EPA's CGP is valid for a five year period, after which time the permit will be reviewed and renewed for another 5-year period. The CGP was originally issued in 1992 and revised in 1998 and thus is due for renewal in 2003. EPA plans to incorporate the small construction activity permitting requirements into its national CGP at the time of the permit's renewal.

1.2 PURPOSE OF THE PROPOSED RULE

The existing NPDES storm water regulations require construction site operators to manage construction site runoff, but do not require any specific level of control. One of the proposed regulatory options (Option 2) would establish effluent limitation guidelines in the form of minimum standards for design and implementation of erosion and sediment controls used during the active phase of construction.

Existing compliance determination practices for construction site storm water controls rely principally on site inspections by local governments, however enforcement efforts are reported to be uneven nationwide, largely due to limited enforcement resources a the Federal, State and local levels. Option 2 would also establish minimum requirements for conducting site inspections and providing

[2] All states with the exception of Alaska, Arizona, District of Columbia, Idaho, Massachusetts, New Hampshire and New Mexico have some level of NPDES permitting authority. Even in those states with NPDES permitting authority, EPA may be responsible for issuing permits for activities conducted at federal facilities and/or on tribal lands.

certification as to the design and completion of various aspects of those controls. These requirements could strengthen the current permit program. Another regulatory option (Option 1) would establish the same site inspection and certification requirements, but without the ESC standards.

1.3 INDUSTRIES AFFECTED BY THE PROPOSED C&D EFFLUENT GUIDELINES

This report focuses on the major C&D industries potentially affected by the proposed ELG requirements. Table 1-1 identifies these industries according to both their North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) codes.[3] A detailed description of these C&D industries may be found in Chapter Two of this report.

[3] The NAICS system recently replaced the SIC system.

Table 1-1. Industries Potentially Affected by Proposed Rulemaking

Regulated Entities	North American Industry Classification System Code (NAICS)	Standard Industrial Classification Codes (SIC)[a]
Land subdivision and development	23311	6552
Single-family housing construction	23321	1521, 1531, 8741
Multifamily housing construction	23322	1522, 1531, 8741
Manufacturing and industrial building construction	23331	1531, 1541, 8741
Commercial and institutional building construction	23332	1522, 1531, 1541, 1542, 8741
Highway and street construction	23411	1611, 8741
Bridge and tunnel construction	23412	1622, 8741
Water, sewer, and pipeline construction	23491	1623, 8741
Power and communication transmission line construction	23492	1623, 8741
Industrial nonbuilding structure construction	23493	1629, 8741
All other heavy construction	23499	1629, 7353, 8741
Excavation contractors	23593	1794
Wrecking and demolition contractors	23594	1795

Source: U.S. Census Bureau 1997 Census of Construction
[a] Some parts of the Standard Industrial Classification Codes are included in other North American Industry Classification Codes.

1.4 OVERVIEW OF KEY DATA SOURCES

A common data source used to support the development of many past ELGs is the CWA Section 308 industry survey. For this proposed rule, however, EPA determined that such a survey should not be undertaken. This determination necessitated the use of existing data sources, including academic literature, industry trade associations, and government data such as that provided by the U.S. Census Bureau. Major data sources are discussed in more detail where they are used to support sections of this analysis. This section provides an overview of several key sources and their importance to the economic analysis of the proposed C&D ELG.

Of primary importance in the development of this EA were the 1992 and 1997 Censuses of Construction, conducted by the U.S. Census Bureau. The Census provided information on the industry sectors potentially affected by the proposed rule, as well as characteristics of each sector such as employment and revenue levels. Also used were several other reports from the Census Bureau, including:[4]

- Report C20 – Housing Starts
- Report C25 – Characteristics of New Housing,
- Report C30 – Value Put in Place,
- Report C40 – Building Permits

All of these reports contributed to the various economic models developed for this EA.

The U.S. Department of Agriculture's (USDA's) Natural Resources Inventory (NRI) was used to determine the amount of disturbed acreage caused by urbanization and new development. This information was important to the environmental assessment, the benefits assessment, and as a way to determine the rate of new development.

EPA also used data collected from permits issued by existing NPDES permitting authorities. Currently, regulation of C&D activity is triggered when a builder/developer files a notice of intent (NOI) with the permitting authority. Permitting authorities record these NOIs in order to track development within their jurisdiction. EPA obtained copies of NOI databases for NPDES-approved states and for those non-authorized states where EPA acts as the NPDES permitting authority.[5] The databases contained a wide variety of information, such as total site size, disturbed acreage, project type (e.g., residential, nonresidential), and project ownership status (public or private). EPA planned to use this information to estimate the number of storm water starts. The databases, however, lacked the level of detail EPA needed to use the data to its full advantage. In addition, inconsistencies in the type of data

[4] These reports are available at the following web address: http://www.census.gov/const/www/.

[5] NPDES permits are fully administered by EPA in six States plus Washington, DC. In other States EPA acts as the permitting authority for activities on Indian and/or Federal lands only.

collected and coverage made it difficult to compare the databases with one another. Although EPA could not use these databases in the manner hoped, they were useful for generating rough estimates of the number of permits issued nationwide, as a check on the permit estimates reported by the Census Bureau. EPA did not conduct further analysis on these databases prior to the proposal of this rule.

An additional source of information for the development of the economic analysis (described in Section 4.2) was a series of focus groups held with representatives of the National Association of Home Builders (NAHB). These focus groups helped EPA understand the process of construction project development and provided estimates of data elements most helpful in building economic models. These estimates were particularly useful when national-level data from other sources (such as the Census Bureau) were not available.

Some of the data and methodologies used in the Phase II EA were also used in this rulemaking effort. These sources and methods were described in detail in Chapters Four, Five, and Six.

1.5 REPORT ORGANIZATION

This EA report is organized as follows:

- **Chapter 2** contains the Industry Profile, which provides background information on the establishments and industry sectors potentially affected by the proposed rule.
- **Chapter 3** summarizes the Proposed Effluent Guidelines Regulations and discusses the regulatory options considered by EPA.
- **Chapter 4**, Economic Impact Analysis Methodology, explores the data, methodology, and analyses used in the determination of project, establishment, and market level impacts due to incremental storm water control costs incurred under the proposed regulation.
- **Chapter 5** presents the impacts of the proposed rule for the model project, model establishment, and national market. This chapter also includes a discussion of other potential impacts of the proposed rule according to Executive Order 12866 including regional and social impacts.

- **Chapter 6** contains information on the Initial Regulatory Flexibility Analysis (IRFA) and the small business analysis under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA).

- **Chapter 7** presents the Benefits Methodology by which EPA identifies, qualifies, quantifies, and where possible monetizes the benefits associated with reduced storm water runoff.

- **Chapter 8** presents the Environmental Assessment and Benefits Analysis, which assesses the nationwide benefits of the proposed regulation following the methodology outlined in the previous chapter.

- **Chapter 9** looks at the Costs and Benefits of the Proposed C&D ELG using the benefits assessment described in Chapter 8. Here, EPA presents an assessment of the nationwide costs and benefits of the proposed regulation pursuant to Executive Order 12866 and the Unfunded Mandates Reform Act (UMRA).

- **Chapter 10** presents a discussion of UMRA.

CHAPTER TWO
PROFILE OF THE CONSTRUCTION AND DEVELOPMENT INDUSTRIES

2.1 INTRODUCTION

The construction and development (C&D) industry plays an integral role in the nation's economy, contributing approximately five percent of the Gross Domestic Product. Establishments in this industry are involved in a wide variety of activities, from land development and subdivision to homebuilding, construction of nonresidential buildings and other structures, heavy construction work (including roadways and bridges), and a myriad of special trades such as plumbing, roofing, electrical, excavation, and demolition work. C&D activity affecting water quality typically involves site selection and planning, and land-disturbing tasks during construction such as clearing, excavating and grading. Disturbed soil, if not managed properly, can be easily washed off-site during storm events. Storm water discharges generated during construction activities can cause an array of physical, chemical and biological impacts. EPA's proposed effluent guidelines for the C&D industry seek to reduce the environmental and economic effects of storm water runoff from construction sites.

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

- Individuals (e.g., homebuyers) are often the direct customers of the C&D industry. With individuals as the direct consumer it is necessary to address issues such as cost passthrough and the impacts of regulations on housing affordability.

- There are complex and varying relationships between developers and builders, resulting in a variety of different business models. Developers may undertake all site improvements and sell completed lots directly to builders, act as builders themselves and remain onsite to build out the development, or some combination of the two.

- The C&D industry is dominated by small businesses. As a result, EPA will carefully consider the impacts on small businesses in accordance with the Regulatory Flexibility Act, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA).

- C&D activities are highly localized. This suggests that a regional approach to analysis is appropriate to account for varying market conditions.

- The standard industry definitions include a large number of establishments primarily engaged in remodeling activities, who are less likely to be involved in land disturbing activities.

The C&D industry as defined for this proposed rule is comprised of four main industry groups that will further affect the structure of this analysis:

- Land development and subdivision
- Residential construction
- Nonresidential construction
- Heavy construction

These four industry groups encompass those parts of the industry most likely to engage in land disturbing activities. Land disturbing activities are further described in the Development Document (EPA, 2002a) and the impacts of these activities are described in the Environmental Assessment (EPA, 2002b).

2.1.1 Recent Trends in the C&D Industry

Between 1992 and 1997, the number of establishments with payroll in the C&D industries overall increased from 235,789 to 261,617, an increase of 11.0 percent (see Table 2-1). This overall modest increase masks some significant offsetting changes in establishment counts within individual industries, as defined under the North American Industrial Classification System (NAICS), i.e.:

- The number of establishments in the land development industry group (NAICS 2331) *decreased* by 46.6 percent;[1]

[1] The decrease in the number of developers may have been a response to changes in tax laws and the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989 (Pub.L. 101-73, August 9, 1989) and the 1993 implementing regulations. The objective of FIRREA and the implementing regulations was to correct events and policies that led to a high rate of bankruptcies in the thrift industry in the late 1980s. The regulations changed lending practices by financial institutions, requiring a higher equity position for most projects, with lower loan-to-value ratios, and more documentation from developers and builders. (Kone, 2000).

- There was a 13.5 percent *increase* in the number of establishments in residential and nonresidential construction (NAICS 233, except 2331);
- The number of establishments in heavy construction *increased* by 14.5 percent;
- There was a 33.0 percent *increase* in the number of special trades contractor establishments, (NAICS 235), including a 31.2 percent increase among excavation contractors and a 59.6 percent increase among demolition contractors.

Table 2-1
Number of Establishments in Construction and Development Industries, 1997 vs 1992

NAICS	Industry	1992	1997	Pct. Change
233, exc. 2331	Building, developing, and general contracting, except land development and subdevelopment	168,407	191,101	13.5%
2331	Land development and subdevelopment	15,338	8,185	-46.6%
234	Heavy construction	37,180	42,557	14.5%
235[a]	Special trade contracting	14,864	19,771	33.0%
Subtotal		**235,789**	**261,617**	**11.0%**

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors).
Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000a).

2.1.2 Data Sources Used

Several data sources are used in this profile chapter to characterize the C&D industry. The primary data source is the 1997 Census of Construction (herein referred to as Census), conducted every five years by the U.S. Census Bureau. A second data source comes from the U.S. Small Business Administration (SBA). The SBA data is used because it provides firm-level data that is necessary for economic modeling purposes and for the small entity analysis (the Census data is reported at the level of the construction establishment, not the firm). Table 2-2 compares the Census data with that from SBA in order to further clarify the differences and identify how each are used in this Economic Analysis. The majority of this chapter uses data from the 1997 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

Characteristic	Data Source	
	Census of Construction	**SBA**
Level of Detail	Establishment[a]	Firm[b] (company) and establishment
Source of Data	Survey (sent to approx. 130,000 establishments from a universe of 650,000)	County Business Patterns SUSB report, which ultimately 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-level analysis, for purposes of 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, 2000a).
[b] A firm is considered to be an aggregation of the establishments owned by a single company; therefore, one firm may be comprised of several establishments.

2.1.3 Organization of this Chapter

The purpose of this industry profile is to provide an overview of the C&D industries, describe their key characteristics and structure, and analyze current and historical trends. Section 2.2 describes the process that EPA used to identify and define the industry for the purposes of the proposed rule. Section 2.3 presents characteristics of the C&D industry, including both industry and firm-level data. Section 2.4 discusses supply and demand factors in the C&D industry while Section 2.5 describes various economic and financial characteristics of the industry. Section 2.6 looks at key business indicators and ratios. Section 2.7 covers industry growth and trends, and Section 2.8 takes a brief look at international competition in the C&D industry.

2.2 INDUSTRY DEFINITION

2.2.1 Basis for Regulation

The proposed rule will cover establishments within the construction sector (NAICS 23) that disturb the land at construction sites of one acre or more.[2] These land-disturbing activities may include site preparation and site clearing tasks such as tree removal, excavation, blasting, scraping, and grading, and are generally accomplished with the aid of heavy equipment such as skidders, bulldozers, backhoes, excavators, and graders. These activities may destabilize soils and create conditions that allow storm water to accumulate and flow across the site. This increase in storm water flow can cause erosion and lead to the transport of soil particles and attached pollutants, which eventually may be conveyed offsite and discharged into receiving waters. Both the 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.

The proposed effluent guidelines will build upon the Phase I and Phase II storm water regulations promulgated under the National Pollutant Discharge Elimination System (NPDES), as well as upon EPA's storm water construction general permit (CGP). The CGP is the vehicle through which Phase I regulations are being implemented, and upon revision in 2003 it will also reflect the Phase II regulations. The CGP also will be the vehicle through which the proposed rule is implemented. The proposed rule will also build upon current state and local storm water control requirements by adding increased specificity and consistency to these requirements. See Chapter Three for more information on the proposed rule. The methodology chapter provides further detail on the planned implementation of the proposed rule.

[2] The Bureau of the Census classifies industries according to the North American Industrial Classification System, or NAICS. Under the NAICS, economic activity is first divided into twenty broad 2-digit industry codes. One of these is Construction (NAICS 23). Each 2-digit industry is further subdivided into 3-, 4-, and 5-digit level industries.

2.2.2 Industry Definition

For the purposes of this economic analysis, the "C&D industries" are assumed to include those establishments within the construction sector (NAICS 23) that may be involved in activities that disturb the ground at construction sites. This includes site clearing or site preparation activities such as tree removal, excavation, blasting, scraping, grading, etc. EPA believes that many establishments in NAICS 233 (Building, developing, and general contracting) and NAICS 234 (Heavy construction) are likely to engage in such activities on a regular basis. Establishments within selected 5-digit industries that are part of NAICS 235 (Special trade contractors) may also engage in land-disturbing activities. The latter may include NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors). However, as discussed in Section VI.A in the preamble of the proposed rule, Special trade contractors are typically subcontractors and not identified as NPDES permittees. Table 2-3 identifies the industries that may be covered by the proposed regulations.

Table 2-3
Industry Definitions for Construction and Development Industry Profile

NAICS Code	Industry	Relevant SIC Codes[a]
233	**Building, developing, and general contracting**	
2331	Land subdivision and development	
23311	Land subdivision and development	6552 Land subdividers and developers, except cemeteries
2332	Residential building construction	
23321	Single-family housing construction	1521 General contractors–single-family houses 1531 Operative builders (partial) 8741 Management services (partial)
23322	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	
23331	Manufacturing and industrial building construction	1531 Operative builders (partial) 1541 General contractors–industrial buildings and warehouses (partial) 8741 Management services (partial)
23332	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	
23411	Highway and street construction	1611 Highway and street construction contractors, except elevated highways 8741 Management services (partial)
23412	Bridge and tunnel construction	1622 Bridge, tunnel, and elevated highway construction
2349	Other heavy construction	
23491	Water, sewer, and pipeline construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
23492	Power and communication transmission line construction	1623 Water, sewer, pipeline, and communications and power line construction (partial) 8741 Management services (partial)
23493	Industrial nonbuilding structure construction	1629 Heavy construction, n.e.c. (partial) 8741 Management services (partial)
23499	All other heavy construction	1629 Heavy construction, n.e.c. (partial) 7353 Heavy construction equipment rental and leasing (partial) 8741 Management services (partial)
235	**Special trade contractors**	
23593	Excavation contractors	1794 Excavation work special trade contractors
23594	Wrecking and demolition contractors	1795 Wrecking and demolition work special trade contractors

[a] NAICS recently replaced the SIC (Standard Industrial Classification) System.
Source: U.S. Census Bureau (2000a).

As seen in Table 2-3, each NAICS industry is comprised of one or more industries defined under the former Standard Industrial Classification (SIC) system. With the 1997 Census, the Census Bureau switched from reporting data on an SIC basis to an NAICS basis, thereby making it difficult to compare data from 1997 with that from the 1992 and earlier Census reporting periods. Within this economic profile the objective is to provide data at the most detailed level as possible, while still maintaining the ability to provide meaningful comparisons between 1997 and earlier Census periods. With this in mind, most of the statistical tables contained in this profile reflect the following industry breakdown:[3]

NAICS 233, except 2331	Building, developing, and general contracting, except land subdivision and land development
NAICS 2331	Land subdivision and land development
NAICS 234	Heavy construction
NAICS 235	Special trades contractors[a]

[a] Covered industries to include NAICS 23593 (Excavation contractors) and NAICS 23594 (Wrecking and demolition contractors) only, when possible.

2.3 INDUSTRY CHARACTERISTICS

Several steps are used to define the number of C&D establishments that may be affected by the proposed regulations. First, EPA identifies all C&D establishments as defined above using data from the 1997 Census of Construction. Second, EPA estimates the number of establishments classified as C&D establishments that are primarily engaged in remodeling work, using data from the National Association of Home Builders (NAHB) and the Joint Center for Housing Studies at Harvard University (Joint Center). Third, EPA estimates the number of establishments classified as C&D establishments that are engaged in C&D activities but are unlikely to disturb more than one acre of land, using data from Census and various secondary sources. Section 2.3.1 looks at the industry-wide characteristics of C&D establishments, including number and size of establishments, employment, and geographic distribution of

[3] Some detailed breakdowns may be available only at the 3-digit NAICS level, in which case separate data for NAICS 2331 cannot be provided and will be included with data for all of NAICS 233. NAICS 233, except 2331, includes data for both residential and nonresidential construction activities. Where more detailed data are available they are included in this profile. In some cases data at a more detailed NAICS level is available (e.g., 5-digit NAICS) but was considered too detailed to present in the body of this profile. The availability of such data is noted throughout the profile, and reference is made to Appendix 2A where such tables are presented.

establishments. Section 2.3.2 describes firm-level data for the C&D industry. Section 2.3.3 describes the number of small entities, and section 2.3.4 looks at the number of entities in the C&D industry that disturb less than one acre during the normal course of business. The estimated number of potentially affected establishments is presented in Section 2.3.5.

2.3.1 Establishment-Level Data

This section presents data for all establishments within the C&D industry as defined in Section 2.2, based primarily on 1997 Census of Construction sources. Included is information on the number and size of establishments, geographic distribution, employment, payroll and benefits, and level of specialization.

2.3.1.1 Number and Size of Establishments

Data from the Census of Construction indicate there were a total of 261,617 establishments with payrolls in the C&D industries in 1997 (i.e., NAICS 233, 234, 23593, and 23594; see Table 2-4). Of these, the largest number of establishments are in NAICS 233 (Building, developing, and general contracting). This subsector includes 199,289 establishments, representing 76.2 percent of all C&D establishments. Within NAICS 233, single-family home construction (NAICS 23321) accounted for the majority of establishments (138,849 out of 199,289 or 69.7 percent).

Land development and subdevelopment (NAICS 2331) accounted for 8,185 establishments or 3.1 percent of all establishments in the C&D industries. NAICS 234 (Heavy construction) includes 42,557 establishments or 16.3 percent of the total. Of these, 27 percent are primarily highway and street construction contractors, another 27 percent are contractors that work on water, sewer, pipeline, communications and power line projects, and 43 percent are engaged in other types of heavy construction (All other heavy construction). Within the special trades contractors subsector (NAICS 235), NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) together account for

19,771 establishments, or 7.6 percent of the C&D industries total. Excavation contractors account for over 90 percent of these establishments.

Table 2-4
Number of Establishments in the Construction and Development Industry, Based on the 1997 Census of Construction

NAICS	Industry	Establishments With Payrolls	
		Number	Percent of Total
233	Building, developing, and general contracting	199,289	76.2%
2331	Land development and subdivision	8,185	3.1%
23321	Single-family residential building construction	138,849	53.1%
23322	Multi-family residential building construction	7,543	2.9%
2333	Nonresidential construction	44,710	17.1%
234	Heavy construction	42,557	16.3%
235[a]	Special trade contracting	19,771	7.6%
SUBTOTAL		**261,617**	**100.0%**

[a]Covered industries include NAICS 23593 (excavation contractors) and NAICS 23594 (wrecking and demolition contractors) only.

Across the board, the C&D industries are dominated by small establishments.[4] As shown in Table 2-5, Census reports that some 60.6 percent of establishments with payrolls have fewer than 5 employees, 77.8 percent have fewer than 10 employees, and 87.1 percent have fewer than 20 employees.[5] Overall, only 1.1 percent of C&D establishments with payrolls have 100 or more employees. On average, establishments in NAICS 234 (Heavy construction) are somewhat larger than those in the other NAICS, with a lower percentage of establishments appearing in each of the smaller establishment size classes.

[4] Establishments are officially defined as “small” by the SBA according to size standards based on either number of employees or annual revenue (13 CFR 121). Qualifying revenue levels differ among NAICS industries, and within the C&D industries there is a range of qualifying revenue levels, from $5.0 million for NAICS 23311 (Land subdivision and development) to $27.5 million for the majority of industries within NAICS 233 and 234. A more detailed review of industry size distribution based on the SBA definitions will be presented as part of the Small Entity Impact Analysis.

[5] And, as noted above, some 450,338 establishments in the C&D industries have *no* employees.

The preponderance of small establishments is equally apparent when analyzed on the basis of revenue size class. Overall in 1997, 37.1 percent of establishments with payrolls had annual revenues below $250,000; 54.7 percent had annual revenues below $500,000; and 69.6 percent had annual revenues below $1.0 million. These data are shown in Table 2-6. Only 9,118 establishments, representing 3.5 percent of the total, had annual revenues in excess of $10.0 million. Section 2.3.1.7 contains more information on small entities in the C&D industry and the small business analysis is presented in Chapter Six of this EA.

In addition to the small establishments with payrolls, a large number of establishments—some 450,338 in 1997[6]—operate with no paid employees and are not included in the totals in Tables 2-4 through 2-6. Available data suggests these establishments are very small relative to establishments with payrolls. While employer establishments in NAICS 233 and 234 had $517.7 billion in receipts for 1997, nonemployer establishments had only $36.5 billion in receipts, which represents only 7 percent of the receipts of employer establishments.

[6] Includes establishments in NAICS 233 and 234 only. Data on nonemployer establishments was not available at the 5-digit NAICS level for NAICS 235, thus information for NAICS 23593 and 23594 could not be separated from the rest of NAICS 2359 (Other special trade contractors). Including all nonemployer establishments in NAICS 2359 (339,521), the total number of such establishments in the C&D industries is 789,859.

Table 2-5
Number of Small Establishments with Payrolls in the Construction and Development Industry, Based on Employment

NAICS	Industry	Total	Establishments with less than 5 employees		Establishments with less than 10 employees		Establishments with less than 20 employees	
			No.	Percent of Total	No.	Percent of Total	No.	Percent of Total
233[a]	Building, developing, and general contracting	199,289	138,926	69.7%	172,079	86.3%	187,672	94.2%
234	Heavy construction	42,557	18,956	44.5%	26,802	63.0%	33,337	78.3%
235[b]	Special trade contractors	19,771	700[c]	3.5%	4,690	23.7%	6,833	34.6%
TOTAL		**261,617**	**158,582**	**60.6%**	**203,571**	**77.8%**	**227,842**	**87.1%**

[a] Data below the 3-digit NAICS (i.e., for NAICS 2331 Land development and subdevelopment) not publishable.
[b] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
[c] Data for NAICS 23593 (Excavation contractors) not included in this calculation because data did not meet publication standards.
Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000a).

Table 2-6
Number of Small Establishments in the Construction and Development Industry, Based on Value of Business Done

NAICS	Industry	Total	Establishments with less than $250,000 in business		Establishments with less than $500,000 in business		Establishments with less than $1 million in business	
			No.	Percent of Total	No.	Percent of Total	No.	Percent of Total
233[a]	Building, developing, and general contracting	199,289	83,536	41.9%	118,493	59.5%	147,917	74.2%
234	Heavy construction	42,557	13,364	31.4%	20,238	47.6%	26,726	62.8%
235[b,c]	Special trade contractors	19,771	269	1.4%	4,344	22.0%	7,385	37.4%
TOTAL		**261,617**	**97,169**	**37.1%**	**143,075**	**54.7%**	**182,028**	**69.6%**

[a] Data below the 3-digit NAICS (i.e., for NAICS 2331 Land development and subdevelopment) not publishable.
[b] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
[c] Figures may be low due to lack of sufficient data for NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) for values under $250,000.
Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000a).

The overall average level of receipts among nonemployer establishments is $81,000 versus $1.98 million for establishments with payrolls. A recent study by the Joint Center for Housing Studies of

Harvard University indicates that a substantial number of the nonemployer establishments—at least 141,000 of those classified as general building contractors (NAICS 233)—are actually remodelers (Joint Center 2001).[7] The Joint Center estimates do not account for nonemployer establishments outside NAICS 233 (i.e., NAICS 234 (Heavy construction) or 235 (Special trades). As discussed further in Section 2.3.2, EPA has reviewed available data on such *nonemployer* establishments and concluded that most are unlikely to be affected by the proposed rules.

2.3.1.2 Legal Form of Organization

The Census Bureau defines construction establishments according to how they are organized legally, using the following classification scheme: (a) corporations, (b) proprietorships, (c) partnerships, and (d) other. In 1997, a total of 173,602 C&D establishments with payrolls (66.4 percent of the total) were organized as corporations (see Table 2-7). A further 64,733 (24.7 percent) were organized as proprietorships while 14,313 (5.5 percent) operated as partnerships and 8,969 (3.5 percent) operated under some other legal form of organization. Organization as a corporation is most prevalent in NAICS 2331 (Land subdivision and development), at 76.6 percent, and least prevalent in NAICS 235 (Special trade contractors), at 61.6 percent. See Appendix 2A for more detailed industry-level data.

[7] The estimate of 141,000 establishments is probably an underestimate. The Joint Center applied the percentage of establishments with payrolls known to be remodelers to the nonemployer establishments. In practice, remodelers probably account for a larger percentage of nonemployer establishments than employer establishments. As the report states, "(o)ur procedures thus generate a conservative estimate of the number of businesses concentrating their activities in residential remodeling" (Joint Center, 2001, p. 35).

Table 2-7
Number of Establishments in the Construction and Development 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**
233	Building, developing, and general contracting, except land subdivision and development (2331)	124,475	65.1%	50,235	26.3%	9,827	5.1%	6,567	3.4%	191,104	100.0%
2331	Land subdivision and development	6,268	76.6%	327	4.0%	1,323	16.2%	267	3.3%	8,185	100.0%
234	Heavy construction	30,682	72.1%	8,401	19.7%	2,115	5.0%	1,359	3.2%	42,557	100.0%
235[a]	Special trade contractors	12,177	61.6%	5,770	29.2%	1,048	5.3%	776	3.9%	19,771	100.0%
TOTAL		**173,602**	**66.4%**	**64,733**	**24.7%**	**14,313**	**5.5%**	**8,969**	**3.5%**	**261,617**	**100.0%**

[a]Covers establishments in NAICS 23593 (Excavation Contractors) and 23594 (Wrecking and Demolition Contractors) only.
Source: U.S. Census Bureau (2000a).

2.3.1.3 Geographic Distribution

Figure 2-1 shows a geographic distribution of establishments by state. The largest concentrations of establishments are in California, New York, Texas, Florida, and Pennsylvania. Combined, these states account for approximately 25 percent of all C&D establishments nationwide.

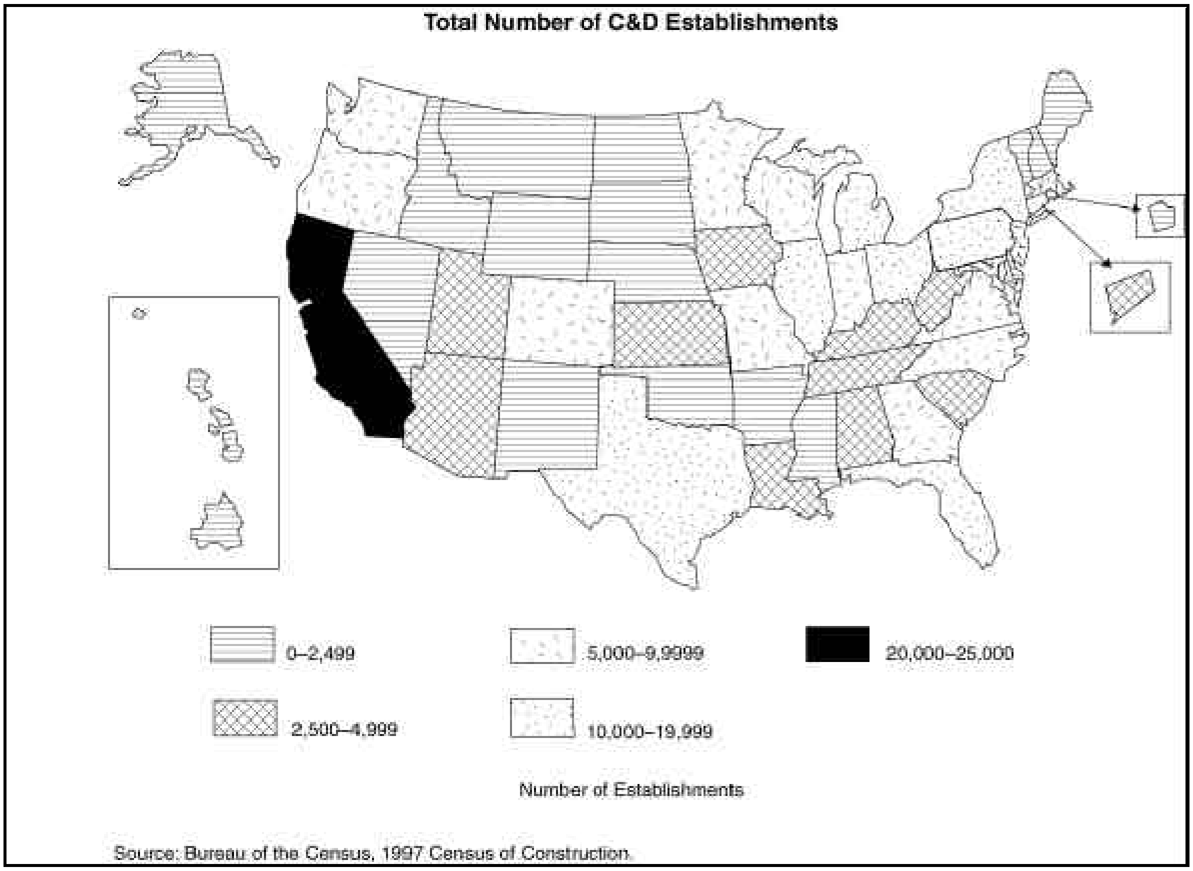

Figure 2-1. Number of establishments in the C&D industries, by state, 1997.

2.3.1.4 Employment

In 1997, establishments with payrolls in the C&D industries employed a total of nearly 2.4 million workers. Table 2-8 shows a distribution of employment by NAICS industry. NAICS 2331 (Land subdivision and land development) accounts for 41,827 employees (1.8 percent of the total), the rest of

NAICS 233 (Building, developing, and general contracting) accounts for 1.3 million employees, or 55.2 percent of the total. A total of 880,400 or 37.3 percent of the total are employed in NAICS 234 (Heavy construction), and NAICS 23593 and 23594 (Excavation contractors and Wrecking/demolition contractors) employ 135,057 (5.7 percent of the total).

Table 2-8
Number of Employees in the Construction and Development Industries Establishments With Payrolls, 1997

NAICS	Industry	Number of Employees	Percent of Total
233, except 2331	Building, developing, and general contracting, except land subdivision and land development	1,301,126	55.2%
2331	Land subdivision and land development	41,827	1.8%
234	Heavy construction	880,400	37.3%
235[a]	Special trade contractors	135,057	5.7%
TOTALS		**2,358,410**	**100.0%**

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

Construction is a seasonal activity in many parts of the country, and employment data from the industry bear this out. Figure 2-2 shows quarterly employment data for all NAICS in the C&D industries, as well as the annual average. Overall, employment of construction workers was lowest in March at 1.59 million and highest in August at 1.83 million.

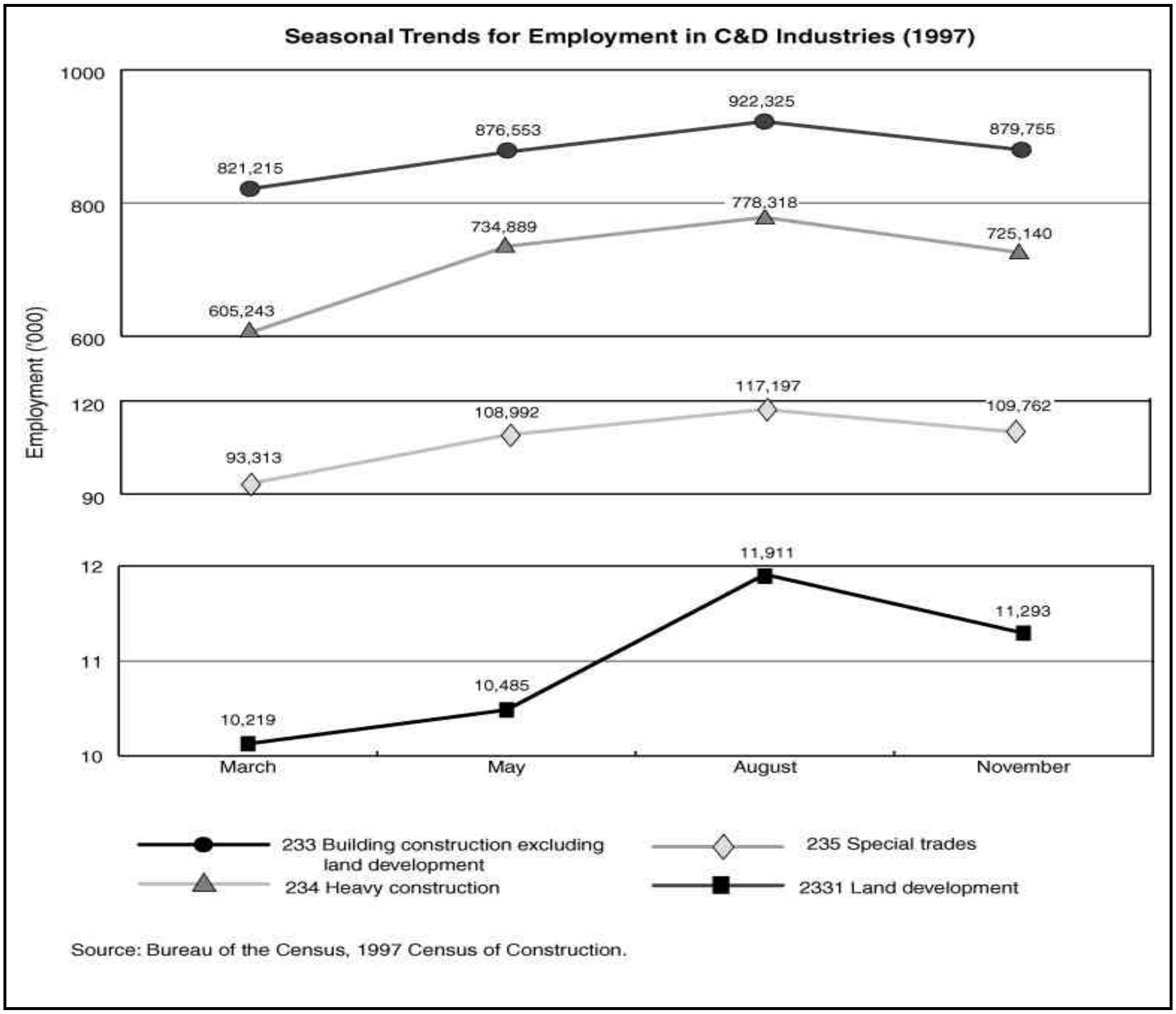

Figure 2-2. Seasonal trends for employment in the C&D industries, 1997.

2.3.1.5 Payrolls and Benefits

In 1997, the payrolls of all C&D industries totaled $76.8 million (see Table 2-9). Of this number $48.3 million (62.9 percent) went to construction workers and $28.5 million (37.1 percent) went to other employees.[8] In addition, the C&D industries incurred $11.2 million in legally required fringe benefit expenditures and $6.5 million in voluntary fringe benefits, for a total of $17.6 million in fringe benefits.[9] Table 2-9 shows detailed data on payrolls and benefits for each of the C&D industries.

2.3.1.6 Specialization

Specialization in the C&D industries refers to the percent of establishment revenues earned from different types of construction activity. Specialization data provide some insight into the homogeneity of businesses classified within the same NAICS industry. When reporting to Census, an establishment self-reports its own degree of specialization by type of construction, based on the percentage of revenue earned from each type of construction work. Table 2-10 shows, as an example, the specialization of establishments in NAICS 23321 (Single-family home construction) across the "type of construction" categories defined by the Census Bureau, and the revenues earned by establishments in each specialization category.[10,11]

[8] *Construction workers* include all workers up 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 on-site recordkeepers and security guards. *Other employees* include employees in executive, purchasing, accounting, personnel, professional, technical activities, and routine office functions.

[9] *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.

[10] Due to high degrees of variation of specialization and types of construction among NAICS sectors, detailed tables for each NAICS in the C&D industries are presented separately in Appendix 2B.

[11] Because the Census Bureau only considers construction establishments to be specialized if they earn more than half of their revenues from one particular type of construction, the total value of construction work shown in these tables will not match industry totals, which cover all establishments, including those that are not specialized.

Table 2-9
Payrolls and Benefits for Employees in the Construction Industry (Thousands of 1997 Dollars)

NAICS	Industry	Payrolls[a]			Fringe Benefits (All Employees)		
		Construction workers[b]	Other employees[c]	All employees[d]	Legally required expenditures[e]	Voluntary expenditures[f]	Total fringe benefits[g]
233	*Building, developing, and general contracting*	*$23,135,832*	*$19,410,280*	*$42,546,112*	*$5,929,710*	*$3,011,115*	*$8,940,824*
23311	Land subdivision and land development	$254,247	$1,255,526	$1,509,773	$164,669	$71,648	$236,317
23321	Single-family housing construction	$7,739,858	$7,224,726	$14,964,583	$2,000,118	$623,079	$2,623,197
23322	Multifamily housing construction	$1,022,265	$744,361	$1,766,627	$255,879	$76,644	$332,523
23331	Manufacturing and industrial building construction	$3,322,347	$1,806,620	$5,128,967	$777,829	$446,522	$1,224,351
23332	Commercial and Institutional building construction	$10,797,116	$8,379,046	$19,176,160	$2,731,214	$1,793,222	$4,524,436
234	*Heavy construction*	*$22,218,582*	*$8,073,267*	*$30,291,850*	*$4,665,757*	*$3,120,979*	*$7,786,736*
23411	Highway and street construction	$7,095,139	$2,432,488	$9,527,626	$1,507,465	$1,109,177	$2,616,641
23412	Bridge and tunnel construction	$1,378,759	$468,401	$1,847,160	$344,821	$263,297	$608,117
23491	Water, sewer,, and pipeline construction	$4,087,007	$1,435,273	$5,522,281	$844,394	$493,761	$1,338,155
23492	Power and communication transmission line construction	$1,748,715	$638,717	$2,387,432	$374,145	$231,538	$605,683
23493	Industrial nonbuilding structure construction	$2,734,020	$988,343	$3,722,363	$486,625	$302,813	$789,439
23499	All other heavy construction	$5,174,943	$2,110,046	$7,284,989	$1,108,307	$720,394	$1,828,701
235[h]	*Special trade contractors*	*$2,940,440*	*$1,005,609*	*$3,946,050*	*$582,157*	*$329,925*	*$912,082*
23593	Excavation contractors	$2,525,857	$828,017	$3,353,874	$483,764	$283,952	$767,716
23594	Wrecking and demolition contractors	$414,583	$177,592	$592,176	$98,393	$45,973	$144,366
TOTAL		**$48,294,854**	**$28,489,156**	**$76,784,012**	**$11,177,624**	**$6,462,019**	**$17,639,642**

[a] Payrolls includes the gross earnings paid in the calendar year 1997 to all employees on the payrolls of construction establishments. It includes all forms of compensation such as salaries, wages, commissions, bonuses, vacation allowances, sick leave pay, prior to such deductions as employees' Social Security contribution, withholding taxes, group insurance, union dues, and savings bonds.
[b] Construction workers include all workers up 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 on-site recordkeepers and security guards.
[c] Other employees include employees in executive, purchasing, accounting, personnel, professional, technical activities, and routine office functions.
[d] Sum of construction workers and other employees.
[e] Legally required contributions include Social Security contributions, unemployment compensation, workman's compensation, and State temporary disability payments.
[f] Voluntary expenditures include life insurance premiums, pension plans, insurance premiums on hospital and medical plans, welfare plans, and union negotiated benefits.
[g] Total fringe benefits represent the expenditures made by the employer during 1997 for both legally required and voluntary fringe benefit programs for employees.
[h] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

Specialized establishments in NAICS 23321 (i.e., those that earn 51 percent or more of revenues from one type of construction) may be specialized in either detached single-family housing construction or attached single-family housing construction.[12] The number of construction type specializations may depend on the NAICS, as some industry definitions encompass a broader set of construction activities (see Appendix 2B). Within NAICS 23321, establishments specialized 51 percent or more in detached, single-family housing construction performed construction work valued at $127.9 billion. Establishments 100 percent specialized in detached, single-family housing construction performed construction work worth $90.4 billion, or 64.4 percent of all work done by establishments with specialization in construction work. Similarly, for establishments specializing in construction of attached single-family houses by 51 percent or more, the value of work was $12.5 billion, and 52.8 percent of the work ($6.6 billion) was done by establishments with complete specialization in attached single-family houses. Further analysis of the value of construction work performed by the C&D industries can be found in Section 2.7.1.

Table 2-10
Specialization within NAICS 23321 (Single-Family Home Construction), Categorized by Value of Construction Work (Millions of 1997 Dollars)

Type of Construction with Specialization	Estabs. spec. 51 % or more	Estabs. with 100 % spec.	Estabs. with 90 to 99 % spec.	Estabs. with 80 to 89 % spec.	Estabs. with 70 to 79 % spec.	Estabs. with 60 to 69 % spec.	Estabs. with 51 to 59 % spec.
Single-family houses, detached	$127,870	$90,434	$14,615	$7,040	$6,600	$6,603	$2,574
Single-family houses, attached, including townhouses and townhouse-type condominiums	$12,534	$6,623	$1,292	$877	$1,074	$1,693	$971

Source: U.S. Census Bureau (2000a).

[12] Although they may earn revenues from other types of construction (e.g., highway construction) they would no longer be classified in NAICS 23321 if they earned 51 percent or more of their revenue from such sources.

2.3.2 Firm-Level Data

The SBA Office of Advocacy contracts with the U.S. Census Bureau to produce firm-level data for U.S. industries. Currently, distributions by employment size are available on an NAICS basis for 1998, and distributions by receipt size are available on an SIC basis for 1997.

The SBA data is based primarily on administrative records and is not generated in conjunction with, nor is it linked to, data collected through the Census of Construction. As a result, there may be minor inconsistences between data reported by SBA and that reported by the Census of Construction.[13] The SBA/Census data, however, is the *only* firm-level data available for C&D industries, so EPA is including it in this analysis because it is valuable to the economic modeling and the small entity analysis, which applies at the firm, not the establishment, level.[14]

2.3.2.1 Number and Size of Firms

Table 2-11 presents the number of firms with payrolls (firms with paid employment) and number of establishments in the C&D industries in 1998.[15] These data indicate that a majority of firms operate a single establishment, and have fewer than 20 employees. Of the 215,301 C&D firms in 1998; approximately 99 percent of these operate only one establishment, and 94 percent have fewer than 20 employees; less than 1 percent of firms have more than 500 employees. In 1998, there were 39,062 firms in heavy construction and these operated 40,091 establishments. More than 97 percent of the heavy

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

[14] 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" (Census, 2000a). A *firm* refers to the aggregation of all establishments owned by one company; therefore one firm may consist of several establishments.

[15] "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)." SBA Office of Advocacy website, http://www.sba.gov/advo/stats/data.html.

construction firms operate a single establishment and approximately 79 percent of heavy construction firms have fewer than 20 employees.

Table 2-11
Employer Firms and Establishments by Employment Size of Firm by NAICS Codes, 1998 -- SBA Data

		Firms					**Establishments**				
Industry	**NAICS**	**Total**	**0**	**<20**	**<500**	**500+**	**Total**	**0**	**<20**	**<500**	**500+**
Building, developing, & general contracting	*233*	*215,301*	*38,904*	*202,969*	*214,921*	*380*	*216,893*	*38,907*	*203,020*	*215,478*	*1,415*
Land subdivision & land development	23310	11,192	2,829	10,618	11,101	91	11,369	2,832	10,628	11,179	190
Single-family housing const.	23321	153,029	29,168	149,240	152,937	92	153,561	29,168	149,253	153,108	453
Multifamily housing const.	23322	8,054	1,405	7,413	8,027	27	8,091	1,405	7,414	8,041	50
Mfg & industrial building construction	23331	6,842	720	5,470	6,775	67	6,904	720	5,471	6,784	120
Commercial & institutional building construction	23332	36,355	4,782	30,240	36,158	197	36,968	4,782	30,254	36,366	602
Heavy construction	*234*	*39,062*	*4,589*	*30,987*	*38,788*	*274*	*40,091*	*4,589*	*31,010*	*39,098*	*993*
Highway & street const.	23411	10,884	1,493	8,265	10,806	79	11,268	1,493	8,273	10,901	367
Bridge & tunnel construction	23412	886	70	520	865	21	925	70	521	880	45
Water, sewer, & pipeline construction	23491	7,749	676	5,786	7,704	45	7,823	676	5,787	7,726	97
Power & communication transmission line construction	23492	3,170	404	2,464	3,133	37	3,305	404	2,465	3,157	148
Industrial nonbuilding structure construction	23493	641	52	411	575	66	709	52	411	583	126
All other heavy construction	23499	15,860	1,894	13,541	15,758	102	16,061	1,894	13,553	15,851	210
Excavation contractors	*23593*	*23,209*	*4,310*	*22,145*	*23,201*	*8*	*23,240*	*4,310*	*22,145*	*23,223*	*17*
Wrecking & demolition contractors	*23594*	*1,336*	*247*	*1,094*	*1,329*	*7*	*1,344*	*247*	*1,094*	*1,332*	*12*

Source: U.S. Small Business Administration (1998), based on data provided by the U.S. Census Bureau.

2.3.2.2 Firm-Level Revenues

Table 2-12 shows the number of employer firms and establishments, in 1997, based on NAICS industry and revenue size class. These data also show that a large number of firms in the C&D industries are small. Approximately three-quarters (75.2 percent) of the firms in the target industry sectors reported under $1.0 million in revenues for 1997 and nearly 94 percent of firms reported revenues under $5.0 million.

Table 2-12
Firms and Establishments with Payrolls by Revenue Size Class (1997)[a] (SBA Data)

	FIRMS							ESTABLISHMENTS[b]						
Description	**Total Number of Firms**	**< $1 Million**	**< $5 Million**	**< $7.5 Million**	**< $25 Million**	**< $100 Million**	**Over $100 Million**	**Total Establish-ments**	**< $1 Million**	**< $5 Million**	**< $7.5 Million**	**< $25 Million**	**< $100 Million**	**Over $100 Million**
Land Subdivision and Development	11,036	7,744	10,207	10,501	10,851	10,948	88	11,205	7,746	10,218	10,514	10,896	11,018	186
Single-Family Housing Construction	149,130	123,414	145,305	146,917	148,634	148,975	155	149,823	123,420	145,339	146,962	148,736	149,161	661
Multifamily Housing Construction	6,911	5,128	6,347	6,518	6,791	6,877	34	7,009	5,129	6,354	6,527	6,810	6,910	99
Manufacturing and Industrial Building Construction	7,950	4,674	6,841	7,156	7,692	7,879	71	8,075	4,675	6,847	7,166	7,713	7,914	160
Commercial and Institutional Building Construction	38,195	22,518	32,523	34,085	36,964	37,882	313	39,044	22,526	32,560	34,133	37,075	38,124	920
Highway and Street Construction	10,778	5,683	8,681	9,291	10,320	10,679	99	11,117	5,683	8,689	9,302	10,349	10,758	359
Bridge and Tunnel Construction	875	287	583	638	788	847	28	915	288	584	640	795	859	56
Water, Sewer, and Pipeline Construction	7,916	4,475	6,861	7,245	7,768	7,883	33	8,075	4,476	6,864	7,251	7,791	7,938	137
Power and Communication Transmission Line Construction	2,781	1,572	2,411	2,546	2,729	2,770	11	2,837	1,572	2,412	2,548	2,738	2,789	48
Industrial Nonbuilding Structure Construction	3,941	2,786	3,612	3,713	3,860	3,909	32	4,023	2,787	3,617	3,720	3,874	3,936	86
All Other Heavy Construction	12,973	9,110	11,873	12,213	12,697	12,863	111	13,594	9,118	11,920	12,279	12,814	13,087	507
Excavation Contractors	22,046	19,093	21,659	21,820	22,002	22,038	8	22,072	19,093	21,661	21,823	22,005	22,055	17
Wrecking and Demolition Contractors	1,270	840	1,165	1,204	1,249	1,261	9	1,285	840	1,166	1,205	1,252	1,271	14
TOTAL	**275,802**	**207,324**	**258,068**	**263,847**	**272,345**	**274,811**	**992**	**279,074**	**207,353**	**258,231**	**264,070**	**272,848**	**275,820**	**3,250**

[a] Data are for 1997. SBA does not report revenue size class data in NAICS format and will not do so until the 2002 Economic Census is published. These figures were calculated using percentages provided in the Census Bureau's NAICS to SIC bridge, which is available at www.census.gov/epcd/ec97brdg.HTM.
[b] The number of establishments reported here may differ from the number reported in previous tables due to the different sources used (see Table 2-2 and accompanying text for further discussion). Earlier tables are based on data from the 1997 Economic Census; Table 2-12 is based on 1997 data from SBA/Census and was converted from SIC to NAICS for the purposes of this analysis.
Source: SBA 1998

2.3.3 Number of Small Entities

Small entities are defined by the SBA according to size standards based on either number of employees or annual revenue (13 CFR 121). For all of the C&D industries, the size standards are based on annual revenues. Table 2-13 presents the SBA revenue thresholds for the C&D industry, which range from $5.0 million for NAICS 233110 (Land subdivision and land development) to $27.5 million for the majority of NAICS 233 (Building, developing, and general contracting) and NAICS 234 (Heavy construction). An estimated 189,805 C&D businesses, representing 99.5 percent of all businesses in the C&D industry, fall below the SBA-defined revenue thresholds for this industry and therefore may be qualified as small businesses. Table 2-13 shows the total estimated number of businesses and total small businesses in the C&D industry; the number of potentially affected small businesses is developed in Chapter Six.

Table 2-13
Number of Firms and Establishments Above and Below SBA Thresholds for Small Business Definition: Based on Data from SBA

NAICS	SBA Revenue Threshold (million $)	Total Estimated Number of Businesses	Estimated Number of Small Businesses	Small Businesses as a Percent of Total
233210: Single-family Housing Construction	$27.5	138,732	138,583	99.9%
233220: Multifamily Housing Construction	$27.5	7,534	7,491	99.4%
233310: Manufacturing and Industrial Building Construction	$27.5	7,257	7,050	97.1%
233320: Commercial and Institutional Building Construction	$27.5	37,220	36,681	98.6%
TOTAL	–	**190,743**	**189,805**	**99.5%**

[a] For those industries with a $27.5 million SBA cutoff, the table shows the number of firms and establishments with revenues below $25.0 million (the next closest SBA data break point). For industries with a $11.5 million SBA cutoff, figures shown are for firms and establishments with revenues below $7.5 million.
Source: SBA 1998; also see Chapter Six, Tables 6-2 and 6-3

2.3.4 Entities Not Covered by the Proposed Rule

Not all establishments and firms that fall within the industry definitions outlined in the previous sections will be affected by the proposed rule. The proposed rule will apply only to those NPDES-permitted establishments engaged in activities that disturb land. EPA believes that some entities will be excluded from regulatory coverage because they are primarily engaged in remodeling activities that will not result in land disturbance. Others will be excluded because they are generally not the primary NPDES permit holder. As discussed in Section VI.A in the preamble of the proposed rule, Special trade contractors are typically not identified as NPDES permit holders and thus will not likely be covered by the proposed rule. In this section EPA estimates the number of establishments that fall into these categories. The resulting estimates are brought together in Section 2.3.5 to derive the number of establishments covered under each option of the proposed rule.

2.3.4.1 Establishments Engaged in Remodeling

Two sources provide information on the potential number of C&D establishments that are actually remodelers. In an article published in *Housing Economics,* NAHB economists estimated that in 1997 approximately 45,952 establishments in the residential building industry were involved in *remodeling activities only* (Ahluwalia and Chapman, 2000). This count is based on analysis of Census microdata on establishments, receipts, and source of receipts. Establishments were classified as remodelers in this study if they earned *100 percent* of revenues from remodeling activities.

The Joint Center for Housing Studies at Harvard University recently published a report focused solely on the remodeling industry (Joint Center, 2001) . This report classified establishments that derive *at least half* of their revenues from remodeling activities as remodelers. When defined in this manner, the study found that 62,400 establishments classified as general contractors/builders in 1997 were actually remodelers.

Both of these estimates are based on establishments classified by Census as *general contractors/builders.* The Joint Center study goes further to identify establishments classified in various special trades (e.g., Carpentry, Plumbing) that are primarily engaged in remodeling, but these estimates do not include those considered part of the C&D industries (i.e., NAICS 23593 Excavation contractors and 23594 Wrecking and demolition contractors).[16] NAHB does not address the issue of special trades contractors in their report. Neither report estimates the number of establishments in NAICS 234 (Heavy construction) that may be engaged primarily in remodeling activities; however, EPA does not expect that establishments in the heavy construction sector would be engaged in remodeling activities.

Following review of these studies, EPA used the estimate from the Joint Center study as the best estimate of the number of remodelers included in statistics of the C&D industries. This study defines remodelers as establishments that earn at least 50 percent of revenues from remodeling activity (and thus earn less than 50 percent from building activity). EPA concludes that these establishments, when engaged in building activity, are unlikely to disturb more than one acre of land and would therefore not be covered by the proposed rule.

2.3.4.2 Establishments That Are Not NPDES Permttees

EPA has included in the universe of potentially affected establishments all establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) because such establishments engage in land disturbing activities. In reality, however, establishments in these industries generally act as subcontractors on C&D projects and are hired by developers or general contractors to perform specific tasks. EPA does not believe that such establishments generally appear as NPDES permittees or copermittees. Therefore, while these establishments are included among the universe of potentially affected establishments (and appear below in Table 2-14), EPA has not included them in the subsequent economic impact analysis chapters (i.e., Chapters Four, Five, and Six).

[16] The Joint Center study does provide an estimate for the number of remodelers classified in "miscellaneous special trades" (NAICS 2359), which includes NAICS 23593 and 23594, but several other industries as well. The number of remodelers classified primarily in NAICS 23593 and 23594 may not be large, however, since the total number in NAICS 2359 is only 6,600.

2.3.5 Number of Potentially Affected Entities

EPA took several steps to adjust the number of affected entities to account for regulatory coverage and data availability. Previous sections estimated that the total number of establishments in the C&D industry is 261,617 (see Table 2-4). Subtracting the 62,400 remodeling establishments estimated in Section 2.3.4 from this figure yields a *potentially affected* universe of 199,214 establishments. EPA subtracted the 62,400 residential remodeling establishments from the single-family and multifamily building construction industries (NAICS 23321 and NAICS 23322), based on their respective shares of residential building establishments.

In preparing its economic impact analysis, EPA concluded that data limitations on land developers (NAICS 2331) would preclude retaining this as a separate industry for purposes of regulatory analysis.[17] Rather than excluding establishments in this industry category (which would potentially underestimate the number of affected entities and associated impacts) EPA distributed them among the four building construction industries (single-family, multifamily, commercial, and industrial construction), based on each industry's share of total establishments.[18] Table 2-14 reflects this allocation, which was done after removing those establishments engaged primarily in remodeling.

EPA has further adjusted the population of affected establishments to account for differences in regulatory coverage. As described in Chapter Three, the proposed rule considers three erosion and sediment control (ESC) options. Option 1 would apply to sites that disturb one acre or more of land, while Option 2 would apply to sites that disturb five acres or more of land. Option 3 is a no regulation option, meaning that no sites or establishments would be affected.

EPA used data from the Census Bureau and other sources to define an average housing density for the nation as a whole (average number of housing units per acre), then used this analysis to identify classes of establishments that would be excluded based on their likelihood of disturbing less than one acre (Option 1) or five acres (Option 2) on a project basis. EPA believes these estimates to be

[17] Specifically, EPA could not obtain equivalent financial data with which to build financial models of the land development industry.

[18] EPA provides further justification for and details about this step in the analysis in Chapter Four.

conservative in terms of identifying establishments unaffected by the proposed rule. First, while the regulatory threshold applies to each *site*, EPA excluded establishments if the estimated number of acres disturbed *in a year* is below the regulatory threshold. In addition, the analysis was not adjusted for the percent of sites normally left undisturbed.[19]

Based on this analysis, EPA assumed that establishments in the single-family building construction industry (NAICS 2331) that complete between 1 and 4 housing units each year would be excluded under Option 1. Under Option 2, EPA also assumed that establishments in the single-family building construction industry (NAICS 2331) that complete between 5 and 9 housing units, as well as establishments in the multifamily building construction industry (NAICS 2332) that complete between 2 and 9 housing units each year, would be excluded. Chapter Four contains further detail on the data sources and method used to make this adjustment.

Table 2-14 shows the distribution of establishments potentially affected under Option 1 and 2, following the redistribution of land developers (NAICS 2331) and adjustment for small builders exempt from the site size limitations of each option. Due to limited data, the number of establishments in NAICS 234 (Heavy construction) and NAICS 235 (Special trades) affected under each option could not be refined further, so no adjustments are made to these establishment counts. Moreover, as discussed in Section XII of the preamble of the proposed rule, special trade contractors are not included in Chapter 5, Economic Impact Analysis Results of this report. Special trade contractors are typically subcontractors and are not NPDES permittees. Therefore, these contractors would not be directly affected by the proposed rule.

[19] For example, an establishment that completes 15 houses per year is estimated to account for 5.6 acres of converted land, based on the average housing density of 2.67 new single-family housing units per acre. EPA would include this establishment among those covered under Option 2, even though the actual area disturbed may well fall below 5 acres once open space, buffers, and other "undisturbed" areas are factored in. Furthermore, as noted, EPA assumes that all of the housing units are covered by a single NPDES permit while in reality the establishment might operate on more than one site, none of which exceeds the 5-acre threshold.

Table 2-14. Number of Affected Establishments in the Construction and Development Industry

NAICS	Industry	Option 1		Option 2	
		Number	Percent of Total	Number	Percent of Total
23321	Single-family residential building construction	34,070	22.9%	21,362	15.9%
23322	Multi-family residential building construction	4,603	3.1%	2,699	2.0%
23331	Manufacturing and industrial building construction	7,742	5.2%	7,742	5.8%
23332	Commercial and institutional building construction	39,810	26.8%	39,810	29.7%
234	Heavy construction	42,557	28.6%	42,557	31.8%
235[a]	Special trade contracting	19,771	13.3%	19,771	14.8%
Potentially affected establishments		**148,553**	**100.0%**	**133,941**	**100.0%**

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000a) and EPA estimates.

2.4 MARKET SUPPLY AND DEMAND

The sections below discuss the supply and demand factors that affect the residential, nonresidential, and heavy construction industries. This discussion provides insight into the dynamics of the construction market and provides a basis for many of the key assumptions used in the economic impact models.

2.4.1 Characteristics of Construction Supply

This section discusses the factors that influence supply in the C&D industry. Topics include number and value of residential, nonresidential, and heavy construction projects; barriers to entry in the industry; and supply trends (the latter primarily for the residential construction market).

2.4.1.1 Residential Building

Number of Projects

The Census Bureau operates three data collection programs that track and report output measures relevant for the C&D industry:

- The *Building Permits Program* collects monthly information on building permits issued for new private residential construction.
- The *Survey of Construction* collects information on residential units started, sold, and completed each month. Several data series are produced from this program. These include:
    - *Housing Starts* (Series C20)—Provides monthly data on the number of housing starts, including number of housing units authorized, started, and authorized but not yet started.
    - *New One-Family Houses Sold* (Series C25)—Provides monthly data on units sold and for sale, average and median sales prices, and price distribution of units sold. This series also produces the Price Index of New One-Family Houses Sold.
    - *Characteristics of New Housing* (Series C25A)—Compiles and publishes data annually on housing prices and physical characteristics such as size of unit, number of bathrooms, type of heating system, and type of exterior wall.
    - *Housing Completions* (Series C22)— This series, published monthly, provides data on the number of housing units completed in a month and on those under construction.

    - *New Residential Construction in Selected Metropolitan Areas* (Series C21)—Provides quarterly data by metropolitan area on units authorized, started, and completed.[20]

- *The Value Put in Place* program publishes estimates of the value of construction work performed each month.

Combined, these data programs produce vast amounts of information on construction industry output. This profile focuses on building permits, since the activities most likely to be influenced by the proposed effluent guidelines regulations are those that take place early in the development process. The following discussion and supporting tables provide further details about the building permits data collection program.

The Building Permits Program collects data on private *residential* construction authorized by building permits based upon reports submitted by local building permit officials.[21] The data include the number of permits authorized by type[22] and the value of permits. These reports are provided in response to a mail survey using Form C-404 "Report of Building or Zoning Permits Issued and Local Public Construction." The mail survey covers a sample of 8,500 permit-issuing places from a universe of 19,000 in the U.S.[23] Approximately 96 percent of all privately owned housing units are built in areas that require building permits.

[20] Census has discontinued publication of this series. The last year for which data were published was 1998.

[21] Census discontinued collection of data on *nonresidential construction* authorized by building permits in 1995 due to budget cuts. EPA has used historical data from this series to create projections of nonresidential building activity beyond 1995. See Section 2.6.1.2.

[22] Private residential construction is classified as: single-family homes, 2-family buildings, 3-4 family buildings, or 5 or more family buildings. Data collection for other types of construction (including nonresidential housekeeping, nonresidential buildings, and demolition and razing) was discontinued in 1995.

[23] All permit-issuing places in the most active MSAs and all CMSAs are selected with certainty for the sample. The remaining places are stratified by State into two strata based on the number of housing units authorized in 1989, 1990, 1991, and 1992. In each State, all places that authorized housing units during the period greater than or equal to a predetermined number of units were selected with certainty. The other places were selected at the rate of 1 in 10.

Figure 2-3 shows monthly data from January 1994 through July 2000 on the number of housing units authorized by building permit. The data in this chart represent seasonally adjusted annual averages. Seasonal adjustment eliminates the effect of changes that normally occur at about the same time and with about the same magnitude every year. [24] As seen, the seasonally adjusted annual rate of building permits issued shows a steady rise over the recent period. From an average of between 1.3 and 1.5 million units per year over the 1994 to 1997 period, the rate then rose through the 1998 to 2000 period. The rate appears to have reached a peak in January 2000 when it hit 1.7 million units, and has since fallen steadily back to approximately 1.5 million units per year.

[24] This includes the influence of factors such as normal or average changes in weather conditions, differences in the lengths of the months, and differences in the composition (trading-day variation) of the months. The seasonally adjusted annual rate is the seasonally adjusted monthly rate multiplied by 12. The seasonally adjusted annual rate for a particular month, for example July, can be interpreted to mean that if the only changes which occur in building permits from July through June of the following year were the normal seasonal changes described by the seasonal indexes, then the total building permits in that 12-month interval would equal the seasonally adjusted annual rate for July. The seasonally adjusted annual rate has the advantage of facilitating comparisons with previous annual building permit figures as well as with the seasonally adjusted annual rates for prior months. The seasonally adjusted annual rate is neither a forecast nor a projection; rather it is a description of the rate at which building permits are issued in the particular month for which it is calculated.

The total number of new housing units authorized in 1997 was 1,441,136. Of these, 1,062,396 or 73.7 percent were for single housing units.[25] Table 2-15 shows the number of new privately owned housing units authorized by building permit, allocated to Census region and subregion.

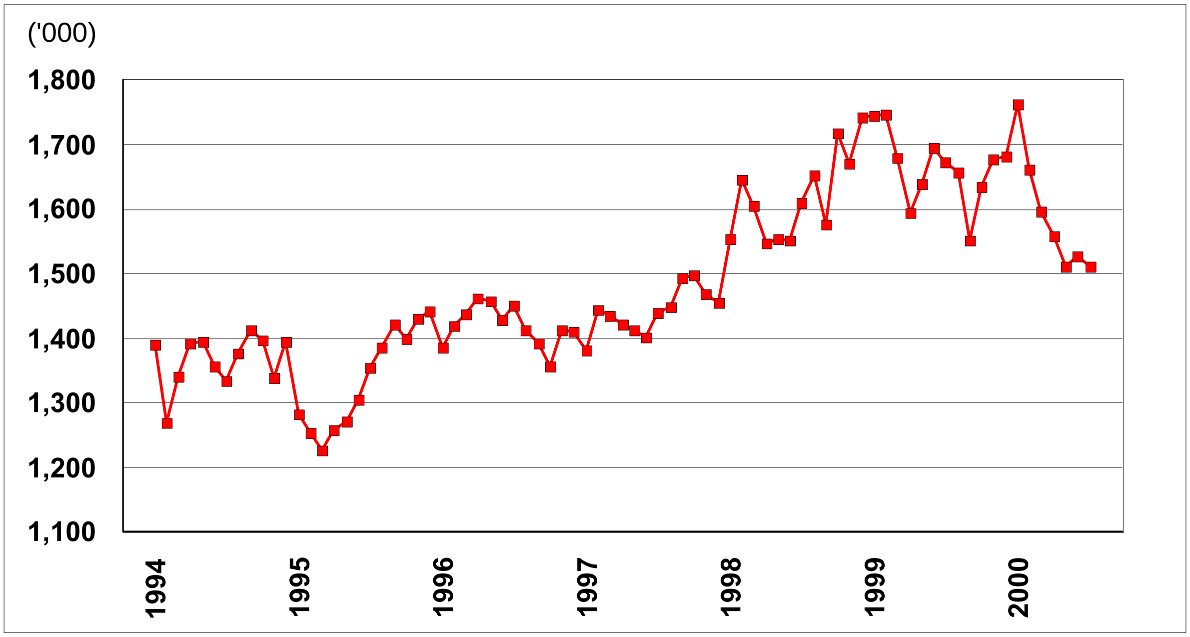

Figure 2-3. New Privately Owned Housing Units Authorized, Seasonally Adjusted Annual Rate, U.S.

Source: U.S. Census Bureau (2000e), Series C-40, Building Permits.

[25] A "housing unit" consists of a room or group of rooms intended for occupancy as separate living quarters by a family, by a group of unrelated persons living together, or by a person living alone. Separate living quarters are those in which the occupants live and eat separately from other persons in the building and have direct access from the outside of the building or through a common hall. In accordance with this definition, each apartment unit in an apartment building is counted as one housing unit.

Table 2-15
New Privately Owned Housing Units Authorized by Building Permits in Permit-Issuing Places in 1997, by Region

Region	Sub-Region	Total	1 Unit	2 Units	3 and 4 Units	5 Units or More	Number of Structures with 5 Units or More
	New England	41,110	35,838	904	687	3,681	236
	Middle Atlantic	100,776	75,312	4,278	2,347	18,839	963
Northeast	**Total Region**	**141,886**	**111,150**	**5,182**	**3,034**	**22,520**	**1,199**
	East North Central	209,213	154,513	8,168	8,401	38,131	3,118
	West North Central	90,628	65,510	4,472	2,910	17,736	1,105
Midwest	**Total Region**	**299,841**	**220,023**	**12,640**	**11,311**	**55,867**	**4,223**
	Mountain	179,632	134,403	2,548	3,675	39,006	3,098
	Pacific	183,913	132,670	4,590	5,180	41,473	2,902
West	**Total Region**	**363,545**	**267,073**	**7,138**	**8,855**	**80,479**	**6,000**
	South Atlantic	392,540	291,564	5,070	5,605	90,301	5,839
	East South Central	79,979	61,863	2,264	1,933	13,919	1,106
	West South Central	163,345	110,723	2,556	2,850	47,216	2,760
South	**Total Region**	**635,864**	**464,150**	**9,890**	**10,388**	**151,436**	**9,705**
TOTALS		**1,441,136**	**1,062,396**	**34,850**	**33,588**	**310,302**	**21,127**

Source: U.S. Census Bureau (2000a).

Value of Projects

The same Census program that compiles and reports data on the number of housing units authorized by building permit also compiles data on the value of permits issued. The value reported in the permits data refers to the value of structures and site improvements covered by the building permit, but excludes land costs.

The total value of residential building permits issued in the U.S. in 1997 was $141.0 billion. Of this, $121.2 billion, or 86.0 percent, was accounted for by single-family housing units.

Table 2-16 shows the value of new privately owned housing units authorized by building permits in 1997, by Census region and subregion. The South region accounted for $55.9 billion (39.6 percent of the total), followed by the West with $40.7 billion (28.8 percent), the Midwest with $30.3 billion (21.4 percent), and the Northeast with $14.1 billion (10.0 percent).

Table 2-16
New Privately Owned Housing Units Authorized- Valuation for Regions (Millions of 1997 Dollars)

Region	Sub-Region	Total	1 Unit	2 Units	3 and 4 Units	5 Units or More
	New England	$4,737.7	$4,423.8	$59.3	$49.0	$205.5
	Middle Atlantic	$9,399.5	$8,142.4	$232.4	$134.3	$890.4
Northeast	**Total Region**	**$14,137.2**	**$12,566.2**	**$291.7**	**$183.3**	**$1,095.9**
	East North Central	$21,688.0	$18,858.2	$584.1	$516.4	$1,729.4
	West North Central	$8,573.9	$7,292.4	$294.3	$184.1	$803.3
Midwest	**Total Region**	**$30,261.9**	**$26,150.5**	**$878.3**	**$700.4**	**$2,532.6**
	Mountain	$17,426.3	$15,038.7	$225.4	$245.8	$1,916.4
	Pacific	$23,299.2	$19,693.7	$389.6	$410.3	$2,805.6
West	**Total Region**	**$40,725.5**	**$34,732.4**	**$615.0**	**$656.1**	**$4,722.0**
	South Atlantic	$35,206.7	$29,973.8	$301.1	$341.9	$4,590.0
	East South Central	$6,840.6	$6,042.5	$106.1	$66.3	$625.7
	West South Central	$13,832.4	$11,729.1	$111.8	$109.6	$1,881.9
South	**Total Region**	**$55,879.7**	**$47,745.4**	**$518.9**	**$517.8**	**$7,097.6**
TOTAL		**$141,004.4**	**$121,194.5**	**$2,304.0**	**$2,057.7**	**$15,448.2**

Figures rounded from thousands reported by Census.
Source: U.S. Census Bureau (2000a).

2.4.1.2 Nonresidential Building

Census discontinued the collection of data on nonresidential construction authorized by building permits in 1995 due to budgetary restraints. To fill this data gap, EPA has used historical (pre-1995) data on nonresidential starts to establish a relationship between residential and nonresidential starts from which current nonresidential activity can be estimated.

Number and Value of Projects

EPA analyzed data from 1980 through 1994 on the number of nonresidential building permits, number of residential building permits, the value of nonresidential buildings put in place, and a time trend to estimate a statistical relationship that could be used to predict the number of nonresidential permits issued in 1997.[26] Table 2-17 shows, for each region and subregion, the results from EPA's analysis. EPA used a linear regression of nonresidential building permits on the remaining three variables to estimate the number of permits.

The value of nonresidential building projects is reported by Census in the *Value Put in Place* data series. Table 2-17 also shows the value of nonresidential projects constructed in 1997 by region and subregion.

[26] EPA assumes that there is a one-to-one correspondence between *permits* and *projects* for nonresidential construction activity. Therefore, the predicted number of nonresidential permits issued in 1997 is assumed to also be the predicted number of nonresidential projects for that year.

Table 2-17
Estimated Number of Nonresidential Building Permits for 1997, by Region

Region	**Sub-Region**	**Nonresidential Permits (estimated)**	**Value Put in Place (millions of dollars)**
	New England	26,936	$1,034
	Middle Atlantic	51,530	$2,482
Northeast	**Total Region**	**78,466**	**$3,516**
	East North Central	62,193	$8,606
	West North Central	30,374	$1,745
Midwest	**Total Region**	**92,568**	**$10,351**
	Mountain	27,696	$2,187
	Pacific	51,408	$6,736
West	**Total Region**	**79,105**	**$8,922**
	South Atlantic	124,452	$6,098
	East South Central	20,340	$3,228
	West South Central	31,093	$4,624
South	**Total Region**	**175,886**	**$13,950**
TOTALS	**United States**	**426,024**	**$36,739**

Figures may not add to totals due to rounding.
Source: U.S. Census Bureau (2000a).

As shown in Table 2-17, the number of nonresidential building projects authorized by permits in 1997 is estimated at 426,024. The South had the highest number of nonresidential permits in 1997, with 175,886, or 41.3 percent of the total. The Northeast had the fewest nonresidential permits issued, with only 78,466, or 18.4 percent of the total.

The total value of nonresidential building projects constructed in 1997 was $36.7 billion. As with nonresidential permits, the South had the highest value put in place, with $13.9 billion (38.0 percent of total value put in place) while the Northeast had the lowest value of projects put in place with $3.5 billion (9.6 percent of total).

2.4.1.3 Heavy Construction

Heavy construction encompasses both building and nonbuilding construction activities, although 95 percent of the work performed by establishments in NAICS 234 (Heavy construction) is classified as nonbuilding construction. The largest component of heavy construction work is highway and street construction. These activities account for one-third of the value of construction work completed by the heavy construction industries. When highway and street construction is combined with bridge and tunnel construction, the total value of work climbs to $53.3 billion, or 41.7 percent of the industry total. Heavy construction activities excluding roads, bridges, and tunnels (e.g., airport runways, sewers and water mains, transmission lines) account for the remaining 58.3 percent of construction value, but there is little data providing further detail on such activities. As a result, this section focuses principally on road, highway, bridge, and tunnel construction.

The Federal Highway Administration (FHWA) publishes the most detailed report on highway, bridge, and transit systems in the United States. The 1999 Report to Congress, *Status of the Nation's Highways, Bridges and Transit: Conditions and Performance* (C&P Report) includes not only information on the condition of these systems, but details on capital expenditures and improvements as well. The sections below summarize some of this data.

Number of Projects

Table 2-18 summarizes information from the C&P Report on the number of miles of highway, urban, and rural roads in the U.S., as well as the number of lane-miles represented Highway lane-mileage has increased by an average of only 0.3 percent annually over the period 1987-1997. Although the report and Table 2-18 show the annual capital and maintenance expenditures on this roadway system, nowhere in the report (nor in any other data reviewed for this analysis) does FHWA present the *number of projects* funded or *number of miles* of new road completed. As a result, EPA lacks current estimates of the number of highway, road, bridge or transit construction projects that potentially would disturb land.

The number of rural highway *road-miles* (as distinguished from *lane-miles*) declined by an average of 0.2 percent annually between 1987 and 1997. During the same period, urban highway road-miles grew by an average of 1.7 percent annually. The decline of rural road mileage and comparative growth in urban road mileage may be due, at least in part, by the expansion of existing urban roadways indicated by the figures above for lane-mileage growth trends. Some areas that were previously classified as rural may also have been reclassified as urban during that 10-year period based on population growth.[27]

Table 2-18. Highway Statistics

Statistic	1997 Data	1987-1997 Average Annual Growth (percent)[a]
Total Rural Highway Miles	3.11 million	-0.2
Total Urban Highway Miles	0.84 million	1.7
Total Highway Miles	3.95 million	--
Total Rural Highway Lane-Miles	6.37 million	--
Total Urban Highway Lane-Miles	1.89 million	2.1
Total Highway Lane-Miles	8.26 million	0.3
Total Highway Expenditures (All Govts.)	$101.3 billion	--
Total Highway Capital Outlay (All Govts.)	$48.7 billion	--
Total Highway Capital Outlay Per Lane-Mile	$5,914	--
Total Highway Capital Outlay Per Road-Mile[b]	$12,329-$12,360	--

-- Not provided
[a] Not provided for all statistic categories.
[b] Range calculated by EPA as described in text.
Source: FHWA 1999, various tables.

[27] The C&P Report defines "rural" areas as areas with a population under 5,000. "Urban" areas are those with a population greater than or equal to 5,000.

Value of Projects

The C&P Report presents highway and road expenditures by all levels of government ownership. Expenditures are further classified as capital and non-capital. Non-capital expenditures include maintenance and service outlays.[28] Maintenance activities are not expected to disturb significant amounts of land. Capital outlays refer to activities such as land acquisition and other right-of-way costs; preliminary and construction engineering; new construction, reconstruction, resurfacing, rehabilitation, and restoration of roadways, bridges, and other structures; and installation of guardrails, fencing, signs, and signals. Capital outlays are further classified according to whether they support system preservation, system expansion, or system enhancement. Definitions for these are as follows:

- **System Preservation**—capital improvements on existing roads and bridges; includes reconstruction, resurfacing, pavement restoration/rehabilitation, widening of narrow lanes and shoulders, bridge replacement and bridge rehabilitation; does <u>not</u> include routine maintenance costs (these costs are captured by “non-capital expenditures”).
- **System Expansion**—construction of new roads and bridges, as well as costs associated with adding lanes to existing roads; includes all of “New Construction,” “New Bridge,” “Major Widening,” and most costs associated with “Reconstruction - Added Capacity.”
- **System Enhancement**—includes safety enhancements, installation of intelligent transportation systems, and environmental enhancements.

Based on a review of these definitions, EPA concludes that the activities classified as capital outlays are most likely to result in land disturbances. In 1997, capital outlays totaled $48.7 billion. Table 2-20 provides a more detailed breakdown of these expenditures.

Another 1999 FHWA report, *Our Nation's Highways*, shows that 6.9 percent of total state disbursements[29] for highways in 1998 went to new road and bridge construction. Another 36.3 percent went to other capital improvements on existing highways. Between 1995 and 1997, expenditures (from all jurisdictions) for system expansion grew at a faster rate than expenditures for either system

[28] Maintenance outlays cover spot patching, crack sealing (roads and bridge decks), and maintenance/repair of route markers, signs, guardrails, fencing, signals, and lighting.

[29] Total state disbursements were $80.5 billion in 1998. This figure includes Federal Aid for highways.

preservation or system enhancements. The C&P report shows that in 1997, 47.6 percent of capital outlays went toward system preservation; 8.0 percent went toward system enhancement; 15.6 percent went toward new roads and bridges; and another 28.8 percent went toward other system expansion.

The FHWA data does not report the mileage of new roads constructed versus the mileage lost (removed or taken out of commission due to condition). Some data is available for capital outlays by improvement type (such as new road construction, resurfacing, etc.). This information is presented in Table 2-19.[30]

[30] The data in Table 2-19 is based on a sample of direct State expenditures on particular improvements. FHWA then used this state data to estimate a national average for roads under jurisdiction of all governmental units (local, state, federal) and for all roadway systems. The "Total, State Arterials & Connectors" is based on the direct State expenditures data; "Total, Arterials and Collectors, All Jurisdictions" is estimated based on the State data. FHWA reports that there is very little information on expenditures for *local functional class* roads. FHWA assumed that the expenditure patterns for local functional class roads more or less followed the expenditure patterns for arterials and collectors and used this assumption to estimate the total capital outlay by all government units for all road systems (arterials, collectors, and local functional class roads). These expenditures are accounts of *governmental unit spending*, not of construction contractor spending, though it may be assumed that since the majority of roads are owned by some government unit (local, state, federal), any costs incurred by the construction contractor would ultimately be paid for with government funds.

Table 2-19. Highway Capital Outlay by Improvement Type, 1997 (Billions of Dollars)

Expenditure Item	System Preservation	System Expansion: New Roads & Bridges	System Expansion: Existing Roads	System Enhancement	Total
Direct State Expenditures on Arterials and Collectors					
Right-of-Way		0.9	1.5		2.4
Engineering	2.6	0.8	1.3	0.4	5.1
New Construction		3.1			3.1
Relocation			1.7		1.7
Reconstruction-Added Capacity	1.1		2.6		3.7
Reconstruction-No Added Capacity	1.0				1.0
Major Widening			1.8		1.8
Minor Widening	0.8				0.8
Restoration & Rehabilitation	2.5				2.5
Resurfacing	3.4				3.4
New Bridge		0.6			0.6
Bridge Replacement	1.7				1.7
Major Bridge Rehabilitation	1.5				1.5
Minor Bridge Work	0.7				0.7
Safety				1.2	1.2
Traffic Management/Engineering				0.4	0.4
Environmental and Other				0.5	0.5
Total, State Arterials & Collectors	***15.2***	***5.4***	***8.9***	***2.5***	***32.1***
Total Expenditures on Arterials and Collectors, All Jurisdictions (estimated)[a]					
Highways and Other	13.7	5.3	11.2	3.1	33.2
Bridge	4.9	0.8			5.6
Total, Arterials and Collectors	***18.5***	***6.0***	***11.2***	***3.1***	***38..9***
Total Capital Outlay on All Systems (estimated)[b]					
Highways and Other	17.1	6.6	14.0	3.9	41.7
Bridges	6.1	1.0			7.0
Total Capital Outlay, All Systems	***23.2***	***7.6***	***14.0***	***3.9***	***48.7***
Percent of Total Expenditures	**47.6%**	**15.6%**	**28.8%**	**8.0%**	**100.0%**

[a] Improvement type distribution was estimated based on State Arterial and Collector data.
[b] Includes expenditures for arterials and collectors as well as for local functional class roads.
Sources: Highway Statistics 1997, Table SF12-A and unpublished FHWA data; all FHWA 1999 Exhibit 6-13

2.4.1.4 Characterization of Supply

This section discusses the characteristics of supply in the C&D industry such as market structure, barriers to entry, and supply trends.

Market Structure

Section 2.3 summarized information about the size distribution of developers and builders, based on employee and revenue size criteria. As shown there, the industry consists predominantly of small firms and sole proprietorships who generally operate on a localized basis within a specific geographic market. Anecdotal information indicates that a large number of small firms focus on niche markets that are not as easily accessible to the large-scale builders (Housing Zone, 2001).

While the majority of firms are small, a small number of large operators do control a sizeable share of the market. In its special report on homebuilding, for example, Census reports that just over 100 builders, representing only 0.3 percent of all establishments, accounted for 90,772 new single-family homes, or 18.4 percent of the total. This represented an average of 865 homes per builder (see Table 2-20).[31] Assuming an average sales price of $200,000, builders in this size class would have average revenues of $173 million, substantially above the overall industry average of $1.0 million. At the top of the industry are builders like Pulte Corporation ($3.8 billion in housing revenues), Kaufman and Broad ($3.7 billion), and Centex Corporation ($3.3 billion) who operate nationwide and wield considerable market power.[32]

Discussions with representatives of the homebuilding industry suggest there are at least two common business models in the industry. Most projects are managed by either a single land developer who sells improved lots to individual builders, or feature a developer-builder who both develops the land and builds on it (some developers may sell some lots and retain others to build on themselves). Figure 2-4 illustrates these two alternatives.

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[31] These data are based on a subset of builders that are 100 percent specialized in new single-family home construction.

[32] http://www.housingzone.com/topics/pb/build/giants2000/2000400.asp accessed 3/9/01.

Table 2-20
Selected Statistics for Establishments by Single-Family Housing Starts Size Class: 1997
[Detail may not add to total because of rounding]

Number of Housing Starts	Establishments		Starts		Starts per Establishment
	No.	% of Total	No.	% of Total	
0	3,736	11.0%	0	0.0%	0.0
1-4	14,781	43.6%	33,363	6.8%	2.3
5-9	6,557	19.3%	42,175	8.6%	6.4
10-24	5,411	16.0%	79,226	16.1%	14.6
25-99	2,608	7.7%	109,258	22.2%	41.9
100-499	720	2.1%	138,000	28.0%	191.7
500+	105	0.3%	90,772	18.4%	864.5
Total	33,918	100.0%	492,792	100.0%	14.5

Source: U.S. Bureau of the Census, Construction Sector Special Study Table 3a.
(http://www.census.gov/ftp/pub/const/www/starts.pdf)

Barriers to Entry

In the economics literature, barriers to entry are considered to exist when it is difficult for a new firm to enter an existing market. According to academics who have studied the homebuilding industry, there are two types of barriers to entry for new homebuilding firms—entry costs and input cost differentials (Landis, 1986).

- *Entry cost differentials* are the additional costs a new homebuilder must incur to participate in a given market. These costs may be manifested in the form of local development fees, abnormally high land costs, or abnormally high wages. In the short run, entry cost barriers raise the cost of building and keep builders who are unable or unwilling to pay the extra costs out of the market. In the long run, builders produce at less than their optimal scale (i.e., to the left of the lowest point on their marginal cost curve) to avoid holding unsold inventory in a downturn. Thus, entry barriers flatten the industry average cost curve by increasing builders' exposure to "cyclical risk." In addition, these barriers tend to reduce the advantage of high volume builders over the long term (Landis, 1986).

- *Input cost differentials* are exhibited when new homebuilders must pay higher prices for inputs than existing firms, or when they are prevented from accessing necessary inputs. Usually, input price differentials are a temporary phenomenon but some forms of regulation can create permanent price differentials.

The existence of entry costs also increases the importance of up-front financing for home building projects. The builder must invest more funds earlier in the project to overcome the entry barrier. Firms with established credit may be able to borrow some of this up-front financing, while less well-established firms must use their own capital. In either case, the opportunity costs of the investment are larger so regulatory delays and environmental compliance requirements become more burdensome (Landis, 1986). Much of the cost of building regulation is the interest that accrues on invested funds while permits and variances are negotiated. Luger and Temkin (2000) estimate that the costs of delay for a 25-unit subdivision rise from $3,692 per month in the approvals stage to $13,400 per month in the construction phase.

Similar issues confront non-residential and heavy construction contractors. Non-residential projects are generally larger than residential projects, so builder financing and carrying costs are proportionately larger. Since fewer firms can take on large projects, the opportunity for incumbent firms to maintain barriers to entry is also greater. Most heavy construction is carried out under government or utility contracts where competitive bidding is required. This may tend to level the playing field for entering firms who can overcome the basic qualification requirements.

2.4.1.5 Supply Trends

This section provides a brief overview of trends in homebuilding practices that could potentially influence baseline ESC practices or the adoption of ESC options proposed by EPA under the effluent guidelines.

The National Governors Association (NGA) recently published a report examining a concept they have termed New Community Design (NCD). According to the report, NCD encompasses many of the concepts popular in residential design today: New Urbanism, Traditional Neighborhood Development, compact development, livable communities, master-planned communities, and neotraditional design. NCD has been described as "neighborhoods of housing, parks, and schools within walking distance of shops, civic services, jobs, and transit–a modern version of the traditional town" (Peter Calthorpe, as quoted in Hirschhorn and Souza, 2001, p. 9). This and other types of design such as low impact development (LID) have garnered new-found attention in recent years, and continue to be key topics for development professionals. Both NCD and LID are discussed in more detail below.

New Community Design

NCD is a development design philosophy aiming to create a walkable, multi-purpose community structure that decreases dependency on automobiles, takes advantage of public transportation, incorporates parks and other green spaces, and uses existing infrastructure. A community based on NCD incorporates residential, commercial, and institutional facilities. Residential communities are a blend of single and multi-family housing, and often blend commercial and retail facilities with housing units as well. According to the NGA report, approximately *one-third* of potential homebuyers would prefer an NCD community versus a traditional, sprawl-based development—provided that the option existed. Currently *less than one percent* of total housing construction is based on NCD principles. This means that the option to live in a NCD community versus a traditional sprawl community does not exist for many potential homebuyers. NGA identifies the following factors as limiting the adoption of NCD and similar concepts:

- Local zoning codes make it difficult for mixed-use communities to get approved.
- Lenders favor single-use residential projects, strip malls, and suburban office parks. This favoritism "causes conventional real estate analyses to discount the long-term returns of NCDs, making them difficult to finance" (Hirschhorn and Souza, p. 13).
- Conventional developers and builders have expertise in single-use projects and, as a result, continue doing what they are already familiar with. In many cases these individuals are not able, or prepared, to deal with the increase in up-front costs arising from the increased intensity at the planning and design stage of a NCD project.

A survey by the Canada Mortgage and Housing Corporation compared the costs and benefits of a conventional development (4,505 dwellings) with an NCD alternative (6,875 dwellings). The incremental savings resulting from the NCD alternative, on a per housing unit basis, were as follows: roads, $3,054; storm water management, $1,499; transit, $1,330; water, $1,099; policing, $1,016; and sanitary services, $975. The total infrastructure savings for the NCD alternative are $61.5 million (Hirschhorn and Souza, p. 36). The NGA report offers one solution to the lagging supply of NCD construction: implement parallel building codes. Such parallel building codes may serve to "level the playing field" with conventional subdivision development while still allowing conventional development to take place.

Low-Impact Development

LID is a development design strategy that aims to protect the natural pre-development hydrological function of a site. True LID shares many features with NCD, such as smaller lot sizes and the addition of greenspace to the site plan. However, whereas NCD focuses on mixed-use development, LID at this time focuses primarily on residential development, although LID concepts may be easily applied to other types of development (e.g., commercial, mixed-use).

The primary goals of LID are to: (1) minimize development impacts by reducing impervious surfaces, maintaining natural site drainage, reducing curb and gutter construction, and reducing clearing and grading; (2) create dispersed runoff controls on individual lots utilizing swales, flatter slopes, rain gardens, etc.; (3) maintain pre-development hydrology; and (4) encourage pollution prevention and runoff management by individual property owners (Coffman et al., 1998).

Conventional site design relies on storm water controls that collect and convey runoff away from the property as quickly as possible. This type of design relies on pipes, paved surfaces, drainage ditches, and gutters as well as traditional best management practices (BMPs) such as ponds and sediment basins. Such conventional design actually amplifies hydrologic changes (increased volume, runoff frequency, and discharge rate) as "natural storage is lost, the amount of impervious surfaces in increased, the time of concentration is decreased, runoff travel times are decreased and the degree of hydraulic connection is increased" (Prince George's County, 1999). In addition, while many conventional storm water control techniques are designed to "maintain the peak runoff discharge rate at predevelopment levels for a particular design storm event," only the runoff *rate* is controlled, leaving the runoff volume, frequency, and duration to increase unchecked (Coffman et al., 1998).

As with any relatively new technology or approach,[33] there are many concerns surrounding the effectiveness, costs, and benefits of LID as compared with conventional site design. Developers and builders want to know how using LID techniques will affect financing and their bottom line, while consumers want to know how it will affect their ability to purchase a new house, as well as their resale value.

Many in the construction industry have found that they face *lower* development costs with LID than with conventional "curb and gutter" design. A presentation at a 1999 Storm Water Workshop for the Florida Keys Carrying Capacity Study (FKCC; sponsored by the U.S. Army Corps of Engineers, Jacksonville Division) demonstrates how LID can lower overall development costs. Table 2-21 reproduces the construction cost table presented for a residential development in Maryland.

Table 2-21. Construction Cost Comparison for Low Impact Development

Cost Element	Conventional Development	Low Impact Development
Grading/Roads	$569,698	$426,575
Storm Drains	$225,721	$132,558
SWM Pond/Fees	$260,858	$10,530
Bioretention/Micro	--	$252,124
Total	$1,086,277	$821,787
Unit Cost	$14,679	$10,146
Lot Yield	74	81

Source: Coffman, 1999

As shown above, construction costs associated with development were estimated to be nearly $250,000 lower for a LID development plan than for a conventional plan. In addition, the LID design actually increased lot yield from 74 lots to 81 lots. This is only one example of reduced construction costs and/or increased lot yield achievable though LID design.

[33] The term "relatively new" is used quite loosely here. LID technologies have been in use for some time, although such designs are just now beginning to gain mainstream acceptance.

The major additional cost developers incur when choosing LID (as well as NCD), is the increased time and effort often needed at the design stage of a project. The additional planning time is used to assess site hydrology, design runoff controls for each lot, and other considerations. Conservation-oriented design "creates significant upfront costs and raises questions of financial viability" (Mammoser, 2000, p. 45). These costs can increase more if structures are built using environmentally-friendly materials, which have generally higher "first cost" compared to more traditional materials. As noted by Mammoser, (2000), potential lenders may be wary of financing a LID project. As more LID projects prove successful and profitable, however, lenders may become more accepting of such "alternative" forms of development and perceive them as no more risky—and perhaps less risky—than conventional developments.

2.4.2 Characteristics of Construction Demand

This section describes the factors and characteristics of demand in the C&D industry. The major demand factors addressed are: housing demand and demand elasticity, the impact of regulation on demand for housing, and demand for nonresidential and heavy construction.

2.4.2.1 Demand Factors Affecting Construction and Development Activities

According to a recent study (Luger and Temkin, 2000), market demand is one of the three major factors taken into consideration by a builder/developer when deciding whether or not to propose a development. Market demand includes the types and quantities of housing units the public wants, and is affected by general macroeconomic conditions, demographics, and consumer tastes. Other factors that may affect demand for C&D activities include inflation (Henderschott, 1980), transaction costs (i.e., costs associated with purchasing a new home/facility) (Haurin and Chung, 1998), expected length of tenure (Haurin and Lee, 1989), mortgage loan to house value (Haurin and Lee, 1989), and borrowing constraints (Linneman et al., 1997; Zorn, 1993). Changing demographics tend to have a fairly large effect on the *type* of residential housing demanded (i.e., single-family versus multifamily) (Hirsch, 1994; Eppli and Childs, 1995).

2.4.2.2 Housing Demand and Elasticity

As discussed above, housing demand is largely determined by macroeconomic factors, demographics, and consumer tastes. Changes in the age of family formation, the size of families, and their perceived needs for space will affect the market's demand for houses of various sizes and styles. Geographic shifts in economic activity and changes in worker mobility affect where people wish to live. As these market factors evolve, an increasing number of buyers find that existing housing does not meet their desires. In other words it becomes an imperfect substitute for new housing (Landis, 1986). As an illustration, the average size of new homes has been increasing in the U.S., even as family sizes have diminished or remained unchanged. In 1995, the average size of a new home was 2,095 square feet. By 1999 the average had risen more than 6 percent, to 2,225 square feet (Census, 2000c). Existing housing does, however, act as a check on the prices of new housing (Landis, 1986) since it serves as the default alternative.

Demand for new construction may be viewed as the outcome of a four-way household decision process in which households decide whether to buy an existing home, buy a newly constructed home, improve their current home, or do nothing. In light of demographically-driven demand and the existence of near substitutes, it is not surprising that empirical studies find a somewhat inelastic demand for new housing (DiPasquale, 1999). Price is not the strong determining factor in housing markets that it is in more commodity-like markets. Luger and Temkin (2000) report that this inelasticity is more pronounced in the higher-end housing markets.

Demographic trends are local as well as national phenomena. Different parts of the country grow at different rates and as the size and make up of the local population changes so do housing tastes and preferences. Location is a key aspect of housing demand, perhaps more significant than price. As a result, demand for homes in favorable locations is far stronger than demand for homes in less desirable locations. Strong demand in certain regions or neighborhoods will be reflected in a less elastic demand curve.

2.4.2.3 Impact of Regulation on Housing Demand

Increased regulations may exert upward pressure on housing prices which may, in turn, price some potential homebuyers out of the market due to income constraints. Luger and Temkin (2000) give the following example: if regulations on the construction industry increase the price of a house by $10,000, a household would need $2,500 more in annual income to still qualify for the house. The authors define “excessive” regulation as those regulations that are “beyond what is essential” to accomplish set environmental or developmental goals, or those delays that are longer than what should be necessary to accomplish a fair review of plans (Luger and Temkin, 2000). Table 2-22 illustrates this effect.

Table 2-22. Impact of Regulatory-Driven Delays on Housing Affordability

Parameters	No Delay/No Excessive Regulation	With Delays and Excessive Regulation
House Price	$175,000	$185,000[b]
PITI Payment[a] (per month)	$1,377	$1,437[c]
Income Needed to Qualify for Mortgage	$55,000	$57,500

[a] Principal, Interest, Tax, Insurance Payment. Assumes an 80 percent, 30-year conventional mortgage at 8 percent interest, using tax and insurance data from New Jersey.
[b] Assumes $10,000 in regulatory costs added to the home price.
[c] Calculated using typical mortgage spending limit equal to 30 percent of gross income.
Source: Luger and Temkin 2000, pages 10-11.

Housing demand, especially in the higher-end market, tends to be fairly inelastic. This inelasticity results in the appearance of a multiplier effect with regard to regulatory costs and sales price. In other words, a one dollar increase in costs to the builder will translate into a more than one dollar cost to the consumer (if costs are passed forward as they tend to be with inelastic markets). Estimates for the magnitude of this multiplier range from two to six, with the average being approximately four (Luger and Temkin, 2000). The potential impact of this proposed rule on housing prices is discussed and analyzed in Chapters Four and Five.

2.4.2.4 Trends in New Homes Sold

Table 2-23 shows the number of new one-family houses sold and for sale from 1981 through 1999, including the median number of months from start to sale, average sales prices, and median sales price.

Table 2-23
New One-Family Houses Sold and For Sale

Year	Total (Thousands)	Median Months Start to Sale	Average Sales Price	Median Sales Price
1981	436	5.1	$83,000	$68,900
1982	412	3.9	$83,900	$69,300
1983	623	2.9	$89,800	$75,300
1984	639	3.4	$97,600	$79,900
1985	688	3.9	$100,800	$84,300
1986	750	3.6	$111,900	$92,000
1987	671	3.9	$127,200	$104,500
1988	676	4.0	$138,300	$112,500
1989	650	4.3	$148,800	$120,000
1990	534	4.5	$149,800	$122,900
1991	509	4.4	$147,200	$120,000
1992	610	3.5	$144,100	$121,500
1993	666	3.6	$147,700	$126,500
1994	670	3.8	$154,500	$130,000
1995	667	4.3	$158,700	$133,900
1996	757	4.2	$166,400	$140,000
1997	804	3.7	$176,200	$146,000
1998	886	3.5	$181,900	$152,500
1999	907	3.3	$195,800	$160,000

Source: Bureau of the Census (2000c).

2.4.2.5 Nonresidential Demand Characteristics

Demand characteristics affecting the nonresidential and heavy construction sectors are similar to those affecting the residential sector. General economic conditions, interest rates, and past industry activity all have an effect on current demand. According to a recent press release by CMD (2001b), the demand and supply cycles in construction are highly localized, and at any given time different cities across the nation are at different points in their own cycles. For example, as of October, 2001, office markets in Washington D.C., San Diego, Los Angeles, and several areas in New York were experiencing increasing office vacancies, but new construction was still occurring. In markets such as Dallas, Jacksonville, Tampa, and Salt Lake City, however, there has been low or even negative demand growth. While buildings in progress are still being completed, new construction starts have slowed dramatically. The industrial market was still fairly stable in October and had not yet begun showing signs of substantial decline (CMD, 2001b).

As with residential construction, general population growth should ensure that demand for all building types will continue to rise in the future (CMD, 2001b). The rate at which demand increases, however, is certainly variable and may not be the same for all markets in all portions of the United States. For the commercial building market in particular, past building activity has affected demand through recent years. The Economic Recovery Tax Act of 1981 fueled a commercial building boom that ultimately generated severe excess capacity in the market (CMD, 2001a). This caused a decrease in demand for new commercial construction throughout the late 1980s and into the 1990s as the market worked to absorb some of the excess commercial space. The growth in the technology sector in the late 1990s spurred another boom in the office market. According to CMD (2001a), approximately 20 million square feet of office space was built between 1998 and 2000 as a result of increased demand from this one sector. Vacancy rates increased once again as the year 2000 brought the decline of the technology sector and associated economic downturn.

For the commercial and industrial sectors, increasing vacancy rates tend to be followed by a decrease in new construction activity as the market tries to absorb the over-supply of space. The demand for new construction in these sectors is heavily influenced by the performance of other sectors, as evidenced by the technology sector example above. A “boom” in one industry necessitates the acquisition of new space for expansion; if the market does not have a ready supply of the type of space needed, then new construction increases. At the same time, a "bust" in a given industry will free up space in the market, and until the space is absorbed, new construction will slow. As with residential construction, lower interest rates may increase construction activity, while higher rates will tend to slow activity.

2.4.2.6 Heavy Construction Demand Characteristics

The heavy construction industry (NAICS 234) is defined by the U.S. Census Bureau to include those establishments that are "engaged in the construction of heavy engineering and industrial projects (except buildings) such as highways, power plants, and pipelines" (U.S. Census Bureau, 2000f). Heavy construction projects are characterized by their linear nature, as many projects are spread along a horizontal, rather than vertical, plane (Ringwald, 1993). Since the definition of heavy construction projects excludes buildings, these projects are much more weather-sensitive than building construction and there are fewer days suited for heavy construction projects nationwide, especially in the northern states (Ringwald, 1993). The general trend in heavy construction through the 1990s was toward the rehabilitation of existing infrastructure (Ringwald, 1993).

In addition, the majority of heavy construction projects (and the majority of the value of construction work) is performed for public, rather than private, owners (Ringwald, 1993; U.S. Census Bureau, 2000f, p.5). As Table 2-24 shows, more than 50 percent of the value of construction work in NAICS 234 occurs under government-owned projects, compared with less than 25 percent of the value in NAICS 233 (Building, developing, and general contracting) and NAICS 235 (Special trades). This division of project ownership sets the heavy construction sector apart from the other major construction sectors.

For heavy construction firms, work done for a public entity generally entails different contractual requirements than work done for private entities. When the project owner is a public entity such as a city, state, or federal government, at least 50 percent of the contract-related jobs are generally performed by the prime contractor, or conversely, less than half of the work under a given contract will be subcontracted to other firms (Ringwald, 1993). This practice provides a public owner with more easily enforceable specifications, since the majority of the work is done by the primary contractor (Ringwald, 1993). On the other hand, 80 to 100 percent of the work on a privately-owned project may be subcontracted to firms other than the prime contractor (Ringwald, 1993).

The negotiated contracts often used in private-sector construction are not as common in the public arena. This is because a private owner generally has to prove the cost-effectiveness of the contract only to the owner's satisfaction, whereas a public owner may be called on to demonstrate the cost-effectiveness of such contracts to large numbers of taxpayers (Ringwald, 1993). For this reason, most heavy construction contracts let by public entities are competitively bid. Often, local law or agency regulations require the use of competitive bidding for public projects. There is a sense that such a system provides fairness in the awarding of contracts, as well as providing value to the taxpayers (ASCE, 2000).

Table 2-24. Value of Construction Work by Project Ownership (1997, $thousands)

1997 NAICS code	Description	Owned by Federal Government	Owned by State/Local Govts.	Total Govt. Owned	Govt. Owned as Percent of Total	Privately Owned	Privately Owned as Percent of Total	Total Private and Government
233	Building, developing, and general contracting	$14,362,134	$43,472,528	$57,834,664	15.2%	$323,806,944	84.8%	$381,641,608
234	Heavy Construction	$8,845,515	$60,368,420	$69,213,936	54.1%	$58,627,664	45.9%	$127,841,600
235	Special Trade Contractors[a]	$559,910	$2,179,346	$2,739,258	17.2%	$13,171,513	82.8%	$15,910,771
TOTAL		**$23,767,559**	**$106,020,294**	**$129,787,858**	**24.7%**	**$395,606,121**	**75.3%**	**$525,393,979**

[a]Covers establishments in NAICSs 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000f), *1997 Census of Construction*.
Figures may not add to totals due to rounding.

2.5 ECONOMIC AND FINANCIAL CHARACTERISTICS

2.5.1 Value of Work Done

For the C&D industries, the Bureau of Census defines the *value of construction work* as the combined value of completed work on new construction, additions, alterations, reconstruction, and maintenance and repair. In addition, the Census defines the *value of business done* as the sum of the value of construction work plus other business receipts, which include: receipts from retail and wholesale trade, rental of equipment, manufacturing, transportation, legal service, insurance, finance, rental of property and other real estate operations, and other non-construction activities. While the value of construction work is a good indicator of economic performance specifically related to C&D activity, the value of business done measure provides a better *overall* indicator of the economic performance of establishments in the C&D industries.

In addition to value of construction work, value of other receipts, and value of work done, the 1997 Census of Construction Industries includes three other measures: value of construction work subcontracted in from others, net value of construction work, and value added. The value of construction work subcontracted in from others includes the value of construction work done by reporting establishments as subcontractors. The net value of construction work is calculated by subtracting the costs of construction work subcontracted out to others from the value of construction work done. The value added component is equal to the value of business done minus the costs of construction work subcontracted to others and the costs for materials, components, supplies, and fuels (see Section 2.5.2 for discussion of these costs).

Table 2-25 below shows, for each of the C&D industries, the dollar value of business done (or total revenues), value of construction work, value of other business receipts, value of construction work subcontracted in from others, net value of construction work, and value added. Overall, the total *value of business done* (or revenues) in the C&D industries was $534.2 billion in 1997. This represented a nominal increase of 57.8 percent over the $338.5 billion in business done in 1992. NAICS 233 (Building and Developing, including NAICS 2331) accounted for $386.9 billion or 72.4 percent of the total in 1997. The value of business done by heavy construction contractors (NAICS 234) was $130.8 billion

(24.4 percent of the total), while special trade contractors (NAICS 23593 and 23594) earned $16.5 billion (3.1 percent of the total).

The total *value of construction work* done in the C&D industries was $525.4 billion and represented 98.3 percent of total business done in 1997. This represented a nominal increase of 58.9 percent over the $330.6 billion in construction work done in 1992. Again, NAICS 233 (Building, developing, and general contracting, including NAICS 2331) accounted for the largest share, completing $381.6 billion (or 74.7 percent) of the total value of construction work done in the C&D industries in 1997. Construction work by heavy construction contractors (NAICS 234) was valued at $127.8 billion (24.3 percent of the total). Work done by excavation and wrecking/demolition contractors (NAICS 23593 and 23594) was worth $15.9 billion and represented 3.0 percent of the total value of construction work done in 1997.

In addition to the $525.4 billion in construction work done, the C&D industries also *subcontracted in* $43.0 billion in construction work from others. This represented a nominal increase of 91.2 percent over the $28.2 billion in work subcontracted in during 1992. Although NAICS 233 accounted for the highest share of construction work value, NAICS 234 (Heavy construction) earned the greatest share of work subcontracted in, totaling $28.4 billion or 52.6 percent of the total construction work subcontracted in by the C&D industries in 1997.

As explained above, the *net value of construction work* is calculated by subtracting the value of work subcontracted out to others from the value of construction work done. For the C&D industries, this measure totaled $318.6 billion in 1997, a nominal increase of close to 60 percent over the 1992 figure of $199.3 billion. Costs for materials, components, supplies, and fuels can be further subtracted to obtain the *value added* measure, which amounted to $199.9 billion in 1997, a nominal increase of 70.3 percent over 1992. Of the 1997 total, NAICS 233 (including NAICS 2331) accounted for $120.3 billion, or 60.2 percent. Establishments in NAICS 234 (Heavy construction) accounted for $68.8 billion, or 34.4 percent of the value added while NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) accounted for $10.8 billion, representing 5.4 percent of the total.

Table 2-26 shows the value of construction work done by major type of construction (building construction, nonbuilding construction, and construction not specified by kind) for each of the large NAICS categories (Building, developing, and general contracting; Heavy construction, and Special trades). The largest type of activity for both building contractors and special trades was single-family house construction. Highways and street-related construction were the largest category of activity for heavy construction contractors, followed by sewer and water main construction. Table 2A-3 in Appendix 2A contains a more detailed table, showing value of construction work done by specific type of construction.

Table 2-25
Value and Net Value of Construction Work (Thousands of 1997 Dollars)

NAICS	Description	Dollar Value of Business Done[a] ($1,000)	Value of const work[b] ($1,000)	Value of other business receipts[c] ($1000)	Construction work subcontracted in[d] ($1,000)	Net value of construction work[e] ($1000)	Value added [f] ($1,000)
233, except 2331	Building, developing, and general contracting, except land development and subdivision	$372,516,170	$368,006,098	$15,451,969	$4,510,092	$188,579,070	$111,168,087
2331	Land subdivision and land development	$14,409,755	$13,635,521	$774,235	$272,860	$10,247,820	$9,154,633
234	Heavy construction	$130,794,520	$127,841,600	$2,952,920	$28,386,274	$105,639,352	$68,775,976
235[g]	Special trade contractors	$16,497,584	$15,910,770	$586,814	$9,845,092	$14,130,038	$10,818,550
TOTAL		**$534,218,029**	**$525,393,989**	**$19,765,938**	**$43,014,318**	**$318,596,280**	**$199,917,246**

[a] Dollar value of business done comprises the total value of construction work and other business receipts from 1997.
[b] Value of construction work includes all value of construction work done during 1997 for construction work performed by general contractors and special trade contractors. Included is new construction, additions and alterations or reconstruction, and maintenance and repair construction work. Also included is the value of any construction work done by reporting establishments for themselves.
[c] Other business receipts include receipts from retail and wholesale trade, rental of equipment, manufacturing, transportation, legal service, insurance, finance, rental of property and other real estate operations, and other non-construction activities.
[d] Value of construction work subcontracted in from others includes the value of construction work during 1997 for work done by reporting establishments as subcontractors
[e] Net value of construction work is derived for each establishment by subtracting the costs for construction work subcontracted to others from the value of construction work done.
[f] Value added, derived for each establishment, is equal to dollar value of business done less the costs of construction work subcontracted to others and costs for materials, components, supplies, and fuels.
[g] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

Table 2-26
Value of Construction Work by Type of Construction (Thousands of 1997 Dollars)

Type of Construction	**Building, developing, and general contracting**		**Heavy construction**		**Special trade contractors**[a]		**Total**	
	Value	***Pct.***	***Value***	***Pct.***	***Value***	***Pct.***	***Value***	***Pct.***
Building construction, total	$371,426,049	97.32%	$5,218,782	4.08%	$12,550,515	78.88%	$389,195,346	74.08%
Nonbuilding construction, total	$5,970,952	1.56%	$121,763,483	95.25%	$3,036,318	19.08%	$130,770,753	24.89%
Construction work, n.s.k.	$4,244,630	1.11%	$859,210	0.67%	$323,939	2.04%	$5,427,779	1.03%
Total value of construction work	**$381,641,600**	**100.00%**	**$127,841,600**	**100.00%**	**$15,910,770**	**100.00%**	**$525,393,970**	**100.00%**

NA = Data Not Available
[a]Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

2.5.2 Selected Costs

The Census of Construction reports on the categories of costs incurred by the C&D industries, including costs of materials, components, and supplies; costs of construction work subcontracted out to others; costs of power, fuels, and lubricants; costs of machinery, equipment, and buildings; and other selected purchased services. Costs of materials, components, and supplies reflect the costs of purchasing all materials, components, and supplies, except fuels, but do not include industrial and specialized machinery and equipment costs such as printing presses and computer systems nor costs of materials furnished to contractors by the owners of projects. Costs of construction work subcontracted out to others do not include the costs of purchasing materials, components, and supplies provided to a subcontractor for use nor costs for machinery or equipment rental. Included in the costs of power, fuels, and lubricants are the costs of fuels, lubricants, and electric energy purchased from other companies or received from other establishments of the company, plus costs for natural and manufactured gas, fuel oil, coal, and coke products. The selected materials costs described above are presented in Table 2-27.

2.5.2.1 All Costs

As shown in Table 2-27, all C&D establishments incurred costs of $334.3 billion in 1997 for materials, components, work subcontracted out, power, fuels, and lubricants. This represented a nominal increase of 59.6 percent over the $209.5 billion in costs incurred in 1992. Establishments in NAICS 233 (Building and developing, including NAICS 2331) accounted for $266.6 billion, or 79.7 percent of the total. Establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) incurred costs of $5.7 billion, or 1.7 percent of the total.

2.5.2.2 Machinery and Equipment Costs

Machinery and equipment costs include the costs to rent or lease construction machinery and equipment; transportation equipment; production equipment; office equipment, furniture and fixtures; and scaffolding; and the costs of renting or leasing office space and buildings, which define the costs of buildings. The Census Bureau also reports costs of selected purchased services, including communication services purchased from other companies or from other establishments of the company, and the costs of all repairs made to structures and equipment by outside companies or from other establishments of the same company. These machinery, equipment costs, and selected services costs are presented in Table 2-28.

According to Table 2-28, establishments in the C&D industries spent $7.3 billion on machinery, equipment, and buildings in 1997. This represented a nominal increase of 43.1 percent from 1992, when these expenditures totaled $5.1 billion. Establishments in NAICS 234 (Heavy construction) accounted for $4.3 billion, or roughly 60 percent of the total. The C&D industries also spent $7.7 billion on communication services, repairs to buildings and other structures, and repairs to machinery and equipment. NAICS 234 (Heavy construction) accounted for $4.2 billion of this total.

Table 2-27
Selected Costs in the Construction Industry (Thousands of 1997 Dollars)

NAICS	Industry	Materials, Components, and Supplies[a]	Construction Work Subcontracted out to Others[b]	Selected Costs of Power, Fuels, and Lubricants[c]					Total Selected Costs
				Electricity	Natural and Manu-factured Gas	Gasoline and Diesel Fuel	Other, Including Lubricating Oils and Greases	Total Power, Fuels, and Lubricants	
233, except 2331	Building, developing, and general contracting, except land subdivision and development	$79,936,341	$179,427,020	$599,022	$134,485	$1,179,930	$73,637	$1,984,736	$261,348,110
2331	Land subdivision and development	$1,778,171	$3,387,700	$31,244	$9,068	$46,600	S	$89,251	$5,255,122
234	Heavy construction	$36,655,772	$22,202,246	$340,172	$160,257	$2,409,752	$250,340	$3,160,521	$62,018,540
235[d]	Special trade contractors	$3,254,362	$1,780,731	$38,952	$12,973	$540,227	$51,789	$643,942	$5,679,034
TOTAL		**$121,624,646**	**$206,797,697**	**$1,009,390**	**$316,783**	**$4,176,509**	**$375,766**	**$5,878,450**	**$334,300,806**

[a] Costs to reporting establishments during 1997 for the purchase of all materials, components, and supplies, except fuels. Does not include industrial and other specialized machinery and equipment such as printing presses and computer systems, and materials furnished to contractors by the owners of projects.
[b] Costs during 1997 for construction work subcontracted out to other contractors, not including costs of purchasing materials, components, and supplies provided to a subcontractor for use and costs for machinery and equipment rental.
[c] Costs include fuels, lubricants, and electric energy purchased during the year from other companies or received from other establishments of the company and costs for natural and manufactured gas, fuel oil, coal, and coke products.
[d] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
S Withheld because estimate did not meet publication standards on the basis of either response rate, associated relative standard error, or a consistency review.
Source: U.S. Census Bureau (2000a).

Table 2-28
Additional Selected Costs in the Construction Industry (Thousands of 1997 Dollars)

NAICS	Description	Machinery, Equipment, and Buildings			Selected Purchased Services			
		For Machinery and Equipment[a]	For Buildings[b]	Total	Communication Services[c]	Repairs to Buildings and Other Structures[d]	Repairs to Machinery and Equipment[e]	Total
233, except 2331	Building, developing, and general contracting, except land development and subdevelopment	$1,403,930	$901,176	$2,260,517	$1,260,796	$203,102	$1,060,589	$2,521,488
2331	Land subdivision and development	S	$36,251	$80,840	$54,022	$10,048	$39,290	$103,359
234	Heavy construction	$3,853,016	$444,702	$4,297,718	$647,860	$188,895	$3,349,522	$4,186,276
235[e]	Special trade contractors	$615,405	$91,657	$707,063	$133,414	$28,471	$729,510	$891,395
TOTAL		**$5,872,351**	**$1,473,786**	**$7,346,138**	**$2,096,092**	**$430,516**	**$5,178,911**	**$7,705,518**

[a] Includes all costs during 1997 for renting or leasing construction machinery and equipment, transportation equipment, production equipment, office equipment, furniture and fixtures, scaffolding, etc.
[b] Includes all costs of renting or leasing office space and buildings.
[c] Includes all costs during 1997 for communication services purchased from other companies or from other establishments of the company.
[d] Includes the cost of all repairs made to structures and equipment by outside companies or from other establishments of the same company. Only costs required to maintain property and equipment are reflected here.
[e] Covers establishments in NAICS 23593 (Excavation contractors) and NAICS 23594 (Wrecking and demolition contractors) only.
S Withheld because estimate did not meet publication standards on the basis of either response rate, associated relative standard error, or a consistency review.
Source: U.S. Census Bureau (2000a).

2.5.3 Capital Expenditures and Depreciation

In addition to the materials costs discussed above, the Census of Construction reports on the capital expenditures incurred by construction establishments. Among these capital expenditures are the costs incurred to cover the acquisition, construction, and the major alteration of the establishment's own new and used buildings and other structures, and the acquisition of machinery and equipment. Table 2-29 presents data for total capital expenditures and depreciation for buildings, structures, machinery, and equipment, both new and used.[34]

Table 2-29 presents total capital expenditures for NAICS 233 (Building and developing), 234 (Heavy construction), 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors). Total capital expenditures (other than land) were $9.5 billion in 1997, which represented a 51.6 percent increase over the $4.9 billion spent in 1992. Beginning of year gross book value of depreciable assets totaled $70.6 billion in 1997. Of this, NAICS 233 (Building and developing, including NAICS 2331) accounted for $20.3 billion (28.8 percent). Establishments in NAICS 234 (Heavy construction) accounted for 60.0 percent of the total with $42.4 billion and establishments in NAICS 235 (Special trade contractors) accounted for 11.2 percent of total value with $7.9 billion. Depreciation charges during the year totaled $7.8 billion, with NAICS 234 (Heavy construction) accounting for $4.6 billion, or 59.3 percent of total depreciation charges. NAICS 233 (Building, developing, and general contracting, including NAICS 2331) accounted for $2.2 billion (27.9 percent) and NAICS 235 (Special trades contractors) accounted for $1.0 billion (12.8 percent) of total depreciation charges.

[34] The 1992 Census of Construction presented considerably more detailed data on capital expenditures, first dividing capital costs into those for (a) buildings and structures, and (b) machinery and equipment and then further subdividing these costs by "new" and "used" categories. The 1997 Census of Construction reports only the industry's total capital expenditure figures.

Table 2-29
Capital Expenditures in the Construction Industry: Total (Thousands of 1997 Dollars)[a]

NAICS	Description	Beginning-of-year gross book value of depreciable assets	Capital expenditures, other than land	Retirements and disposition of depreciable assets	End-of-year gross book value of depreciable assets	Depreciation charges during year
233, except 2331	Building, developing, and general contracting, except land development and subdevelopment	$18,737,612	$2,761,153	$940,445	$20,558,320	$2,021,179
2331	Land subdivision and development	$1,571,722	$276,804	$102,440	$1,746,086	$152,751
234	Heavy construction	$42,372,868	$5,313,180	$1,839,777	$45,846,272	$4,627,363
235[b]	Special trade contractors	$7,890,728	$1,104,527	$291,243	$8,704,113	$1,001,533
TOTAL		**$70,572,930**	**$9,455,664**	**$3,173,905**	**$76,854,791**	**$7,802,826**

[a] Capital expenditures refers to all costs actually incurred during 1997 which were or would be chargeable to the fixed assets accounts of the reporting establishments and which were the type for which depreciation accounts are ordinarily maintained. These expenditures cover the acquisition, the construction, and the major alteration of the reporting establishment's own buildings and other structures, and the acquisition of machinery and equipment.
[b] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

2.5.4 Value of Inventories

The Census of Construction Industries presents data on establishments' end-of-year inventories of materials and supplies. A total of 47,841 establishments in the C&D industries reported holding inventories of materials and supplies at the end of 1997. These inventories were valued at $7.0 billion at the end of the year. An additional 109,094 establishments reported no inventories, while 104,680 establishments did not report their inventories. Table 2-30 presents the inventory data for C&D establishments.

Table 2-30
Total Value of Inventories for Construction Industry Establishments, 1997 ($1,000)

		Establishments with Inventories[a]				Establishments without Inventories		Establishments not Reporting	
NAICS	Description	Number	Value of Construction Work[b]	End of year Materials & Supply Inventory	Beginning of year Materials & Supply Inventory	Number	Value of Construction Work[b]	Number	Value of Construction Work[b]
233, except 2331	Building, developing, and general contracting, except land development and subdevelopment	33,100	$89,182,562	$5,648,406	$5,015,102	81,735	$196,519,085	76,268	$82,304,448
2331	Land subdivision and development	2,248	$2,137,038	$269,847	$214,701	1,486	$2,993,955	4,452	$8,504,528
234	Heavy construction	9,634	$50,131,852	$1,017,171	$910,164	17,864	$54,143,044	15,058	$23,566,700
235[c]	Special trade contractors	2,859	$8,865,177	$35,467	$61,040	8,009	$7,389,990	8,902	$4,655,603
TOTALS		**47,841**	**$150,316,629**	**$6,970,891**	**$6,201,007**	**109,094**	**$261,046,074**	**104,680**	**$119,031,279**

[a] Inventory includes all of the materials and supplies that are owned regardless of where they are held, excluding materials that are owned by others, but held by the reporting establishment.
[b] Value of construction work includes all value of construction work done during 1997 for construction work performed by general contractors and special trades contractors. Included is new construction, additions and alterations or reconstruction, and maintenance and repair construction work. Also included is the value of any construction work done by reporting establishments for themselves.
[c] Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
Source: U.S. Census Bureau (2000a).

Among establishments in the C&D industries that reported inventories, NAICS 233 (Building, developing, and general contracting, including NAICS 2331) accounted for $5.9 billion or 84.9 percent of the total. A further $1.0 billion was reported by NAICS 234 (Heavy construction), representing 14.6 percent, while NAICS 235 (Special trades contractors) held $35.5 million in materials and supplies (1.0 percent).

2.6 KEY BUSINESS INDICATORS AND RATIOS

Table 2-31 below presents key financial characteristics for the construction industry as a whole (i.e., not just C&D industries). The items presented in the table are taken from Dun and Bradstreet's (D&B) *Industry Norms & Key Business Ratios Desk-Top Edition 1999-2000*. D&B bases this report on more than one million financial statements of U.S. corporations, partnerships and proprietorships, in all size ranges, including more than 800 business sectors defined by SIC codes. Though the Census Bureau is now using NAICS codes for most reporting of industry data, Dun & Bradstreet continues to use SIC codes. Therefore, Table 2-31 differs from the rest of this profile in presenting data based on the SIC code system.

In addition to various financial terms, Table 2-31 also presents a series of financial ratios for solvency, efficiency, and profitability. The table also notes the sample size of the financial statements used to estimate the values in each SIC code. The sample size for SIC 15 (General building contractors) is roughly three times the sample size for this SIC in 1998 (6,746 establishments versus 2,138). The sample size for SIC 16 (Heavy construction) also increased from 1998, from 2,135 to 2,847. The sample sizes for SICs 1794 (Excavation work) and 1795 (Wrecking and demolition work) are, as expected, much smaller than the sample sizes for the previous two SICs, at 755 and 87 establishments, respectively.

Solvency, or liquidity, ratios are used to evaluate a company's ability to meet short and long-term obligations and include the Quick Ratio, Current Ratio, Current Liability to Net Worth, Current Liability to Inventory, Total Liability to Net Worth , and Fixed Assets to Net Worth. The Quick Ratio is defined as the sum of cash and accounts receivable divided by total current liabilities and reveals the amount of liquid assets available to cover each dollar of current debt. The larger this ratio, the greater the liquidity.

The Current Ratio is calculated by dividing current assets by current liabilities; this ratio measures the margin of safety available to cover any possible shrinkage in the value of current assets. The quotient of current liabilities divided by net worth is the Current Liability to Net Worth ratio and relates the funds that are temporarily risked by creditors with the funds permanently invested by owners. Another ratio, Current Liability to Inventory, is obtained by dividing current liabilities by inventory, and is an indicator of the extent to which a business relies on funds from disposal of unsold inventories to meet its debts. Total Liability to Net Worth, calculated by dividing total liabilities by net worth, can be used to determine the effect of long-term (funded) debt on a business when compared with the Current Liabilities to Net Worth ratio. The final solvency ratio, Fixed Assets to Net Worth, is calculated when fixed assets are divided by Net Worth and identifies the proportion of net worth that consists of fixed assets. Chapter Four presents the financial characteristics of model firms in the C&D industry and an analysis of the effects of the proposed rule on the financial health of the model firms.

Table 2-31
Key Business Statistics and Ratios of the Construction Industry (1999)[a]

SIC	15	1521	1522	1531	1541	1542	16	1611	1622	1623	1629	1794	1795
Item	Building Constn. General Contrs. and Operative Builders	General Contrs. -- Single-Family Houses	General Contrs. -- Residential Buildings, Other Than Single-Family	Operative Builders	General Contrs. -- Industrial Buildings and Warehouses	General Contrs. - Non-residential Buildings, Other Than Industrial Buildings and Warehouses	Heavy Constn. Other Than Building Constn. Contrs.	Highway and Street Constn., Except Elevated Highways	Bridge, Tunnel, and Elevated Highway Constn.	Water, Sewer, Pipeline, and Communi-cations and Power Line Constn.	Heavy Constn., NEC	Excavation Work	Wrecking and Demolition Work
Sample Size[b]	6,746	1,780	283	112	870	3,701	2,847	959	159	1,086	643	755	87
Cash	245,212	102,836	250,363	425,696	309,137	323,254	277,028	333,899	385,604	238,632	247,547	132,318	137,765
Accounts Receivable	374,595	112,769	364,659	318,378	579,430	532,241	459,331	536,775	461,613	444,349	384,015	247,424	371,096
Notes Receivable	11,090	7,012	17,689	25,041	14,567	10,525	10,724	12,680	3,708	9,874	11,108	6,455	6,206
Inventory	71,469	84,138	57,148	1,087,493	24,278	30,070	37,533	46,492	31,516	27,978	44,431	17,212	31,028
Other Current Assets	247,675	108,094	303,429	790,579	313,992	315,737	257,368	278,954	317,010	245,215	228,504	96,818	162,587
Total Current Assets	950,041	414,849	993,288	2,647,187	1,241,404	1,211,827	1,041,984	1,208,800	1,199,451	966,048	915,605	500,227	708,682
Fixed Assets	209,477	129,129	261,248	565,210	280,004	215,002	639,846	794,596	532,060	580,945	566,501	531,423	480,315
Other Non-current	72,701	40,317	106,132	364,883	97,111	76,678	105,450	109,891	122,355	98,744	104,731	44,106	52,128
Total Assets	1,232,219	584,295	1,360,668	3,577,280	1,618,519	1,503,507	1,787,280	2,113,287	1,853,866	1,645,737	1,586,837	1,075,756	1,241,125
Accounts Payable	312,984	92,903	327,921	293,337	424,052	457,066	266,305	336,013	292,911	230,403	231,678	112,954	142,729
Bank Loans	8,626	7,596	10,885	60,814	3,237	7,518	8,936	10,566	3,708	6,538	9,521	7,530	7,447
Notes Payable	54,218	49,665	83,001	525,860	38,844	36,084	64,342	73,965	40,785	57,601	66,647	59,167	71,985
Other Current Liabilities	272,319	170,614	459,906	1,019,525	310,756	275,142	298,476	321,220	339,257	291,295	271,350	204,394	245,743
Total Current Liabilities	648,147	320,778	881,713	1,899,536	776,889	775,810	638,059	741,764	676,661	585,882	579,196	384,045	467,904
Other Long Term Debt	99,810	79,464	134,706	422,119	119,770	81,189	266,305	336,013	226,172	236,987	242,785	244,197	249,466

Table 2-31
Key Business Statistics and Ratios of the Construction Industry (1999)[a]

SIC	15	1521	1522	1531	1541	1542	16	1611	1622	1623	1629	1794	1795
Item	Building Constn. General Contrs. and Operative Builders	General Contrs. -- Single-Family Houses	General Contrs. -- Residential Buildings, Other Than Single-Family	Operative Builders	General Contrs. -- Industrial Buildings and Warehouses	General Contrs. - Non-residential Buildings, Other Than Industrial Buildings and Warehouses	Heavy Constn. Other Than Building Constn. Contrs.	Highway and Street Constn., Except Elevated Highways	Bridge, Tunnel, and Elevated Highway Constn.	Water, Sewer, Pipeline, and Communi-cations and Power Line Constn.	Heavy Constn., NEC	Excavation Work	Wrecking and Demolition Work
Deferred Credits	2,464	1,169	5,443	28,618	1,619	3,007	7,149	10,566	11,123	4,937	3,174	3,227	4,965
Net Worth	481,798	182,884	338,806	1,227,007	720,241	643,501	875,767	1,024,944	939,910	817,931	761,682	444,287	518,790
Total Liability & Net Worth	1,232,219	584,295	1,360,668	3,577,280	1,618,519	1,503,507	1,787,280	2,113,287	1,853,866	1,645,737	1,586,837	1,075,756	1,241,125
Net Sales	4,191,221	1,941,179	4,490,653	5,176,961	5,359,334	5,238,700	3,910,897	4,727,711	4,128,878	3,562,201	3,397,938	2,130,210	2,709,880
Gross Profit	779,567	475,589	853,224	1,180,347	986,117	832,953	985,546	1,054,280	792,745	961,794	965,014	705,100	875,291
Net Profit After Tax	138,310	77,647	157,173	62,124	182,217	157,161	175,990	203,292	156,897	167,423	152,907	104,380	124,654
Working Capital	301,894	94,071	111,575	747,651	464,515	436,017	403,925	467,036	522,790	380,166	336,409	116,182	240,778
RATIOS (median)													
SOLVENCY RATIOS													
Quick Ratio (times)	1.1	0.8	1.0	0.2	1.2	1.2	1.2	1.2	1.3	1.2	1.1	1.1	1.2
Current Ratio (times)	1.5	1.4	1.5	1.4	1.6	1.5	1.6	1.6	1.8	1.7	1.6	1.4	1.6
Current Liability to Net Worth (%)	122.3	115.5	102.7	143.2	107.7	128.1	65.7	67.1	62.9	64.2	66.6	65.5	75.1
Current Liability to Inventory (%)	740.3	153.5	837.6	96.9	999.9	999.9	999.9	999.9	999.9	999.9	841.5	999.9	668.1
Total Liability to Net Worth (%)	145.9	157.4	128.0	179.6	130.0	145.6	100.1	103.1	93.5	96.3	100.6	119.3	116.9

Table 2-31
Key Business Statistics and Ratios of the Construction Industry (1999)[a]

SIC	15	1521	1522	1531	1541	1542	16	1611	1622	1623	1629	1794	1795
Item	Building Constn. General Contrs. and Operative Builders	General Contrs. -- Single-Family Houses	General Contrs. -- Residential Buildings, Other Than Single-Family	Operative Builders	General Contrs. -- Industrial Buildings and Warehouses	General Contrs. - Non-residential Buildings, Other Than Industrial Buildings and Warehouses	Heavy Constn. Other Than Building Constn. Contrs.	Highway and Street Constn., Except Elevated Highways	Bridge, Tunnel, and Elevated Highway Constn.	Water, Sewer, Pipeline, and Communi-cations and Power Line Constn.	Heavy Constn., NEC	Excavation Work	Wrecking and Demolition Work
Fixed Assets to Net Worth (%)	25.9	37.0	23.1	17.1	27.6	23.0	68.5	75.4	51.7	66.1	68.6	105.0	77.8
EFFICIENCY RATIOS													
Collection Period (days)	42.0	21.5	39.1	4.8	47.1	48.2	49.6	46.4	46.7	54.6	49.3	51.5	56.2
Sales to Inventory (times)	65.3	13.8	34.8	2.6	203.7	149.9	86.2	98.2	78.8	96.8	53.5	99.4	46.5
Assets to Sales (%)	29.4	30.1	30.3	69.1	30.2	28.7	45.7	44.7	44.9	46.2	46.7	50.5	45.8
Sales to Net Working Capital (times)	12.5	12.1	10.5	6.6	11.8	12.9	9.0	9.5	7.7	8.5	8.9	9.7	8.3
Accounts Payable to Sales (%)	7.2	4.3	6.5	3.9	7.6	8.6	5.7	5.9	5.6	5.8	5.4	5.0	4.6
PROFITABILITY RATIOS													
Return on Sales (%)	2.0	2.5	2.6	2.9	2.0	1.8	3.2	3.0	3.1	3.5	3.2	3.5	3.4
Return on Assets (%)	6.5	8.0	6.7	4.4	6.5	6.0	6.6	6.5	6.4	6.9	6.6	6.7	9.0
Return on Net Worth (%)	18.3	27.5	22.7	16.8	15.1	16.4	15.5	14.8	12.9	16.4	15.0	17.7	24.2

[a]The dollar figures are the result of translating the common-size percentages into dollar figures. Common-size percentages are calculated for each item as a percentage of its respective aggregate total. The dollar figures are then computed by multiplying the common-size percentages for each statement item by their respective total amounts. This detailed data is not available for NAICS 655
[b]Number of establishments upon which calculations are based.
Source: Dun and Bradstreet Industry Norms & Key Business Ratios 1999-2000.

Efficiency ratios are indicators of how effectively a company uses and controls its assets. The five efficiency ratios presented by D&B are Collection Period, Sales to Inventory, Asset to Sales, Sales to Net Working Capital, and Accounts Payable to Sales. The Collection Period, measured in number of days, is calculated by multiplying 365 by the quotient of accounts receivable divided by sales. This measure helps determine the quality of the receivables of a company when compared with selling terms and industry norms. Dividing annual net sales by inventory results in the Sales to Inventory ratio, an indicator of the rapidity with which merchandise moves and the effect of the flow of funds into the business. Total assets are divided by net sales to obtain the Asset to Sales ratio. This ratio relates sales volume to the total investment used to generate those sales. Another sales-related ratio, Sales to Net Working Capital, is obtained by dividing sales by net working capital. This is an indicator of whether a company is overtrading or, conversely, carrying more liquid assets than needed for its volume. Finally, dividing accounts payable by annual net sales yields the Accounts Payable to Sales ratio, which measures how the company is paying its suppliers in relation to the volume being transacted.

D&B also reports three measures of profitability: Return on Sales (also known as Profit Margin), Return on Assets, and Return on Net Worth (also known as Return on Equity). These profitability ratios show how successfully a business is at earning a return for its owners. The Return on Sales ratio is computed by dividing net profits after taxes by annual net sales; this measure reveals the profits earned per dollar of sales, and ultimately is an indicator of the operation's efficiency. The Return on Assets ratio, derived by dividing net profit after taxes by total assets, is a key indicator of a firm's profitability as it matches operating profits with the assets available to earn a return. The final financial ratio is Return on Net Worth, or the value of net profit after taxes divided by net worth. This ratio can be used to analyze the ability of the firm to achieve an adequate return on the capital invested by the owners.

Further information about all ratios presented in D&B can be found in Appendix 2C.

2.7 INDUSTRY GROWTH

Table 2-32 presents annual totals for private housing units authorized by building permits for 1981 through 1999, by type of structure. These data show fluctuation in the number of units authorized each year, increasing from 985,500 units in 1981 to a peak of 1.8 million units in 1986. The period of 1987 through 1991 was marked by a steady decrease, with a low of 948,800 units in 1991. The number of units authorized then began a steady increase to 1.7 million units in 1999, representing an annual growth rate of 9.4 percent from 1991 to 1999. Table 2-33 shows national growth in terms of value of housing units authorized by building permits, by type of structure. Valuation of units authorized has grown from $78.8 billion in 1991 to $181.2 billion in 1999 (nominal), with an annual growth rate of 16.3 percent.

Total value of new privately owned housing units rose steadily from 1991 to 1994. From 1994 to 1995, total value of new privately owned housing units declined slightly, from $123.3 billion to $120.8 billion. This decrease was realized only in the 1-unit sector, which showed a decline from $109.3 billion in 1994 down to $104.8 billion in 1995; the remaining sectors actually realized continued increases in value.

Table 2-32
New Privately Owned Housing Units Authorized by Building Permit - Annual (Number of Housing Units), 1981-1999

Year	Total Units	Number of Units by Type of Structure			
		1 Unit	2 units	3 and 4 units	5 units or more
1981	985,500	564,300	44,600	57,200	319,400
1982	1,000,500	546,400	38,400	49,900	365,800
1983	1,605,200	901,500	57,500	76,100	570,100
1984	1,681,800	922,400	61,900	80,700	616,800
1985	1,733,300	956,600	54,000	66,100	656,600
1986	1,769,400	1,077,600	50,400	58,000	583,500
1987	1,534,800	1,024,400	40,800	48,500	421,100
1988	1,455,600	993,800	35,000	40,700	386,100
1989	1,338,400	931,700	31,700	35,300	339,800
1990	1,110,800	793,900	26,700	27,600	262,600
1991	948,800	753,500	22,000	21,100	152,100
1992	1,094,900	910,700	23,300	22,500	138,400
1993	1,199,100	986,500	26,700	25,600	160,200
1994	1,371,600	1,068,500	31,400	30,800	241,000
1995	1,332,500	997,300	32,200	31,500	271,500
1996	1,425,600	1,069,500	33,600	32,200	290,300
1997	1,441,100	1,062,400	34,900	33,600	310,300
1998	1,612,300	1,187,600	33,200	36,000	355,500
1999	1,663,500	1,246,700	32,500	33,300	351,100

Source: Bureau of the Census (2000e).

Table 2-33
Value of New Privately Owned Housing Units Authorized by Building Permit, Annual (Millions of Dollars)

Year	Total Value	Valuation by Type of Structure			
		1 unit	2 units	3 and 4 units	5 units or more
1991	$78,772.2	$69,772.7	$1,169.6	$1,061.6	$6,818.3
1992	$95,539.0	$87,071.5	$1,272.2	$1,126.2	$6,069.2
1993	$106,801.0	$97,118.6	$1,478.6	$1,281.7	$6,922.0
1994	$123,278.3	$109,294.0	$1,813.3	$1,595.7	$10,575.3
1995	$120,810.7	$104,738.7	$1,910.4	$1,713.3	$12,448.4
1996	$134,175.8	$116,535.0	$2,069.1	$1,861.4	$13,710.2
1997	$141,004.4	$121,194.5	$2,304.0	$2,057.7	$15,448.2
1998	$165,265.7	$142,240.8	$2,254.2	$2,282.0	$18,488.8
1999	$181,245.7	$157,123.5	$2,319.9	$2,317.5	$19,485.2

Source: Bureau of the Census (2000e).

2.8 INTERNATIONAL COMPETITIVENESS

Construction activities are highly localized, with most activities being performed either within the state the establishment is located in or within neighboring states. Some of the largest builders may perform work nationwide. The Census Bureau reports only construction activities within the United States; no data is reported on construction work by U.S. establishments that takes place outside the U.S. (Census, 2000a). EPA concludes that only a very small percentage of construction work done by U.S. construction firms is conducted outside of the U.S.

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APPENDIX 2A

Additional Detailed 5-Digit NAICS Tables

Table 2A-1
Detailed Number of Establishments in the C&D Industry with Payroll, by Legal Form of Organization

		Corporations		Proprietorships		Partnerships		Other		Total	
NAICS Code	**Description**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**	**Number**	**Percent of Total**
23311	Land subdivision and land development	6,268	76.6%	327	4.0%	1,323	16.2%	268	3.3%	8,186	100.0%
23321	Single-family housing construction	84,437	60.8%	41,735	30.1%	7,567	5.5%	5,110	3.7%	138,850	100.0%
23322	Multifamily housing construction	5,265	69.8%	1,430	19.0%	494	6.5%	355	4.7%	7,544	100.0%
23331	Manufacturing and industrial building construction	5,863	80.5%	1,052	14.5%	239	3.3%	126	1.7%	7,280	100.0%
23332	Commercial and institutional building construction	28,910	77.2%	6,018	16.1%	1,527	4.1%	975	2.6%	37,430	100.0%
23411	Highway and street construction	8,390	74.4%	1,933	17.2%	606	5.4%	341	3.0%	11,270	100.0%
23412	Bridge and tunnel construction	1,032	87.7%	60	5.1%	66	5.6%	19	1.6%	1,177	100.0%
23491	Water, sewer, and pipeline construction	6,267	77.9%	1,214	15.1%	342	4.3%	218	2.7%	8,042	100.0%

Table 2A-1
Detailed Number of Establishments in the C&D Industry with Payroll, by Legal Form of Organization

NAICS Code	Description	Corporations		Proprietorships		Partnerships		Other		Total	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
23492	Power and communication transmission line construction	2,395	72.6%	625	18.9%	158	4.8%	122	3.7%	3,300	100.0%
23493	Industrial nonbuilding structure construction	419	78.9%	77s	14.5%	19	3.6%	16	3.0%	531	100.0%
23499	All other heavy construction	12,177	66.8%	4,493	24.6%	923	5.1%	643	3.5%	18,236	100.0%
23593	Excavation contractors	11,001	60.3%	5,529	30.3%	951	5.2%	747	4.1%	18,229	100.0%
23594	Wrecking and demolition contractors	1,176	76.3%	241	15.6%	97	6.3%	29	1.9%	1,542	100.0%

s: Sampling error exceeds 40 percent.
Source: Bureau of the Census (1997)

Table 2A-2
Detailed Number of Small Establishments with Payroll in the C&D Industry, By Employment Size Class

NAICS Code	Description	Total	Establishments with less than 5 employees		Establishments with less than 10 employees		Establishments with less than 20 employees	
			Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
23311	Land subdivision and development	8,186	S	--	1,011	12.4%	1,465	17.9%
23321	Single-family housing construction	138,850	S	--	21,377	15.4%	28,611	20.6%
23322	Multifamily housing construction	7,544	S	--	1,456	19.3%	2,238	29.7%
23331	Manufacturing and industrial building construction	7,280	3,136	43.1%	4,802	66.0%	6,063	83.3%
23332	Commercial and institutional building construction	37,430	S	--	7,644	20.4%	13,505	36.1%
23411	Highway and street construction	11,270	S	--	1,987	17.6%	3,863	34.3%
23412	Bridge and tunnel construction	1,177	S	--	212	18.0%	439	37.3%
23491	Water, sewer, and pipeline construction	8,042	2,892	36.0%	4,332	53.9%	5,976	74.3%
23492	Power and communication transmission line construction	3,300	1,432	43.4%	2,167	65.7%	2,564	77.7%
23493	Industrial nonbuilding structure construction	531	S	--	30	5.6%	95	17.9%
23499	All other heavy construction	18,236	10,100	55.4%	13,542	74.3%	15,868	87.0%
23593	Excavation contractors	18,229	S	--	3,642	20.0%	5,522	30.3%
23594	Wrecking and demolition contractors	1,542	700	45.4%	1,048	68.0%	1,311	85.0%

Source: Bureau of Census (1997)

Table 2A-3
Value of Construction Work by Type of Construction (Thousands of 1997 Dollars)

Type of Construction	Building, developing, and general contracting		Heavy construction		Special trade contractors[a]		Total	
	Value	*Pct.*	*Value*	*Pct.*	*Value*	*Pct.*	*Value*	*Pct.*
Building construction, total	**$371,426,049**	**97.32%**	**$5,218,782**	**4.08%**	**$12,550,515**	**78.88%**	**$389,195,346**	**74.08%**
Single-family houses	$150,532,478	39.44%	$840,247	0.66%	$4,863,142	30.57%	$156,235,867	29.74%
Detached	$133,869,882	35.08%	$689,265	0.54%	$4,147,573	26.07%	$138,706,720	26.40%
Attached, including townhouses and townhouse-type condominiums	$16,662,596	4.37%	$150,982	0.12%	$715,569	4.50%	$17,529,147	3.34%
Apartment buildings, apartment type condominiums and cooperatives	$19,617,644	5.14%	$77,084	0.06%	$611,174	3.84%	$20,305,902	3.86%
All other residential buildings	$954,291	0.25%	$9,661	0.01%	NA	0.00%	$963,952	0.18%
Manufacturing and light industrial buildings	$26,211,179	6.87%	$1,314,909	1.03%	$1,215,516	7.64%	$28,741,604	5.47%
Manufacturing and light industrial warehouses	$10,666,086	2.79%	$98,046	0.08%	$429,738	2.70%	$11,193,870	2.13%
Hotels and motels	$9,370,227	2.46%	$85,071	0.07%	$176,654	1.11%	$9,631,952	1.83%
Office buildings	$40,371,389	10.58%	$730,524	0.57%	$1,207,915	7.59%	$42,309,828	8.05%
All other commercial buildings, nec	$36,519,818	9.57%	$952,333	0.74%	$2,283,510	14.35%	$39,755,661	7.57%
Commercial warehouses	$8,262,304	2.16%	$106,978	0.08%	$433,003	2.72%	$8,802,285	1.68%
Religious buildings	$4,936,913	1.29%	$21,500	0.02%	$131,868	0.83%	$5,090,281	0.97%
Educational buildings	$25,194,532	6.60%	$261,157	0.20%	$445,626	2.80%	$25,901,315	4.93%
Health care and institutional buildings	$18,798,347	4.93%	$81,173	0.06%	$276,604	1.74%	$19,156,124	3.65%
Public Safety buildings	$5,584,102	1.46%	$129,939	0.10%	NA	0.00%	$5,714,041	1.09%
Farm buildings, nonresidential	$2,107,126	0.55%	$52,862	0.04%	NA	0.00%	$2,159,988	0.41%
Amusement, social, and recreational buildings	$7,265,413	1.90%	$42,312	0.03%	NA	0.00%	$7,307,725	1.39%
Other building construction	$5,034,201	1.32%	$414,988	0.32%	$475,764	2.99%	$5,924,953	1.13%
Nonbuilding construction, total	**$5,970,952**	**1.56%**	**$121,763,483**	**95.25%**	**$3,036,318**	**19.08%**	**$130,770,753**	**24.89%**
Highways, streets, and related work	$1,639,808	0.43%	$42,628,013	33.34%	$675,214	4.24%	$44,943,035	8.55%
Airport runways and related work	$16,088	0.00%	$1,696,575	1.33%	NA	0.00%	$1,712,663	0.33%
Private driveways and parking areas	$107,129	0.03%	$3,722,761	2.91%	$437,042	2.75%	$4,266,932	0.81%

Table 2A-3
Value of Construction Work by Type of Construction (Thousands of 1997 Dollars)

Type of Construction	Building, developing, and general contracting		Heavy construction		Special trade contractors[a]		Total	
	Value	*Pct.*	*Value*	*Pct.*	*Value*	*Pct.*	*Value*	*Pct.*
Bridges, tunnels, and elevated highways	$587,747	0.15%	$10,697,254	8.37%	56,554	0.36%	11,341,555	2.16%
Bridges and elevated highways	$477,670	0.13%	$8,799,646	6.88%	NA	0.00%	$9,277,316	1.77%
Tunnels	$110,076	0.03%	$1,897,608	1.48%	NA	0.00%	$2,007,684	0.38%
Sewers, water mains, and related facilities	$211,602	0.06%	$19,475,202	15.23%	$988,387	6.21%	$20,675,191	3.94%
Sewers, sewer lines, septic systems, and related facilities	$123,480	0.03%	$11,642,425	9.11%	$642,755	4.04%	$12,408,660	2.36%
Water mains and related facilities	$88,122	0.02%	$7,832,777	6.13%	$325,439	2.05%	$8,246,338	1.57%
Pipeline construction other than sewer or water lines	$31,188	0.01%	$5,437,692	4.25%	NA	0.00%	$5,468,880	1.04%
Power and communication transmission lines, cables, towers, and related facilities	$160,372	0.04%	$8,79,079	6.48%	NA	0.00%	$8,439,451	1.61%
Power plants	$24,237	0.01%	$2,621,409	2.05%	NA	0.00%	$2,645,646	0.50%
Power and cogeneration plants, except hydroelectric	$11,702	0.00%	$1,916,102	1.50%	NA	0.00%	$1,927,804	0.37%
Power plants, hydroelectric	$12,535	0.00%	$705,307	0.55%	NA	0.00%	$717,842	0.14%
Blast furnaces, petroleum refineries, chemical complexes, etc	$37,950	0.01%	$6,505,276	5.09%	NA	0.00%	$6,543,226	1.25%
Sewage treatment and water treatment plants	$1,790,144	0.47%	$5,401,944	4.23%	NA	0.00%	$7,192,088	1.37%
Sewage treatment plants	$787,323	0.21%	$3,110,034	2.43%	NA	0.00%	$3,897,357	0.74%
Water treatment plants	$1,002,821	0.26%	$2,291,910	1.79%	NA	0.00%	$3,294,731	0.63%
Mass transit construction	$69,134	0.02%	$2,127,939	1.66%	NA	0.00%	$2,197,073	0.42%
Urban mass transit construction	$28,929	0.01%	$745,507	0.58%	NA	0.00%	$774,436	0.15%
Railroad construction	$40,205	0.01%	$1,382,432	1.08%	NA	0.00%	$1,422,637	0.27%
Conservation and development construction	$63,574	0.02%	$2,954,381	2.31%	NA	0.00%	$3,017,955	0.57%
Dam and reservoir construction	$18,688	0.00%	$876,118	0.69%	NA	0.00%	$894,806	0.17%
Dry/solid waste disposal	$13,970	0.00%	$1,101,556	0.86%	NA	0.00%	$1,115,526	0.21%
Harbor and port facilities	$66,927	0.02%	$681,255	0.53%	NA	0.00%	$748,182	0.14%

Table 2A-3
Value of Construction Work by Type of Construction (Thousands of 1997 Dollars)

	Building, developing, and general contracting		Heavy construction		Special trade contractors[a]		Total	
Type of Construction	***Value***	***Pct.***	***Value***	***Pct.***	***Value***	***Pct.***	***Value***	***Pct.***
Marine construction	S	–	$2,240,422	–	NA	0.00%	$2,240,422	0.43%
Outdoor swimming pools	$17,356	0.00%	$11,307	0.01%	NA	0.00%	$28,663	0.01%
Water storage facilities	$6,667	0.00%	$289,122	0.23%	NA	0.00%	$295,789	0.06%
Tank storage facilities other than water	$7,298	0.00%	$129,440	0.10%	$84,043	0.53%	$220,781	0.04%
Fencing	$4,485	0.00%	S	--	NA	0.00%	$4,485	0.00%
Recreational facilities	$213,600	0.06%	$2,084,069	1.63%	NA	0.00%	$2,297,669	0.44%
Billboards	D	--	D	–	NA	0.00%	D	0.00%
Heavy military construction	D	--	D	–	NA	0.00%	D	0.00%
Ships	$738	0.00%	S	–	NA	0.00%	$738	0.00%
Oilfields	D	–	D	–	NA	0.00%	D	0.00%
Other nonbuilding construction, nec	$805,656	0.21%	$2,639,358	2.06%	$795,078	5.00%	$4,240,092	0.81%
Construction work, n.s.k.	$4,244,630	1.11%	$859,210	0.67%	$323,939	2.04%	$5,427,779	1.03%
Total value of construction work	**$381,641,600**	**100.00%**	**$127,841,600**	**100.00%**	**$15,910,770**	**100.00%**	**$525,393,970**	**100.00%**

NA = Data Not Available
[a]Covers establishments in NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors) only.
D = Withheld to avoid disclosure.
S = Data withheld because it did not meed publication standards.
Source: Bureau of the Census (1997).

APPENDIX 2B

Specialization Within the C&D Industry, Categorized by Value of Construction Work

Table 2B-1
Specialization within NAICS 23311 (Land subdivision and land development), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached and Single-family houses, attached, including townhouses and townhouse-type condominiums	$7,903,746	$5,705,996	$633,804	$701,844	$519,252	$162,598	$180,251
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$1,690,850	$1,561,253	S	S	$15,817	--	$33,114
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
All other commercial buildings, n.e.c.	$1,009,513	$935,619	D	D	$11,283	S	$37,543
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-1
Specialization within NAICS 23311 (Land subdivision and land development), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-2
Specialization within NAICS 23321 (Single-family housing construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$127,870,584	$90,434,819	$14,615,758	$7,040,769	$6,600,743	$6,603,687	$2,574,808
Single-family houses, attached, including townhouses and townhouse-type condominiums	$12,534,326	$6,623,485	$1,292,951	$877,906	$1,074,921	$1,693,806	$971,257
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-2
Specialization within NAICS 23321 (Single-family housing construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-3
Specialization within NAICS 23322 (Multifamily housing construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$12,806,889	$5,719,872	$1,913,033	$1,301,955	$1,381,979	$1,267,724	$1,222,326
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$302,387	$156,078	S	$71,059	$60,965	$11,358	--
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-3
Specialization within NAICS 23322 (Multifamily housing construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-4
Specialization within NAICS 23331 (Manufacturing and industrial building construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$17,409,811	$5,934,603	$1,398,775	$2,472,131	$1,713,645	$3,795,456	$2,095,200
Warehouses	$5,725,339	$1,495,030	$601,604	$662,223	$663,498	$770,299	$1,532,686
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-4
Specialization within NAICS 23331 (Manufacturing and industrial building construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-5
Specialization within NAICS 23332 (Commercial and institutional building construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$5,336,593	$2,593,469	$240,813	$403,713	$931,858	$505,167	$661,573
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$26,385,309	$6,293,039	$5,074,920	$2,976,921	$3,531,528	$5,531,461	$2,977,440
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
All other commercial buildings, n.e.c.	$27,163,363	$11,059,298	$3,048,609	$3,714,883	$3,343,257	$3,127,898	$2,869,418
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$4,530,491	$1,198,731	$470,726	$402,550	$609,786	$1,421,744	$426,956
Religious buildings	$1,152,216	$230,911	$36,077	$196,952	$173,876	$319,808	$194,592
Educational buildings	$15,079,182	$2,176,769	$2,024,132	$1,921,258	$3,214,962	$2,560,961	$3,181,102
Hospitals and institutional buildings	$7,772,628	$1,768,726	$844,655	$592,229	$1,359,586	$1,911,122	$1,296,310
Public safety buildings	$884,390	$254,765	$120,669	$77,181	$70,047	$298,196	$63,532
Farm buildings, nonresidential	$1,637,968	$1,077,154	$141,707	$66,058	$96,840	$163,533	$92,675
Amusement, social, and recreational buildings, indoors	$2,424,893	$689,938	$599,733	$411,573	S	$363,722	$200,426
Other nonresidential buildings	$2,557,999	$1,446,128	$310,839	$337,232	$100,882	$276,818	$86,100
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0

Table 2B-5
Specialization within NAICS 23332 (Commercial and institutional building construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-6
Specialization within NAICS 23411 (Highway and street construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$43,439,086	$15,061,825	$5,949,644	$5,659,718	$6,827,389	$5,700,890	$4,239,620
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$476,352	$206,565	–	–	$164,989	$87,063	$17,736
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-6
Specialization within NAICS 23411 (Highway and street construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-7
Specialization within NAICS 23412 (Bridge and tunnel construction) Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Bridges, tunnels and elevated highways	$8,249,795	$3,472,091	$547,816	$952,468	$1,095,565	$1,623,637	$558,218
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0

Table 2B-7
Specialization within NAICS 23412 (Bridge and tunnel construction) Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-8
Specialization within NAICS 23491 (Water, sewer, and pipeline construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-8
Specialization within NAICS 23491 (Water, sewer, and pipeline construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$5,862,775	$1,760,074	$459,745	$455,130	$1,101,984	$1,470,400	$615,442
Water mains and related facilities	$3,011,687	$873,574	$165,404	$214,313	$427,597	$1,074,354	$256,446
Pipeline construction other than sewer or water lines	$4,250,644	$2,881,228	$257,301	$332,370	$197,666	$244,868	$337,212
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-9
Specialization within NAICS 23492 (Power and communication transmission line construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-9
Specialization within NAICS 23492 (Power and communication transmission line construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$7,598,682	$5,714,825	$596,189	$315,103	$426,416	$271,981	$274,169
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-10
Specialization within NAICS 23493 (Industrial non-building structure construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$0	$0	$0	$0	$0	$0	$0
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-10
Specialization within NAICS 23493 (Industrial non-building structure construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$6,499,398	$3,103,223	$802,685	$683,762	$75,497	$1,520,280	$313,951
Power plants, all	$1,616,857	$1,095,143	$53,785	$216,704	$176,694	$49,333	$25,197
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-11
Specialization within NAICS 23499 (All other heavy construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached	$0	$0	$0	$0	$0	$0	$0
Single-family houses, attached, including townhouses and townhouse-type condominiums	$0	$0	$0	$0	$0	$0	$0
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$0	$0	$0	$0	$0	$0	$0
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
Industrial buildings	$316,194	S	$42,314	$61,092	$6,240	$113,838	$15,227
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$428,206	$99,675	D	S	D	D	$50,790
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$499,123	$193,346	$40,682	$75,732	$84,589	$82,867	$21,908
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$1,606,298	$1,185,338	$48,268	$98,438	$60,307	$112,769	$101,178
Bridges, tunnels, and elevated highways	$272,411	$64,282	$39,300	$36,403	$54,103	$39,085	$39,239
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0

Table 2B-11
Specialization within NAICS 23499 (All other heavy construction), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Marine construction	$1,728,083	$1,433,105	$108,622	$81,257	$38,123	$47,960	S
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$2,215,356	$1,159,140	$229,741	$249,653	$134,677	$353,501	$88,644
Power and communication transmission lines, towers, and related facilities	$468,520	$368,874	S	$24,608	$8,159	$11,886	S
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, water mains and related facilities	$1,420,057	$485,718	$131,224	$121,354	$220,041	$291,336	$170,385
Pipeline construction other than sewer or water lines	$351,404	$112,249	$78,524	$32,448	D	D	$78,678
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Mass transit construction, total	$1,675,367	$1,043,053	$112,182	D	$107,298	D	D
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Sewage and water treatment plants	$2,699,575	$818,096	$327,674	$255,130	$413,160	$539,916	$345,601
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Dry/solid waste disposal	$746,785	$352,148	$90,543	$53,407	$74,059	S	$70,040
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-12
Specialization within NAICS 23593 (Excavation contractors), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached and Single-family houses, attached, including townhouses and townhouse-type condominiums	$4,056,605	$1,537,017	$594,683	$459,760	$734,403	$493,142	$237,601
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$296,995	$104,666	$27,862	S	D	$137,324	D
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$379,068	$76,339	$42,754	$31,338	$128,109	$70,563	$29,965
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
All other commercial buildings, n.e.c.	$1,103,861	$433,494	$84,081	$119,400	$142,382	$136,372	$188,133
Manufacturing and light industrial buildings	$482,405	$168,083	$66,232	$28,855	$79,252	$94,099	$45,883
Manufacturing and light industrial warehouses	$50,302	$14,307	$1,709	D	$18,071	$9,185	D
Commercial warehouses	$103,275	$20,441	$5,074	$19,998	$35,699	S	$13,556
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$158,777	$10,557	$42,653	$50,732	$11,804	$30,845	$12,185
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$207,614	$109,377	S	$21,017	$17,709	$24,895	$29,177
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$341,556	$154,315	$26,982	$49,792	$26,455	$67,760	$16,253
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0

Table 2B-12
Specialization within NAICS 23593 (Excavation contractors), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

Table 2B-13
Specialization within NAICS 23594 (Wrecking and demolition contractors), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Single-family houses, detached and Single-family houses, attached, including townhouses and townhouse-type condominiums	$131,122	$73,376	S	$17,406	$5,488	$18,869	$7,553
Apartment buildings with two or more units, including rentals, apartment-type condominiums, and cooperatives	$0	$0	$0	$0	$0	$0	$0
Hotels, motels, and tourist cabins	$0	$0	$0	$0	$0	$0	$0
Other residential buildings	$0	$0	$0	$0	$0	$0	$0
Office buildings	$134,487	$66,668	$10,005	$27,727	$13,096	$13,996	S
Other commercial buildings such as stores, restaurants, and automobile service stations	$0	$0	$0	$0	$0	$0	$0
All other commercial buildings, n.e.c.	$266,265	$184,232	$13,410	$19,643	D	$42,138	D
Manufacturing and light industrial buildings	$201,368	$76,279	$25,174	D	$35,900	D	D
Warehouses	$0	$0	$0	$0	$0	$0	$0
Religious buildings	$0	$0	$0	$0	$0	$0	$0
Educational buildings	$0	$0	$0	$0	$0	$0	$0
Hospitals and institutional buildings	$0	$0	$0	$0	$0	$0	$0
Farm buildings, nonresidential	$0	$0	$0	$0	$0	$0	$0
Amusement, social, and recreational buildings, indoors	$0	$0	$0	$0	$0	$0	$0
Other nonresidential buildings	$0	$0	$0	$0	$0	$0	$0
Highways, streets, and related work such as installation of guard rails, highway signs, lighting, etc.	$0	$0	$0	$0	$0	$0	$0
Outdoor swimming pools	$0	$0	$0	$0	$0	$0	$0
Airport runways and related work	$0	$0	$0	$0	$0	$0	$0
Private driveways and parking areas	$0	$0	$0	$0	$0	$0	$0
Fencing	$0	$0	$0	$0	$0	$0	$0
Recreational facilities	$0	$0	$0	$0	$0	$0	$0
Tunnels	$0	$0	$0	$0	$0	$0	$0
Bridges and elevated highways	$0	$0	$0	$0	$0	$0	$0

Table 2B-13
Specialization within NAICS 23594 (Wrecking and demolition contractors), Categorized by Value of Construction Work (Thousands of 1997 Dollars)

Type of Construction	Estabs. specializing 51 % or more	Estabs. with 100 % specialization	Estabs. with 90 to 99 % specialization	Estabs. with 80 to 89 % specialization	Estabs. with 70 to 79 % specialization	Estabs. with 60 to 69 % specialization	Estabs. with 51 to 59 % specialization
Dam and reservoir construction	$0	$0	$0	$0	$0	$0	$0
Marine construction	$0	$0	$0	$0	$0	$0	$0
Harbor and port facilities	$0	$0	$0	$0	$0	$0	$0
Conservation and development construction	$0	$0	$0	$0	$0	$0	$0
Power and communication transmission lines, towers, and related facilities	$0	$0	$0	$0	$0	$0	$0
Sewers, sewer lines, septic systems, and related facilities	$0	$0	$0	$0	$0	$0	$0
Water mains and related facilities	$0	$0	$0	$0	$0	$0	$0
Pipeline construction other than sewer or water lines	$0	$0	$0	$0	$0	$0	$0
Urban mass transit	$0	$0	$0	$0	$0	$0	$0
Railroad construction	$0	$0	$0	$0	$0	$0	$0
Blast furnaces, petroleum refineries, chemical complexes, etc.	$0	$0	$0	$0	$0	$0	$0
Power plants, nuclear	$0	$0	$0	$0	$0	$0	$0
Power plants and cogeneration plants, except nuclear	$0	$0	$0	$0	$0	$0	$0
Sewage treatment plants	$0	$0	$0	$0	$0	$0	$0
Water treatment plants	$0	$0	$0	$0	$0	$0	$0
Water storage facilities	$0	$0	$0	$0	$0	$0	$0
Heavy military construction, missile sites, etc.	$0	$0	$0	$0	$0	$0	$0
Ships	$0	$0	$0	$0	$0	$0	$0
Oilfields	$0	$0	$0	$0	$0	$0	$0
Other nonbuilding construction	$0	$0	$0	$0	$0	$0	$0
Construction work, n.s.k.	$0	$0	$0	$0	$0	$0	$0

APPENDIX 2C

Definitions of Key Business Ratios From Dun & Bradstreet

SOLVENCY RATIOS

Quick Ratio

$$\frac{\text{Cash + Accounts Receivable}}{\text{Current Liabilities}}$$

The Quick Ratio is computed by divided cash plus accounts receivable by total current liabilities. Current liabilities are all the liabilities that fall due within one year. This ratio reveals the protection afforded short-term creditors in cash or near-cash assets. It shows the number of dollars of liquid assets available to cover each dollar of current debt. Any time this ratio is as much as 1 to 1 (1.0) the business is said to be in a liquid condition. The larger the ratio the greater the liquidity.

Current Ratio

$$\frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Total current assets are divided by total current liabilities. Current assets include cash, accounts and notes receivable (less reserves for bad debts), advances on inventories, merchandise inventories and marketable securities. This ratio measures the degree to which current assets cover current liabilities. The higher the ratio the more assurance exists that the retirement of current liabilities can be made. The current ratio measures the margin of safety available to cover any possible shrinkage in the value of current assets. Normally a ratio of 2 to 1 (2.0) or better is considered good.

Current Liabilities to Net Worth

$$\frac{\text{Current Liabilities}}{\text{Net Worth}}$$

Current Liabilities to Net Worth is derived by dividing current liabilities by net worth. This contrasts the funds that creditors temporarily are risking with the funds permanently invested by the owners. The smaller the net worth and the larger the liabilities, the less security for the creditors. Care should be exercised when selling any firm with current liabilities exceeding two-thirds (66.6 percent) of net worth.

Current Liabilities to Inventory

Current Liabilities
Inventory

Dividing current liabilities by inventory yields another indication of the extent to which the business relies on funds from disposal of unsold inventories to meet its debts. This ratio combines with Net Sales to Inventory to indicate how management controls inventory. It is possible to have decreasing liquidity while maintaining consistent sales-to-inventory ratios. Large increases in sales with corresponding increases in inventory levels can cause an inappropriate rise in current liabilities if growth isn't made wisely.

Total Liabilities to Net Worth

Total Liabilities
Net Worth

Obtained by dividing total current plus long-term and deferred liabilities by net worth. The effect of long-term (funded) debt on a business can be determined by comparing this ratio with Current Liabilities to Net Worth. The difference will pinpoint the relative size of long-term debt, which, if sizable, can burden a firm with substantial interest charges. In general, total liabilities shouldn't exceed net worth (100 percent) since in such cases creditors have more at stake than owners.

Fixed Assets to Net Worth

Fixed Assets
Net Worth

Fixed assets are divided by net worth. The proportion of net worth that consists of fixed assets will very greatly from industry to industry but generally a smaller proportion is desirable. A high ratio is unfavorable because heavy investment in fixed assets indicates that either the concern has a low net working capital and is overtrading or has utilized large funded debt to supplement working capital. Also, the larger the fixed assets, the bigger then annual depreciation charge that must be deducted from the income statement. Normally, fixed assets over 75 percent of net worth indicate possible over-investment and should be examined with care.

EFFICIENCY RATIOS

Collection Period

$$\frac{\text{Accounts Receivable}}{\text{Sales}} \times 365$$

Accounts receivable are divided by sales and then multiplied by 365 days to obtain this figure. The quality of the receivables of a company can be determined by this relationship when compared with selling terms and industry norms. IN some industries where credit sales are not the normal way of doing business, the percentage of cash sales should be taken into consideration. Generally, where most sales are for credit, any collection period more than one-third over normal selling terms (40.0 for 30-day terms) is indicative of some slow-turning receivables. When comparing the collection period of one concern with that of another, allowances should be made for possible variations in selling terms.

Sales to Inventory

$$\frac{\text{Annual Net Sales}}{\text{Inventory}}$$

Obtained by dividing annual net sales by inventory. Inventory control is a primate management objective since poor controls allow inventory to become costly to store, obsolete or insufficient to meet demands. The sales-to-inventory relationship is a guide to the rapidity at which merchandise is being moved and the effect on the flow of funds into the business. This ratio varies widely between lines of business and a company's figure is only meaningful when compared with industry norms. Individual figures that are outside either the upper or lower quartiles for a given industry should be examined with care. Although low figures are usually the biggest problem, as they indicate excessively high inventories, extremely high turnovers might reflect insufficient merchandise to meet customer demand and result in lost sales.

Asset to Sales

$$\frac{\text{Total Assets}}{\text{Net Sales}}$$

Assets to sales is calculated by dividing total assets by annual net sales. This ratio ties in sales and the total investment that is used to generate those sales. While figures vary greatly from industry to industry, by comparing a company's ratio with industry norms it can be determined whether a firm is overtrading (handling an excessive volume of sales in relation to investment) or undertrading (not generating sufficient sales to warrant the assets invested). Abnormally low percentages (above the upper quartile) can indicate overtrading which may lead to financial difficulties if not corrected. Extremely high percentages (below the lower quartile) can be the result of overly conservative or poor sales management, indicating a more aggressive sales policy may need to be followed.

Sales to Net Working Capital

$$\frac{\text{Sales}}{\text{Net Working Capital}}$$

Net Sales are divided by net working capital (net working capital is current assets minus current liabilities). This relationship indicates whether a company is overtrading or conversely carrying more liquid assets than needed for its volume. Each industry can vary substantially and it is necessary to compare a company with its peers to see if it is either overtrading on its available funds or being overly conservative. Companies with substantial sales gains often reach a level where their working capital becomes strained. Even if they maintain an adequate total investment for the volume being generated (Assets to Sales), that investment may be so centered in fixed assets or other noncurrent items that it will be difficult to continue meeting all current obligations without additional investment or reducing sales.

Accounts Payable to Sales

$$\frac{\text{Accounts Payable}}{\text{Annual Net Sales}}$$

Computed by dividing accounts payable by annual net sales. This ratio measures how the company is paying its suppliers in relation to the volume being transacted. An increasing percentage, or one larger than the industry norm, indicates the firm may be using suppliers to help finance operations. This ratio is especially important to short-term creditors since a high percentage could indicate potential problems in paying vendors.

PROFITABILITY RATIOS

Return on Sales (Profit Margin)

$$\frac{\text{Net Profit After Taxes}}{\text{Annual Net Sales}}$$

Obtained by dividing net profit after taxes by annual net sales. This reveals the profits earned per dollar of sales and therefore measures the efficiency of the operation. Return must be adequate for the firm to be able to achieve satisfactory profits for its owners. This ratio is an indicator of the firm's ability to withstand adverse conditions such as falling prices, rising costs and declining sales.

Return on Assets

$$\frac{\text{Net Profit After Taxes}}{\text{Total Assets}}$$

Net profit after taxes divided by total assets. This ratio is the key indicator of profitability for a firm. It matches operating profits with the assets available to earn a return. Companies efficiently using their assets will have a relatively high return while less well-run businesses will be relatively low.

Return on Net Worth (Return on Equity)

$$\frac{\text{Net Profit After Taxes}}{\text{Net Worth}}$$

Obtained by dividing net profit after tax by net worth. This ratio is used to analyze the ability of the firm's management to realize an adequate return on the capital invested by the owners of the firm. Tendency is to look increasingly to this ratio as a final criterion of profitability. Generally, a relationship of at least 10 percent is regarded as a desirable objective for providing dividends plus funds for future growth.

APPENDIX 2D
Summary Statistics for the C&D Industry, By NAICS Code

Table 2D-1.
Summary Statistics for the C&D Industry

NAICS	Description	Number of Establishments	Number of Employees	Annual Payroll ($1000)	Number of Construction Workers	Annual Payroll - Construction Workers ($1000)	Value of Construction Work ($1000)	Value of Construction Work Subcontracted In ($1000)	Net Value of Construction Work	Value Added ($1000)
23	Construction	656,448	5,664,853	174,184,608	4,332,737	119,676,792	845,543,552	237,691,136	612,209,024	383,845,728
233	Building, developing, and general contracting	199,289	1,342,953	42,546,112	885,939	23,135,832	381,641,600	15,724,829	198,826,896	120,322,720
2331	Land subdivision and land development	8,186	41,827	1,509,773	10,977	254,247	13,635,521	272,860	10,247,820	9,154,633
233110	Land subdivision and land development	8,186	41,827	1,509,773	10,977	254,247	13,635,521	272,860	10,247,820	9,154,633
2332	Residential housing construction	146,394	629,886	16,731,210	407,801	8,762,123	161,286,076	5,260,611	100,124,176	56,374,697
233210	Single-family housing construction	138,850	570,990	14,964,583	367,719	7,739,858	146,798,768	4,985,452	92,802,168	52,585,924
233220	Multifamily housing construction	7,544	58,896	1,766,627	40,082	1,022,265	14,487,308	275,159	7,322,008	3,788,773
2333	Nonresidential building construction	44,709	671,238	24,305,128	467,161	14,119,463	206,720,022	10,191,358	88,454,894	54,793,388
233310	Manufacturing and industrial building construction	7,280	143,066	5,128,967	107,180	3,322,347	33,514,342	2479077	17202078	10429844
233320	Commercial and institutional building construction	37,430	528,173	19,176,160	359,981	10,797,116	173,205,680	7712281	71252816	44363544
234	Heavy construction	42,557	880,400	30,291,850	710,898	22,218,582	127,841,600	28,386,274	105,639,352	68,775,976

NAICS	Description	Number of Establishments	Number of Employees	Annual Payroll ($1000)	Number of Construction Workers	Annual Payroll - Construction Workers ($1000)	Value of Construction Work ($1000)	Value of Construction Work Subcontracted In ($1000)	Net Value of Construction Work	Value Added ($1000)
2341	Highway, street, bridge & tunnel construction	12,447	325,742	11,374,785	265,267	8,473,898	58,011,325	13,657,005	46,274,086	27,477,466
234110	Highway and street construction	11,270	277,979	9,527,626	227,066	7,095,139	48,472,284	12,246,944	39,102,084	22,983,910
234120	Bridge and tunnel construction	1,177	47,764	1,847,160	38,201	1,378,759	9,539,041	1,410,061	7,172,002	4,493,556
2349	Other heavy construction	30,107	554,655	18,917,062	445,630	13,744,685	69,830,272	14,729,269	59,365,265	41,298,511
234910	Water, sewer, and pipeline construction	8,042	162,566	5,522,281	134,023	4,087,007	22,204,058	5,233,440	19,126,738	12,280,098
234920	Power and communication transmission line construction	3,300	74,050	2,387,432	60,880	1,748,715	7,849,436	1,312,622	6,741,945	5,201,423
234930	Industrial nonbuilding structure construction	531	98,555	3,722,363	79,473	2,734,020	9,255,216	966,283	8,129,656	6288698
234990	All other heavy construction	18,236	219,486	7,284,989	171,254	5,174,943	30,521,562	7,216,924	25,366,926	17,528,292
235	Special trade contractors	414,602	3,441,500	101,346,648	2,735,901	2,940,440	336,060,352	193,580,032	307,742,752	194,747,056
235930	Excavation contractors	18,229	116,237	3,353,874	92,830	2,525,857	13,746,608	8,745,278	12,216,146	9,086,184
235940	Wrecking and demolition contractors	1,542	18,820	592,176	14,486	414,583	2,164,162	1,099,814	1,913,892	1,732,366

[a]An establishment is a single physical location at which business is conducted. It is not necessarily identical with a company or enterprise, which may consist of one establishment or more.
[b]Value of construction work includes all value of construction work done during 1992 for construction work performed by general contractors and special trades contractors. Included is new construction, additions and alterations or reconstruction, and maintenance and repair construction work. Also included is the value of any construction work done by the reporting establishments for themselves. This value is not available for SIC 655, instead estimates of annual revenue from the Census of Financial, Insurance, and Real Estate Industries is used. The measure includes 'reported revenues, which include revenues from all business activities, including amounts received for work subcontracted out to others.
[c]Employment comprises all full-time and part-time employees on the payrolls of construction establishments, who worked or received pay for any part of the pay period including the 12th of March, May, August, and November. Included are all persons on paid sick leave, paid holidays, and paid vacations during these pay periods. Officers of corporations are included, but proprietors and partners of unincorporated firms are not. All employees is the sum of all employees during the pay periods including the 12th of March, May, August, and November, divided by 4.
[d]Payroll includes the gross earnings paid in the calendar year 1992 to all employees on the payroll of construction establishments. It includes all forms of compensation such as salaries, wages, commissions, bonuses, vacation allowances, sick leave pay, prior to such deductions as employees' Social Security contribution, withholding taxes, group insurance, union dues, and savings bonds.
[e]Construction workers include all workers up 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 on-site recordkeepers and security guards.
[f]Construction worker payroll includes gross earnings paid in the calendar year 1992 to all construction workers only.
[g]Net value of construction work is derived for each establishment by subtracting the costs for construction work subcontracted to others from the value of construction work done.
[h]Value added, derived for each establishment, is equal to dollar value of business done less the costs of construction work subcontracted to others and costs for materials, components, supplies, and fuels.
[i]Value of construction work subcontracted in from others includes the value of construction work during 1992 for work done by reporting establishments as subcontractors.
[j]Covers establishments in SICs 1794 (Excavation Work) and 1795 (Wrecking and Demolition Work) only.
[k]Covers establishments in SICs 6552 (Land Subdividers and Developers, Except Cemeteries) and 6553 (Cemetery Subdividers and Developers) only.
S Withheld because estimate did not meet publication standards on the basis of either the response rate, associated relative standard error, or a consistency review.
NA These values are not included in the Census of Financial, Insurance, and Real Estate Industries and therefore are unavailable for SIC 655.

CHAPTER THREE
DESCRIPTION OF PROPOSED RULE AND REGULATORY OPTIONS

Chapter One provides a summary of the Phase I and Phase II National Pollutant Discharge Elimination System (NPDES) Storm Water Regulations and the Construction General Permit (CGP) for the construction industry. This chapter describes the effluent limitation guidelines and standards program (Section 3.1), the technology alternatives for the proposed effluent limitation guidelines (Section 3.2), and the regulatory options that EPA is proposing for the C&D industry (Section 3.3).

3.1 EFFLUENT LIMITATION GUIDELINES AND STANDARDS

The Federal Water Pollution Control Act, passed in 1972 (CWA, 33 U.S.C. §1251 et seq.), establishes a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (§101(a)), often referred to as "fishable, swimmable" status. The statute was amended in 1987 to include requirements for a comprehensive program to address storm water discharges. Moreover, EPA is authorized under section 301, 304, 306, and 307 of the CWA to establish effluent limitation guidelines and pretreatment standards for industrial dischargers. EPA is authorized to publish the following standards:

- ***Best Practicable Control Technology Currently Available (BPT)***. Under section 304(b)(1), these rules apply to direct dischargers. BPT limitations are generally based on the average of the best existing performances by plants of various sizes, ages, and unit processes within a point source category or subcategory.
- ***Best Available Technology Economically Achievable (BAT)***. Under section 304(b)(2), these rules apply to direct discharges of toxic and nonconventional[1] pollutants.

[1] Toxic pollutants are listed in Table 1 of U.S.C 1317 Section 307(a)(1) and currently include 64 pollutants and their organic and inorganic compounds. This list includes arsenic, DDT, lead, and mercury. Nonconventional pollutants are any pollutants that are not statutorily listed (not covered by the list of toxic or conventional pollutants) or which are poorly understood by the scientific community.

- ***Best Conventional Pollutant Control Technology (BCT)***. Under section 304(b)(4), these rules apply to direct discharges of conventional pollutants.[2] BCT limitations are generally established using a two-part cost-reasonableness test. BCT replaces BAT for control of conventional pollutants.

- ***Pretreatment Standards for Existing Sources (PSES)***. Under section 307. Analogous to BAT controls, these rules apply to existing indirect dischargers (i.e., dischargers to publicly owned treatment works (POTWs).

- ***New Source Performance Standards (NSPS)***. Under section 306(b), these rules apply to discharges of toxic and nonconventional pollutants and apply to new direct dischargers.

- ***Pretreatment Standards for New Sources (PSNS)***. Under section 307. Analogous to NSPS controls, these rules apply to new source indirect dischargers (i.e., dischargers to publicly owned treatment works (POTWs).

Under the proposed effluent limitation guidelines (ELG), EPA is proposing BAT, BPT, BCT and NSPS guidelines and standards for erosion and sediment control (ESC) during the active construction phase.

3.2 REQUIREMENTS UNDER THE EXISTING CONSTRUCTION GENERAL PERMIT

The CGP, published in 1992 and revised in 1998, directs NPDES permittees to prepare a storm water pollution prevention plan (SWPPP) for certain construction activities. The CGP also calls for installation of temporary sediment basins for construction sites with disturbed area of 10 acres or more. The permit lists a variety of options and goals for other ESCs, but none are required. A description of ESCs, if any, is to be contained in the SWPPP. Options and goals for post-construction storm water best management practices (BMPs) are also contained in the CGP, but none are required. As with ESCs, selected BMPs, if any, are to be described in the SWPPP.

The C&D industry ELG would build upon and complement the CGP by adding inspection and certification (I&C) requirements for active construction ESCs. As described below, under one option

[2] Conventional pollutants include biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, pH, and oil and grease.

EPA would add the I&C requirements for sites of one acre or more in size, while under another option the I&C requirements would apply to sites of 5 acres and above. This second option would also codify in the Code of Federal Regulations (CFR) the requirements found in the CGP. These options are described more fully below.

3.3 SUMMARY OF REGULATORY OPTIONS/TECHNOLOGY ALTERNATIVES

EPA is co-proposing two regulatory alternatives, along with a "no regulation" option, for a total of three regulatory options. EPA has defined the baseline for the proposed rule as full compliance with the current Phase I NPDES storm water regulations and the future Phase II regulations. If any additional costs are incurred by dischargers under the existing storm water regulations the costs will be added to the baseline assumption. Table 3-1 summarizes the regulatory options. Throughout the analysis presented in this report, EPA treats the baseline as "Option 3."

Table 3-1. Summary of Regulatory Options Being Co-Proposed by EPA

Option	Description	Regulatory Mechanism	Applicability
Option 1	Inspection and Certification of Construction Site Erosion and Sediment Controls	Amendment to NPDES storm water permitting regulations	Sites of 1 acre or more
Option 2	"Codification" of the Construction General Permit (CGP) plus Inspection and Certification Requirements	Effluent limitation guidelines	Sites of 5 acres or more
Option 3	No Regulation (Baseline)	N/A	All sites

3.3.1 Option 1

Option 1 would amend 40 CFR Part 122, the section of the CFR covering NPDES permitting, adding a new paragraph (t) section to §122.44 entitled *Inspection and Certification for Construction Site Storm Water Discharges*. These requirement in this section would include:

(1) Site log book. The permittee for a point source discharge under § 122.26(b)(14)(x) or § 122.26(b)(15) shall maintain a record of site activities in a site log book. The site log book shall be maintained as follows:

(i) A copy of the site log book shall be maintained on site and be made available to the permitting authority upon request;

(ii) In the site log book, the permittee shall certify, prior to the commencement of construction activities, that any plans required by the permit meet all Federal, State, Tribal and local erosion and sediment control requirements and are available to the permitting authority;

(iii) The permittee shall have a qualified professional (knowledgeable in the principles and practices of erosion and sediment controls, such as a licensed professional engineer, or other knowledgeable person) conduct an assessment of the site prior to groundbreaking and certify in the log book that the appropriate best management practices (BMPs) described in plans required by the permit have been adequately designed, sized and installed to ensure overall preparedness of the site for initiation of groundbreaking activities. The permittee shall record the date of initial groundbreaking in the site log book. The permittee shall also certify that any inspection, stabilization and BMP maintenance requirements of the permit have been satisfied within 48 hours of actually meeting such requirements; and

(iv) The permittee shall post at the site, in a publicly-accessible location, a summary of the site inspection activities on a monthly basis;

(2) Site Inspections. The permittee or designated agent of the permittee (such as a consultant, subcontractor, or third-party inspection firm) shall conduct regular inspections of the site and record the results of such inspection in the site log book in accordance with paragraph (t)(1) of this section.

(i) After initial groundbreaking, permittees shall conduct site inspections at least every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. These inspections shall be conducted by a qualified professional. During each inspection, the permittee or designated agent shall record the following information:

(A) Indicate on a site map the extent of all disturbed site areas and drainage pathways. Indicate site areas that are expected to undergo initial disturbance or significant site work within the next 14 days;

(B) Indicate on a site map all areas of the site that have undergone temporary or permanent stabilization;

(C) Indicate all disturbed site areas that have not undergone active site work during the previous 14 days;

(D) Inspect all sediment control practices and note the approximate degree of sediment accumulation as a percentage of the sediment storage volume (for example 10 percent, 20 percent, 50 percent, etc.). Note all sediment control practices in the site log book that have sediment accumulation of 50 percent or more; and

(E) Inspect all erosion and sediment control BMPs and note compliance with any maintenance requirements such as verifying the integrity of barrier or diversion systems (e.g., earthen berms or silt fencing) and containment systems (e.g., sediment basins and sediment traps). Identify any evidence of rill or gully erosion occurring on slopes and any loss of stabilizing vegetation or seeding/mulching. Document in the site log book any excessive deposition of sediment or ponding water along barrier or diversion systems. Note the depth of sediment within containment structures, any erosion near outlet and overflow structures, and verify the ability of rock filters around perforated riser pipes to pass water.

(ii) Prior to filing of the Notice of Termination or the end of permit term, a final site erosion and sediment control inspection shall be conducted by the permittee or designated agent. The inspector shall certify that the site has undergone final stabilization as required by the permit and that all temporary erosion and sediment controls (such as silt fencing) not needed for long-term erosion control have been removed.

Option 1 would also amend §122.44(i)(4) to *exclude* construction activities from requirements for monitoring of storm water discharges.

Option 1 would apply to sites of one acre or more in size.

3.3.2 Option 2

Option 2 would add a new section to the effluent limitation guidelines section of the CFR, i.e., Part 450—Construction and Development Point Source Category. This section would essentially codify in the CFR the provisions of the CGP (see Section 3.2), and in addition would add the provisions for I&C introduced under Option 1 (Section 3.3.1). Option 2 would amend 40 CFR 122(i)(3) to specify that discharges from construction activity are instead governed by Part 450.

40 CFR Part 450, Subpart A describes applicability and provides definitions. Subpart B would establish the ESC requirements based on application of BPT, BAT, BCT, and NSPS.

Part 450 would apply to construction and development activities subject to an NPDES permit under the definition of "construction activity" at 40 CFR 122.26(b)(14)(x). Section 450.11 establishes some general definitions for the following terms: BMPs, commencement of construction, final stabilization, groundbeaking, new source, operator, perimeter controls, qualified professional, runoff coefficient, and stabilization.

Section 450.21 would establish effluent limitations reflecting **best practicable technology currently available (BPT)**, as follows:[3]

Except as provided in 40 CFR 125.30 through 125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of the best practicable control technology currently available (BPT). Permittees with operational control over construction plans and specification, including the ability to make modifications to those plans and specifications (e.g., developer or owner), must ensure the project specifications that they develop meet the minimum requirements of a SWPPP required by § 450.21(d).

(a) General Erosion and Sediment Controls. Each SWPPP shall include a description of appropriate controls designed to retain sediment on site to the extent practicable. These general erosion and sediment controls shall be included in the SWPPP developed pursuant to paragraph (d) of this section. The SWPPP must include a description of interim and permanent stabilization practices for the site, including a schedule of when the practices will be implemented. Stabilization practices may include:

(1) Establishment of temporary or permanent vegetation;

[3] Parts 450.22, 450.23, and 450.24 would establish identical requirements for BAT, BCT, and NSPS, respectively.

(2) Mulching, geotextiles, or sod stabilization;

(3) Vegetative buffer strips;

(4) Protection of trees and preservation of mature vegetation.

(b) Sediment Controls. The SWPPP must include a description of structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable.

(1) For common drainage locations that serve an area with 10 or more acres disturbed at one time, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 2 year, 24-hour storm from each disturbed acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. Where no such calculation has been performed, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. When computing the number of acres draining into a common location it is not necessary to include flows from off-site areas and flows from on-site areas that are either undisturbed or have undergone final stabilization where such flows are diverted around both the disturbed area and the sediment basin.

(2) In determining whether a sediment basin is attainable, the operator may consider factors such as site soils, slope, available area on site, etc. In any event, the operator must consider public safety, especially as it relates to children, as a design factor for the sediment basin, and alternative sediment controls shall be used where site limitations would preclude a safe basin design.

(3) For portions of the site that drain to a common location and have a total contributing drainage area of less than 10 disturbed acres, the operator should use smaller sediment basins and/or sediment traps.

(4) Where neither a sediment basin nor equivalent controls are attainable due to site limitations, silt fences, vegetative buffer strips or equivalent sediment controls are required for all down slope boundaries of the construction area and for those side slope boundaries deemed appropriate as dictated by individual site conditions.

(c) Pollution Prevention Measures. The SWPPP shall include the following pollution prevention measures:

(1) Litter, construction chemicals, and construction debris exposed to storm water shall be prevented from becoming a pollutant source in storm water discharges (e.g., screening outfalls, picked up daily); and

(2) A description of construction and waste materials expected to be stored on-site with updates as appropriate, and a description of controls to reduce pollutants

from these materials including storage practices to minimize exposure of the materials to storm water, and spill prevention and response.

(d) Storm Water Pollution Prevention Plan. Operators subject to this Part shall compile Storm Water Pollution Prevention Plans (SWPPPs) prior to groundbreaking at any construction site. In areas where EPA is not the permit authority, operators may be required to prepare documents that may serve as the functional equivalent of a SWPPP. Such alternate documents will satisfy the requirements for a SWPPP so long as they contain the necessary elements of a SWPPP. A SWPPP shall incorporate the following information:

(1) A narrative description of the construction activity, including a description of the intended sequence of major activities that disturb soils on the site (major activities include grubbing, excavating, grading, and utilities and infrastructure installation, or any other activity that disturbs soils for major portions of the site);

(2) A general location map (e.g., portion of a city or county map) and a site map. The site map shall include descriptions of the following:

(i) Drainage patterns and approximate slopes anticipated after major grading activities;

(ii) The total area of the site and areas of disturbance;

(iii) Areas that will not be disturbed;

(iv) Locations of major structural and nonstructural controls identified in the SWPPP;

(v) Locations where stabilization practices are expected to occur;

(vi) Locations of off-site material, waste, borrow or equipment storage areas;

(vii) Surface waters (including wetlands); and

(viii) Locations where storm water discharges to a surface water;

(3) A description of available data on soils present at the site;

(4) A description of BMPs to be used to control pollutants in storm water discharges during construction as described elsewhere in this section;

(5) A description of the general timing (or sequence) in relation to the construction schedule when each BMP is to be implemented;

(6) An estimate of the pre-development and post-construction runoff coefficients of the site;

(7) The name(s) of the receiving water(s);

(8) Delineation of SWPPP implementation responsibilities for each site owner or operator;

(9) Any existing data that describe the storm water runoff characteristics at the site.

(e) Updating the SWPPP. The operator shall amend the SWPPP and corresponding erosion and sediment control BMPs whenever:

(1) There is a change in design, construction, or maintenance that has a significant effect on the discharge of pollutants to waters of the United States which has not been addressed in the SWPPP; or

(2) Inspections or investigations by site operators, local, State, Tribal or Federal officials indicate that the SWPPP is proving ineffective in eliminating or significantly minimizing pollutant discharges.

(f) Site Log Book/Certification. The operator shall maintain a record of site activities in a site log book, as part of the SWPPP. The site log book shall be maintained as follows:

(1) A copy of the site log book shall be maintained on site and be made available to the permitting authority upon request;

(2) In the site log book, the operator shall certify, prior to the commencement of construction activities, that the SWPPP prepared in accordance with paragraph (d) of this section meets all Federal, State and local erosion and sediment control requirements and is available to the permitting authority;

(3) The operator shall have a qualified professional conduct an assessment of the site prior to groundbreaking and certify in the log book that the appropriate BMPs and erosion and sediment controls described in the SWPPP and required by paragraphs (a), (b), (c) and (d) of this section have been adequately designed, sized and installed to ensure overall preparedness of the site for initiation of groundbreaking activities. The operator shall record the date of initial groundbreaking in the site log book. The operator shall also certify that the requirements of paragraphs (g), (h) and (i) of this section have been satisfied within 48 hours of actually meeting such requirements;

(4) The operator shall post at the site, in a publicly-accessible location, a summary of the site inspection activities on a monthly basis.

(g) Site Inspections. The operator or designated agent of the operator (such as a consultant, subcontractor, or third-party inspection firm) shall conduct regular inspections of the site and record the results of such inspection in the site log book in accordance with paragraph (f) of this section.

(1) After initial groundbreaking, operators shall conduct site inspections at least every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater. These inspections shall be conducted by a qualified professional. During each inspection, the operator or designated agent shall record the following information:

(i) On a site map, indicate the extent of all disturbed site areas and drainage pathways. Indicate site areas that are expected to undergo initial disturbance or significant site work within the next 14-day period;

(ii) Indicate on a site map all areas of the site that have undergone temporary or permanent stabilization;

(iii) Indicate all disturbed site areas that have not undergone active site work during the previous 14-day period;

(iv) Inspect all sediment control practices and note the approximate degree of sediment accumulation as a percentage of the sediment storage volume (for example 10 percent, 20 percent, 50 percent, etc.). Record all sediment control practices in the site log book that have sediment accumulation of 50 percent or more; and

(v) Inspect all erosion and sediment control BMPs and record all maintenance requirements such as verifying the integrity of barrier or diversion systems (earthen berms or silt fencing) and containment systems (sediment basins and sediment traps). Identify any evidence of rill or gully erosion occurring on slopes and any loss of stabilizing vegetation or seeding/mulching. Document in the site log book any excessive deposition of sediment or ponding water along barrier or diversion systems. Record the depth of sediment within containment structures, any erosion near outlet and overflow structures, and verify the ability of rock filters around perforated riser pipes to pass water.

(2) Prior to filing of the Notice of Termination or the end of permit term, a final site erosion and sediment control inspection shall be conducted by the operator or designated agent. The inspector shall certify that the site has undergone final stabilization using either vegetative or structural stabilization methods and that all temporary erosion and sediment controls (such as silt fencing) not needed for long-term erosion control have been removed.

(h) Stabilization. The operator shall initiate stabilization measures as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. This requirement does not apply in the following instances:

(1) Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceased is precluded by snow cover or frozen ground conditions, stabilization measures shall be initiated as soon as practicable;

(2) Where construction activity on a portion of the site is temporarily ceased, and earth-disturbing activities will be resumed within 21 days, temporary stabilization measures need not be initiated on that portion of the site.

(3) In arid areas (areas with an average annual rainfall of 0 to 10 inches), semi-arid areas (areas with an average annual rainfall of 10 to 20 inches), and areas experiencing droughts where the initiation of stabilization measures by the 14th day after construction activity has temporarily or permanently ceased is precluded by seasonably arid conditions, the operator shall initiate stabilization measures as soon as practicable.

(i) Maintenance. Sediment shall be removed from sediment traps or sediment ponds when design capacity has been reduced by 50 percent.

Option 2 would apply to sites of five acres or more.

3.3.3 Option 3

Option 3 is the "no regulation" option. Storm water runoff from construction and development activities would continue to be managed in accordance with the requirements of the CGP. There would be no incremental compliance requirements and consequently no incremental compliance costs or benefits.

CHAPTER FOUR
ECONOMIC IMPACT ANALYSIS METHODOLOGY

4.1 OVERVIEW OF ECONOMIC IMPACT ANALYSIS METHODOLOGY

This chapter presents EPA's methodology for analyzing the economic impacts of the proposed erosion and sediment control (ESC) regulations for the construction and development (C&D) industry. EPA has employed a number of different methods for assessing the economic impacts of the proposed rule. These include models that analyze impacts at the level of the individual construction project, the individual firm, national construction markets, and the national economy as a whole. The analysis considers impacts on the firms in the C&D industry who would be complying with the regulations, on those who purchase the output of the C&D industry, and on those who would be responsible for implementing the proposed rule.

The analysis is based upon engineering cost estimates developed by EPA. The engineering costs reflect the costs to comply with requirements related to erosion and sediment controls (ESCs) employed over a relatively short period (generally less than one year) during which land is being converted from an undeveloped to a developed state. The engineering costs also include the costs associated with meeting any paperwork requirements triggered by the proposed rule, including any requirements related to the permitting of construction and development projects, and incremental inspection and certification requirements for ESCs.

The outline of the chapter is as follows:

- **Section 4.2** presents EPA's analysis of the impacts of the proposed rule on model C&D projects. Here EPA develops pro forma financial analyses for representative projects and analyzes the impact of the incremental regulatory costs on project viability. The section includes a description of the model projects, model project analysis methodology, data sources, and assumptions used in the model project analysis. The model project analysis results are presented in Chapter Five, Section 5.2.

- **Section 4.3** presents EPA's analysis of the impacts of the proposed rule on model C&D firms. This section uses data on the financial condition of representative firms to examine the impact of the incremental compliance requirements on the model firm's financial condition. This section also describes how the model firm analysis is used to evaluate economic achievability and barrier to entry considerations for the proposed rule, and to conduct the firm closure analysis and small entity impact analysis. This section includes a description of the model firms, model firm analysis methodology, data sources, and assumptions used in the model firm analysis. The model firm analysis results, including those from the economic achievability, barrier to entry, closure, and employment loss analyses, are presented in Chapter Five, Sections 5.4 through 5.6.

- **Section 4.4** presents EPA's methodology for estimating the national compliance costs of the proposed rule. These costs are estimated starting with the per-acre compliance costs estimated by EPA. The per-acre costs are applied to national estimates of the amount of land converted to developed status annually. National compliance cost estimates are presented in Chapter Five, Section 5.3.

- **Section 4.5** describes EPA's partial equilibrium market model analysis. This section considers the impact of the incremental compliance requirements on consumers of the construction industry's output, in particular the impacts on home buyers and on housing affordability. The section includes a description of the market model methodology, data sources, and assumptions used in the market models. The market modeling results are presented in Chapter Five, Section 5.6.

- **Section 4.6** expands the analysis to consider the net impacts of the proposed rule on the national economy. While the compliance costs would reduce output in the construction industry there may be an offsetting increase in spending related to ESCs and inspection and certification. EPA uses input-output analysis to trace the implications of these spending shifts on the national economy. The result is an overall estimate of the impact on macroeconomic variables such as output and national employment. The results of the national economic impact analysis are presented in Chapter Five, Section 5.7.

- **Section 4.7** considers the impacts on governmental units associated with establishing or modifying permitting programs to reflect the requirements in the proposed rule as well as new or increased costs related to permit processing. The results of the government cost impact analyses are presented in Chapter Five, Section 5.8.

4.1.1 Compliance and Baseline Assumptions

In this analysis EPA assumes that the proposed rule would impact markets that have already fully implemented existing regulations related to storm water controls for C&D activities. EPA assumes that all states, tribal lands, and territories comply with the existing regulations or have equivalent programs. These programs are assumed to include all of the requirements affecting C&D activities that were part of the national storm water Phase I and Phase II NPDES storm water regulations. Since the Phase II regulations are not scheduled to be fully implemented until 2003, however, EPA acknowledges that current market conditions may not fully reflect the baseline that would apply at the time the proposed rule comes into force. Specifically, EPA notes that the baseline market conditions assumed in this analysis (including baseline financial conditions for affected firms) may not fully reflect the implementation of Phase II NPDES storm water requirements. For this reason, EPA has conducted a supplemental analysis that reflects less than 100 percent implementation of the Phase II NPDES storm water rule in the baseline. The supplemental baseline analysis is presented in Appendix 5C of this report.

4.1.2 Cost Pass Through Assumptions

EPA has incorporated into each of the impact analyses described below specific assumptions about the incidence of the compliance costs. This section describes generally EPA's conclusions about cost incidence for the proposed regulation and then outlines the specific assumptions made for each impact analysis.

In general, EPA believes that developers and builders faced with an increase in costs due to new ESC requirements would have an incentive to pass on all or some of the increased cost to the project owner. (This is referred to as cost pass through, or CPT). The extent to which the costs can be passed through in practice would depend on market conditions. The demand elasticity of the project owner (i.e., the sensitivity of the purchase decision to incremental changes in price) would be influenced by two main factors:

- The magnitude of the cost increase relative to the overall cost of the project. For example, on a large office project or even a high end single-family home, the buyer may put up little resistance if the cost increase is small relative to the overall cost of the project.
- The availability and price of substitutes. If the cost increase affects all suppliers and all substitutes equally, then the project owner is less likely to resist an incremental price increase.

Since the proposed rule would be national in scope and the compliance costs would be similar within a given geographic region (assuming similar sites), the compliance costs should affect the buyer's alternate suppliers roughly equally. This suggests that if the costs are small relative to the total cost of the project, demand should be relatively inelastic and the builder would be able to pass all or most of the cost increase on to the buyer.

Another factor facilitating cost pass through for builders is that project owners often plan for unexpected cost changes by building contingencies into their budgets. A common mechanism in new residential construction, for example, is for the home buyer to absorb an unexpected cost increase at one stage of construction by reducing costs on a later stage. This might be done, for example, by selecting less expensive flooring material, deferring finishing of a basement, or opting to build a garage at a later date.

This line of reasoning, which suggests demand is generally inelastic, presumes that the “good” the buyer is purchasing is “new construction.” In most markets, however, the owner can also elect to buy from an inventory of existing homes, office or retail space, or industrial facilities available for sale, or to rent from a corresponding inventory of rental properties. To the extent that existing construction and rental property serves as a perfect or even partial substitute for new construction, the buyer’s demand elasticity would also be influenced by conditions in the existing construction and rental markets.

Existing homes and existing office, retail or industrial space would not be affected by the proposed regulation. Cost increases that differentially affect new construction may cause some buyers to choose existing construction over new, i.e., they could elect to buy or rent rather than build. The strength of demand for new relative to existing construction depends on the relative availability, suitability, and price of each type of construction. Buyers choosing new over existing construction often do so for reasons related to location, the ability to match their specific needs, expected length of tenure, and greater certainty about a structure’s condition and future maintenance requirements. Demand for new construction is also highly influenced by the availability, quality, and age of existing construction. In geographic areas or market segments where the existing inventory is weak or unsuitable, demand for new construction would be stronger.

Evidence from the literature suggests that in residential construction, regulatory-related costs are usually passed on to consumers (e.g., Luger and Temkin 2000), and this general observation was echoed during EPA’s focus group sessions with members of NAHB. Industry literature points out that in the recent past, a variety of market forces have shifted the new construction market towards larger, more expensive homes (NAHB 2001a). Other things equal, demand in the higher end of the housing market tends to be more inelastic. Efforts to model the housing sector have shown that new construction is more affected by changes in household formation and income than marginal changes in price (Hirsch 1994). Given this evidence, EPA believes overall that demand in the single-family housing sector is relatively inelastic.

In the other sectors modeled (multifamily housing, commercial, industrial), EPA believes demand to be relatively inelastic as well. In the non-residential sectors, interest rates, regional economic performance and outlook, and changing technological needs are important drivers of building demand. As shown in the subsequent chapter, the change in costs relative to total project costs in these markets are relatively small and unlikely to influence the purchase decision, given the greater significance of these other factors.

EPA notes that under certain conditions developers might also attempt to pass regulatory costs back to land owners. In a depressed market, builders may argue successfully that a regulatory cost increase would make a particular project unprofitable unless the land costs can be reduced. For example, if the land owner is convinced that a residential subdivision project would not go ahead because home buyers would not absorb an unexpected increase in sales price, they may be willing to accept a lower price per acre for raw land. The ability of developers to pass such costs back would likely depend on the land owner's experience in land development projects, their knowledge of the local real estate market, and in particular their understanding of the regulation and its likely cost. While some evidence of cost pass-back to land owners exists for fixed and readily identifiable regulatory costs, such as development impact fees (Luger and Temkin 2000), it is unclear whether a builder's claim that costs would be higher due to the types of requirements imposed by the proposed rule would induce land owners to make concessions.

In the sections below, EPA has made differing assumptions concerning whether compliance costs are passed through to buyers, and to what extent. In the model project analyses in Section 4.2, for example, EPA analyzes results under the extreme conditions of zero and 100 percent CPT. This enables EPA to examine the impacts under worst-case assumptions with respect to builders (zero CPT), as well as to owners (100 percent CPT).

In other parts of the impact analysis EPA introduces more realistic assumptions about actual market conditions. For example, it is generally thought that the long run supply of new construction is almost perfectly elastic, as resources can shift easily into the industry. When empirical elasticity estimates are used to estimate actual cost pass through, the combination of inelastic demand and highly elastic supply results in relatively high cost pass through rates, on the order of 85 percent. In the model firm and closure analysis (Section 4.3), EPA analyzes the impacts under conditions of zero CPT (worst-case) as well as under the most realistic estimates of actual CPT. In the market models (Sections 4.5 and 4.6) EPA uses only the estimates of actual CPT.

4.1.3 Operation and Maintenance Costs

In order to remain effective all of the ESCs should be maintained. The engineering costs for ESCs include costs for operating and maintaining the controls. The controls used during the active phase of construction are assumed to be in place for one year and therefore should be maintained throughout the period.

4.1.4 Impacts Associated With NSPS

Under Option 2, EPA is proposing to define a "new source" under Part 450 as: "any source of storm water discharge associated with construction activity that results in the disturbance of at least five acres total land area that itself will produce an industrial source from which there may be a discharge of pollutants regulated by some other new source performance standard elsewhere under subchapter N."[1] This definition would mean that the land-disturbing activity associated with constructing a particular facility would not itself constitute a "new source" unless the results of that construction would yield a "new source" regulated by other new source performance standards. For example, construction activity that is intended to build a new pharmaceutical plant covered by 40 CFR 439.15 would be subject to new source performance standards under § 450.24. At the same time, EPA is seeking comment on whether

[1] All new source performance standards promulgated by EPA for categories of point sources are codified in subchapter N.

no sources regulated under Option 2 should be deemed “new sources” on the grounds that construction activity itself is outside the scope of those activities intended to be covered by Section 306 of the Clean Water Act (CWA).[2]

Under the proposed definition, EPA believes that the NSPS standards could trigger a National Environmental Policy Act (NEPA) review process for those C&D activities permitted by EPA. To assess the potential impact of such a result, EPA examined NPDES construction permitting data for 19 states fully or partially administered by EPA. In 2000, the number of permits administered by EPA was 8,563. EPA believes, however, that by the time the proposed C&D rule is finalized the states of Florida, Maine, and Texas (currently fully administered by EPA) will have assumed permitting authority for construction activities. In 2000, the number of permits administered by EPA *excluding these three states* was 1,454.

The NPDES permitting data does not include sufficient detail to indicate the number of sources that could be new sources covered by CWA Section 306. EPA notes, however, that in a 1999 study of 14 jurisdictions, slightly under one percent of construction permits were for industrial facilities (EPA, 1999; see Table 4-15). Based on this, EPA believes that the number of construction permits for new sources (regulated under Subchapter N) that would be administered by EPA is likely to be small. At this time, therefore, EPA has not estimated any potential costs for NEPA review as part of this economic analysis.

4.2 IMPACTS ON MODEL PROJECTS

EPA has analyzed the impacts of the proposed rule by developing financial models of representative C&D projects. These models evaluate whether the additional costs of complying with the proposed regulation would make the model project unprofitable and vulnerable to abandonment or closure. In the absence of an industry survey, the economic models are based on EPA’s best available data and assumptions concerning construction project characteristics, and are designed to depict as accurately as possible the change in cash flow resulting from compliance with the proposed rule for typical projects, representative of the type required to comply with the proposed rule. The models developed reflect the range of C&D projects typically undertaken by industry participants.

[2] "The term 'new source' means any source, <u>the construction of which</u> is commenced . . ." 33 U.S.C. sec. 1316(a)(2)(emphasis added).

4.2.1 Description of Model Project Approach

EPA selected the model project types by analyzing data on the output of the C&D industry. The industry output reflects both the diversity of the industry itself and the diversity of the U.S. economy overall. To illustrate this diversity, EPA notes that the Census of Construction assigns construction projects to one of 17 building and 32 nonbuilding construction categories (see Appendix 2A, Table 2A-3). In terms of economic value, building construction projects accounted for $371.4 billion (97.3 percent of total construction revenues) in 1997, while nonbuilding construction projects accounted for only $5.9 billion (1.5 percent).[3]

The largest single category of construction activity, accounting for $150.5 billion (39.4 percent of the total), was single-family home construction. This was followed by office buildings at $40.3 billion (10.6 percent of the total), all other commercial buildings at $36.5 billion (9.6 percent of the total), manufacturing and light industrial buildings at $26.2 billion (6.8 percent of the total), educational buildings at $25.1 billion (6.6 percent of the total), and multifamily housing at $19.6 billion (5.1 percent of the total). Based on this review, EPA developed models for four types of development projects that reflect the range of projects undertaken by the industry and that would fall within the ambit of the proposed rule. These included:

- A residential development of single-family homes
- A residential development of multifamily housing units
- A commercial development (enclosed shopping center)
- An industrial development (industrial park)

Furthermore, for each class of project , EPA has developed models that correspond to a range of project sizes. In each case, there are versions of the model for projects of 1, 3, 7.5, 25, 70, and 200 acres. The combination of four project types and six project size classes results in a total of 24 model projects.

EPA's models for these projects assess their vulnerability to shutdown or closure by predicting the cash flow changes that would result from the incremental costs that project developers would incur in

[3] Another $4.2 billion (1.1 percent of the total) was not specified by kind.

complying with the proposed rule. The models establish the baseline financial conditions for each representative project and assess the significance of the change in cash flow that results from the incremental compliance costs. The model project characteristics are based on best available data and reasonable assumptions about development activities and project financing.

4.2.2 Treatment of Nonbuilding Construction Projects

As noted above, an estimated $5.9 billion in nonbuilding construction is put in place each year. This total includes highways, roads and streets ($1.6 billion); sewage and water treatment facilities ($1.7 billion); bridges, tunnels, and elevated highways ($587 million); sewers and water mains ($211 million); power and communication lines and towers ($160 million); and private driveways and parking areas ($100 million). While considerable in absolute value, such nonbuilding construction activity represents less than two percent of the total value of construction completed. Estimates of the land area disturbed as a result of nonbuilding construction activity are not available.

EPA has not developed engineering costs applicable to nonbuilding construction projects, due to the diversity of the activities covered under this category and the relatively small share of overall construction activity it accounts for.[4] By way of analysis, EPA has developed a reduced form model project for highway construction and analyzed the likely magnitude of the costs and impacts using the highway model. This analysis is presented in Section 4.2.7.

4.2.3 Description of Model Projects

To develop the model projects, EPA focused first on the single-family residential model project. As noted above, single-family residential construction represents the highest value category of construction, and information about the construction and development process for single-family homes is

[4] The national costs of the proposed rule, however, do account for the costs borne for these types of projects. See Section 4.4.

readily available.[5] EPA was able to develop a relatively detailed model for the single-family development and then adjusted the model parameters as necessary to reflect differences in the other project categories. In general, EPA believes that projects in the other categories follow a roughly similar development path, and has thus used a similar general structure for all of the models.

Since many of the data elements and modeling assumptions are based on the single-family residential model, this model is discussed in detail below. Many of the assumptions and data elements defined for this model were applied directly or modified only slightly for use in the other models. The discussion of the other three project types focuses primarily on those assumptions or methods that differ from those employed in the single-family residential model.

4.2.3.1 Residential Single-family Development

The model single-family residential project or site is an undeveloped parcel zoned for single-family residential housing. The number of housing units built would depend on the size of the model project.[6] The location of the site is unspecified, and for this reason EPA has used national-level data wherever possible. In this case, the site is assumed to be controlled by a developer-builder (sometimes referred to in the industry as merchant builders or operative builders). The developer-builder is responsible for all aspects of the project, from land acquisition through permitting, subdivision of the parcel, installation of any ESCs, and construction and marketing of all completed housing units. EPA recognizes that there are many variations on how a particular site may be developed, but believes this model project to be representative of a large number of projects actually undertaken each year in the U.S.[7]

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[5] For example, EPA was able to obtain input to the single-family residential model from representatives of the National Association of Home Builders (NAHB), a prominent C&D industry association. Input from NAHB assisted EPA in identifying cost elements associated with each stage of project development.

[6] Model projects were developed for sites of 1, 3, 7.5, 25, 70, and 200 acres.

[7] Other common scenarios involve the developer selling all or some of the finished lots to builders. The developer may or may not retain lots in the development to complete and sell. See Figure 2-4, for example.

The starting point for the project is the acquisition of the parcel, which is assumed to be purchased or optioned from another land owner.[8] The development and construction process, as modeled, is assumed to proceed through three phases, characterized as follows:

- **Land acquisition**—The developer-builder puts together the necessary financing to purchase the parcel. When lenders are involved, they may require certain 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 city/town to install infrastructure, environmental approvals, etc. To satisfy these factors, the developer may 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 stage are divided among *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 of the housing units. A substantial portion of this work may be subcontracted out to specialty subcontractors (foundation, framing, roofing, plumbing, electrical, painting, etc.). Marketing of the development generally begins prior to the start of this phase, hence the developer-builder may also incur some marketing costs at this time. Housing units may come under sales agreement at any time prior to, during, or after completion of construction.

While the length of each phase and the overall length of the project may vary considerably, EPA assumes, for modeling purposes, that the time elapsed from acquisition of the parcel through development and construction totals 36 months. Focus groups with NAHB in Dallas provided estimates that ranged from 13 to 63 months. While acknowledging there will be wide variation in the duration of each phase, EPA further assumes that each phase—land acquisition, development, and construction—takes 12 months.

EPA presently lacks detailed data on the exact timing of ESC installation during project development. EPA assumes that ESCs installed to control runoff during the active phase of construction

[8] Options involve payments from the developer to a land owner to secure the rights to develop the land for a specified period of time, usually while a more complete assessment of project viability is undertaken.

are put in place early in the development phase and are maintained throughout the construction phase. Thus, the capital costs for such ESCs would generally be incurred early in the project, and the structures would be maintained in place for the duration of the project. The costs for removing the ESCs would be incurred at project completion.[9] These general assumptions aside, in this analysis EPA has used the simplifying assumption that the costs for all ESCs are incurred at the beginning of the project. EPA acknowledges that capital costs would actually be incurred some time after the start of the project, and that as a result, the costs would be discounted back to their present value. In making this assumption, EPA is thus overstating the magnitude of the true costs incurred, since costs incurred in the future would have a lower present value.

EPA understands that land development projects involve significant cash outflows early on to finance land acquisition, development, and construction, with revenues generally received only after completed houses are sold to buyers. For this reason, EPA assumes that the integrated developer-builder assumed here would be motivated to have several projects underway at one time. Cash inflows from the sale of completed units in one development can offset cash outflows associated with the earlier stages of development on another project. For simplicity, EPA assumes that the developer-builder involved in the model project has three projects underway so that in any given year the developer-builder incurs all of the costs—and earns all of the revenues—associated with completing the land acquisition, development, and construction phases of a project, even though these may occur on different projects.

Additional assumptions and sources for data used in the model project analysis are presented below. The model project is developed using assumptions about the types and magnitude of costs incurred during various phases of the project, the sources for these funds (i.e., the amounts borrowed versus the amounts provided from the developer-builder's equity), and the expected profit margins earned by the developer-builder from each phase of the project. EPA is seeking comments on these assumptions as well as any additional data that may enable the Agency to more accurately model such impacts at the project level.

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[9] In practice, some ESCs installed to control runoff during the construction phase that are then converted to permanent BMPs to control post-construction flows. These structures would not need to be removed.

Assumptions regarding the various cost elements incurred during each phase of the residential single-family development are described in detail in Section 4.2.5.

4.2.3.2 Residential Multifamily Development

The model multifamily residential development is an apartment building or complex. The project is assumed to be developed in a similar fashion to the single-family model development described above: a single developer-builder is responsible for all site acquisition, site preparation, construction, and marketing of the project; the project timeline is similar, i.e., three years from start to finish; and the project proceeds through the same project phases. Similarly, the developer-builder is assumed to have several projects underway to help balance cash flows. This assumption makes it possible to examine the impacts of a three year project on a single year's cashflow for the affected business. Data sources and inputs specific to the model multifamily development are discussed in Section 4.2.5.

4.2.3.3 Commercial Development

The commercial development is assumed to be an enclosed retail shopping or office area. Depending on the size of the model project, it could range from a small stand-alone retail outlet to a large, enclosed mall or office complex. As with the residential projects, a single developer-builder is assumed to be responsible for all site acquisition, site preparation, construction, and marketing of the project. The project timeline is assumed to be the same as for the residential projects, i.e., three years from start to finish, and to proceed through the same project phases. Similarly, the developer-builder is assumed to have several projects underway to help balance cash flows. This assumption makes it possible to examine the impacts of a three year project on a single year's cashflow for the affected business. Again, the particular data sources used and inputs to this model project are discussed further in Section 4.2.5.

4.2.3.4 Industrial Development

The industrial development is assumed to be an industrial park or a stand-alone manufacturing facility. As with the residential and commercial projects, a single developer-builder is assumed to be responsible for all site acquisition, site preparation, construction, and marketing of the project. The project timeline is assumed to be the same as for the residential and commercial projects, i.e., three years from start to finish, and to proceed through the same project phases. Similarly, the developer-builder is assumed to have several projects underway to help balance cash flows. This assumption makes it possible to examine the impacts of a three year project on a single year's cashflow for the affected business. A detailed discussion of data sources and inputs, which are similar to those used for the model commercial development, follows in Section 4.2.5.

4.2.4 Cost Pass Through Assumptions

For modeling purposes, EPA has analyzed the impacts of the regulatory options on each model development project under two extreme alternatives: 100 percent cost pass through (CPT) and zero percent CPT. As explained in Section 4.2, this allows EPA to show the impacts under worst-case conditions for builders (zero percent CPT) and worst-case conditions for owners (100 percent CPT). Under the 100 percent CPT scenario, a fixed percentage is assumed for the developer-builder's profit margin and the model calculates the final sales price that each buyer would be asked to pay after the compliance costs have been passed through. Under the zero CPT scenario, a fixed percentage is assumed for the developer-builder's profit under baseline conditions and the change in profit is calculated under each regulatory option, with the sale price of each housing unit remaining the same. Section 4.2.5 contains further details on the assumed profit levels and other inputs.

4.2.5 Inputs to the Model Project Analysis

As noted above, the representative projects take place in three phases: land acquisition, site development, and construction. The process of obtaining options on land to be developed (a common but not universal step that occurs in the very early stages of development), has been combined with the "land acquisition" activities for simplicity. Assumptions regarding the various costs that are incurred during each phase of the project are summarized in Table 4-1 below.

Table 4-1. Costs Incurred at Various Stages of a Residential Construction Project

Project Phase	**Cost Elements**
Land Acquisition	• Raw land (purchase or option) • Interest on land acquisition loan • Opportunity cost of capital
Development	• Engineering • Due diligence • Land development • Storm water controls • Contingency • Impact fees • Interest on development loan • Opportunity cost of capital • Overhead
Building Construction	• Lot cost (if sold to a builder; includes land acquisition and development costs plus profit to the developer) • Construction cost • Builder overhead • Interest on construction loan • Opportunity cost of capital • Real estate and marketing fees

Overall, EPA has used more than two dozen different modeling parameters, although not all project types encompass all of these parameters. Since the project location is not specified, national estimates are used where possible. Participants in the NAHB focus group meetings in Chicago assisted EPA with identifying ranges for a number of cost elements for the hypothetical residential construction project, developing estimates for raw land costs, engineering costs, and construction costs, among others. Some of the estimates proposed during the NAHB Chicago meetings are used in the model project, especially where actual national-level data has not yet been identified, and may reflect market conditions in that part of the country. Table 4-2 presents the assumptions used in the single-family residential model, along with the data source(s) used. Appendix 4A contains a similar table outlining the data parameters and sources for all four model project types. A more detailed discussion of selected parameters and data sources used for the project models is contained in Appendix 4B.

Table 4-2. Model Parameters and Data Sources

Model Parameter		Source
1, 3, 7.5, 25, 70, and 200	size of parcel, in acres	EPA assumption
$40,000	cost of raw land, per acre	Estimate from NAHB Chicago focus groups, based on experience of the Chicago-area participants. See Appendix 4B for further discussion.
0.33	size of lot, in acres	Census Report C25 (Characteristics of New Housing, 1999) reports a mean lot size for new single-family homes sold of 12,910 square feet, which represents a density of close to 3 lots per acre (evenly distributed with 1/3 acre lots). (The *median* lot size is 8,750 square feet, which implies a density of almost 5 lots per acre.)
2.67	approximate density (number of lots per acre)	Calculated based on impervious surface ratios from “Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygons,” to account for impervious surface area. Total number of lots (density x site size) is rounded to nearest whole number.
$2,500	due diligence costs, per acre	Based on $100,000 in total due diligence costs for a hypothetical 40-acre development discussed by the NAHB Chicago focus group participants. Participants considered the costs associated with all necessary environmental and engineering assessments, usually done prior to land acquisition. During these assessments the developer works to identify any potential future problems or liabilities. See Appendix 4B for further discussion.
$25,000	land development costs, per lot	Estimate from NAHB Chicago focus groups. This figure includes any construction activities related to land development (e.g., infrastructure costs).
6%	engineering costs, as percent of land development costs	Estimate from NAHB Chicago focus groups.
10%	overhead costs, as percent of development costs	Estimate from NAHB Chicago focus groups.
10%	contingency, as percent of land development costs (before impact fees)	Estimate from NAHB Chicago focus groups.
$15,000	impact fees, per lot	Estimate from NAHB Chicago focus groups. See Appendix 4B for further discussion.
7%	real estate and marketing fees, as percent of house sales price	Estimate from NAHB Chicago focus groups.
2,310	average square footage of new house	From Census Report C25, the average size of new single-family homes sold in 1999 and conventionally financed was 2,310 square feet
$53.80	cost of house construction, per square foot	From NAHB’s website, construction costs for a generic single-family house are $124,276. $124,276 ÷ 2,310 sq. ft. = $53.80 per sq. ft. (NAHB 2001b). See Appendix 4B for further discussion.
65%	percent of total land cost that a developer can finance for land acquisition	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix 4B for further discussion.

Table 4-2. Model Parameters and Data Sources

Model Parameter		Source
75%	percent of total development costs that a developer can finance for this stage	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix 4B for further discussion.
80%	percent of total building construction cost that a builder can finance	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix 4B for further discussion.
7.5%	loan interest rate for builder/developer	EPA estimate.
3	term of land acquisition loan, years	EPA assumption. Assumes that the land acquisition loan is paid off over the life of the project, which in this case is 3 years.
1	term of development loan, years	EPA assumption. Assumes that the land development loan term is equal to the length of the development phase of the project, which in this case is 1 year.
1	term of construction loan, years	EPA assumption. Assumes that the construction loan term is equal to the length of the construction phase of the project, which in this case is 1 year.
10%	assumed baseline profit on land development	NAHB Chicago focus group estimated 12-14 percent; 10 percent is an EPA assumption. See Appendix 4B for further discussion.
10%	assumed baseline pre-tax profit on construction	NAHB Chicago focus groups estimated 8 to 12 percent pre-tax at time of sale. R.S. Means also uses 10 percent as a profit assumption in their Cost Data series.

4.2.6 Model Project Analysis Approach

The model project defines the baseline financial performance of the residential subdivision project prior to the promulgation of the proposed rule. The baseline case is assumed to incorporate the costs of full compliance with the existing Phase I and future Phase II NPDES storm water regulations. The model is set up to then assess the incremental impact of additional requirements imposed under the proposed effluent guidelines.

4.2.6.1 Baseline Model Project Performance

Table 4-3 presents the model project analysis under baseline conditions, that is prior to adding in compliance costs associated with the proposed regulatory requirements. The model estimates the final sales price per housing unit using the assumptions discussed above. The model incorporates built-in targets for profit margins on both the development and construction portions of the project, as well as other assumptions that affect the target sales price for each unit. As seen, using the assumptions discussed here, the calculated sales price for each unit is $283,093. EPA notes that this is higher than the national mean sales price for conventionally-financed new single-family housing units, which was $234,900 in 2000 (FHFB 2001). EPA attributes the difference to assumptions in the model that may reflect higher-priced housing markets. Despite this likely bias, EPA believes that the model is sufficiently well-calibrated to allow comparison of the impacts of alternative storm water control costs on the model project financials.

It is important to note that while the model recognizes that projects are developed over time, the model does not fully account for the time value of money. Assumptions have been made regarding the duration of each stage of development in order to determine the period for any loans taken on by the developer, i.e., three years for land acquisition loan, one year for development loan, one year for construction loan. These assumptions influence the debt carrying costs incurred by the developer. What the model does not account for, however, is the fact that some costs are incurred in years two and three (e.g., construction costs are incurred three years out) and therefore should be discounted back to the base year, which is the year the project starts. The discount factors for costs incurred two and three years in the future are 0.873 and 0.816, respectively, assuming a seven percent discount rate. This means that any adjustments made to reflect the time value of money would reduce the overall project costs, but to a fairly limited degree.[10]

4.2.6.2 Results of Model Project Analysis

The model incorporates the costs of incremental regulatory costs via the shaded line item shown in Table 4-3. These engineering cost estimates are specific to both the type of project and project size. As these costs are added to the other costs incurred during development, the financing requirements in the development stage also increase. Table 4-4 shows the baseline project data and illustrates how the

[10] These comments apply to the baseline costs incurred for project development, but do not apply to the incremental regulatory costs. EPA has discounted all regulatory costs that wold be incurred in the future back to the baseline year, in accordance with EPA and OMB guidance for conducting regulatory impact analysis.

project financials change in response to the regulatory costs associated with Option 1 under the proposed regulation.

As seen, the incremental controls for the option shown in the example, \$483, would raise the calculated sales price on each housing unit from \$283,093 to \$283,137, a difference of \$44. This represents 0.02 percent of the baseline sales price. When the \$44 per lot cost passed on to the buyer is compared with the contractor's per-lot cost of controls (i.e., \$483 ÷ 20 lots = \$24.15), the calculated cost "multiplier" for this model project is in the range of 1.814. The cost multiplier is determined by taking the calculated increase in house sales price (over baseline) and dividing it by the actual per-lot cost of storm water controls incurred by the builder. In this example, all costs are passed on to the buyer (100 percent CPT). In Chapter Five, EPA presents the results for all combinations or regulatory options under both the 100 percent and zero CPT assumption. Under the zero CPT assumption, the builder would absorb the \$24.15 in compliance costs on each lot. The impact would be reflected in a decrease in the builder profit, and the sales price of the housing unit would remain the same.

Table 4-3. Baseline Economic Model of Hypothetical 7.5 Acre Residential Development

Project Cost Element	**Value**
Land Acquisition (7.5 acre parcel)	
Raw land	$300,000
Interest on land acquisition	$29,955
Opportunity cost of capital	$16,129
Land acquisition costs	*$346,084*
Land development (7.5 acre parcel)	
Engineering	$30,000
Due diligence	$18,750
Land development	$500,000
ESC engineering costs	$0
Contingency	$50,000
Impact fees	$300,000
Interest on development loan	$50,555
Opportunity cost of capital	$16,852
Overhead [a]	$78,079
Land development costs	*$1,044,235*
Land acquisition + land development costs	$1,390,319
Profit on land acquisition and development	$154,480
Total—Land acquisition and development	*$1,544,799*
Construction Costs (per lot)	
Finished lot cost	$77,240
Construction cost	$124,276
Interest on construction loan	$12,091
Opportunity cost of capital	$3,023
Builder overhead [a]	$18,338
Total costs to builder	$234,968
Marketing fees	$19,817
Profit on construction costs	$28,309
House sales price (calculated)	$283,093
Incremental Regulatory Impacts	
Change in sales price per lot	$0
Costs as percent of sales price	0.00%
Multiplier	0.00

[a] Overhead in both the development and construction stages is calculated as total overhead (based on 10 percent of development or construction costs) less the opportunity cost of capital. This was done to avoid double-counting the opportunity cost of capital.
Source: EPA estimates. See also Table 4-2 for model parameters and data sources.

Table 4-4. Illustration of Impact of Incremental Storm Water Control Requirements on Model Project Under Proposed Rule Option 1—*100 Percent Cost Pass Through Scenario*

Project Cost Element	**Baseline**	**Option 1**
Land Acquisition (7.5 acre parcel)		
Raw land	$300,000	$300,000
Interest on land acquisition	$29,955	$29,955
Opportunity cost of capital	$16,129	$16,129
Land acquisition costs	*$346,084*	*$346,084*
Land Development (7.5 acre parcel)		
Engineering	$30,000	$30,000
Due diligence	$18,750	$18,750
Land development	$500,000	$500,000
ESC engineering costs	$0	$483
Contingency	$50,000	$50,000
Impact fees	$300,000	$300,000
Interest on development loan	$50,555	$50,582
Opportunity cost of capital	$16,852	$16,861
Overhead [a]	$78,079	$78,121
Land development costs	*$1,044,235*	*$1,044,796*
Land acquisition + land development costs	$1,390,319	$1,390,880
Profit on land acquisition and development	$154,480	$154,542
Total—Land acquisition and development	*$1,544,799*	*$1,545,422*
Construction Costs (per lot)		
Finished lot cost	$77,240	$77,271
Construction cost	$124,276	$124,276
Interest on construction loan	$12,091	$12,093
Opportunity cost of capital	$3,023	$3,023
Builder overhead [a]	$18,338	$18,341
Total costs to builder	$234,968	$235,004
Marketing fees	$19,817	$19,820
Profit	$28,309	$28,314
House sales price (calculated)	$283,093	$283,137
Incremental Regulatory Impacts		
Change in sales price per lot	$0	$44
Costs per lot as % of baseline sales price	0.00%	0.02%
Multiplier [b]	0.000	1.814

[a] Overhead in both the development and construction stages is total overhead (based on 10 percent of development or construction costs) minus the opportunity cost of capital. This was done to avoid double-counting of the opportunity cost.
[b] [Incremental regulatory costs per lot x number of lots] ÷ [engineering costs]
Source: EPA estimates. See also Table 4-2 for model parameters and data sources.

4.2.7 Model Nonbuilding Project Analysis

As noted in Section 4.2.2, nonbuilding construction such as roads, highways, bridges, etc. s a sizeable activity but overall represents less than two percent of the total value of construction completed each year. To assess the potential impacts of the proposed rule on such activities EPA has developed a model highway construction project and used this model to assess the proposed rule's costs and impacts. EPA believes the model captures and reflects the likely magnitude and significance of the impacts of the proposed rule on the nonbuilding construction sector overall.

From the highway engineering literature, EPA assumed that the typical four-lane interstate roadway is configured as follows: two travel lanes of 24 feet each, one 20-foot median between the travel lanes, and 10 foot buffer on each side of the highway (Wright, 1996). EPA assumed that the combined width of the road surface, median, and buffers, 88 feet, represents the typical disturbed area for new highway construction. One mile of new highway would therefore represent 10.67 acres in disturbed area.[11]

To develop representative baseline costs for the model highway project, EPA examined data from the Federal Highway Administration's (FHWA's) *Highway Statistics* publication. Table FA-10 ("Obligation of Federal-Aid Highway Funds for Highway Improvements") of the *Highway Statistics* series shows the number of miles, federal funds obligated, and total cost for approved projects in a number of highway improvement categories and roadway functional classifications. Improvement categories include new construction, relocation, widening, and bridge work, among others. Roadway functional classifications include arterials, collectors, and local roads, both rural and urban. Arterials are further divided into interstate, other freeways and expressways, other principal arterials, and minor arterials.

EPA aggregated the mileage and cost for the following improvement categories: new construction, relocation, reconstruction with added capacity, and major widening. EPA further used only data for urban interstates and other freeways and expressways, since other functional classifications may

[11] The disturbed area is 88 feet or 0.0167 miles wide (88 ÷ 5,280 feet). One mile of roadway therefore disturbs 0.0167 square miles, or 10.67 acres (0.0167 x 640 acres/square mile).

include projects that do not closely match the model project characteristics. Since highway and road funding can fluctuate from year to year, EPA estimated the average miles and average cost over the period 1995-2000. Table 4-5 shows these data, with all dollar values expressed in 1997 dollars.[12] Once all dollar amounts were expressed in constant year dollars, EPA summed the number of miles, federal funds, and total costs across the two functional classifications and four improvement types to generate an overall estimate of total cost and miles affected. The total cost was then divided by the miles affected to generate a weighted average cost per mile over all relevant improvement types and functional classifications. Table 4-5 shows the weighted average cost is $5.4 million per mile.

Some caveats should be noted about the data from the "Highway Statistics" series, and as used in EPA's impact model. First, the dollar amounts used represent obligated funds, rather than actual finished project cost. Therefore, the final project cost (as well as the actual payment to private sector contractors carrying out the work) may be different than the costs reported here (Benedict 2002).[13] Second, the costs reported in Table FA-10 of "Highway Statistics" are for multi-year projects (Benedict 2002). This does not present a serious problem for the analysis because the costs provide consistent estimates of project-level costs and affected miles with which to calculate a project-level cost per mile. The fact that project completion may span multiple years is not particularly relevant for this analysis. These caveats aside, this is the most complete and well-documented set of data available on the cost for highway construction projects nationwide.[14] The results of this analysis are presented in Sections 5.2 and 5.4.

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[12] Values were converted to 1997 equivalents using data from Table PT-1 of the *Highway Statistics* publication, "Price Trends for Federal-Aid Highway Construction" (FHWA, 2001a).

[13] Actual costs may be higher due to unforeseen construction problems. However, to the extent this occurs, it will lessen the impacts of the proposed rule as modeled. Higher costs per mile will decrease the average number of miles constructed per year. Fewer miles constructed results in fewer acres disturbed, and therefore lower compliance costs.

[14] EPA previously has used an estimate of $24.61 million per mile as an estimate for highway project cost (weighted rural and urban average; FHWA 2001b). This figure, from the FHWA Office of Program Administration, may reflect many improvement types and other costs that EPA determined should not be included in this analysis. It also contains significant costs for land acquisition, engineering, design, and other work that would not be paid to the contractor for actual construction.

Table 4-5. Obligation of Federal-Aid Highway Funds for Selected Highway Improvements and Functional Classifications - 1995 to 2000. (Thousands of 1997 dollars)

	Urban		
Type of Improvement	**Interstate**	**Other Freeways and Expressways**	**Total**
New Construction			
Number Of Miles	175	277	452
Federal Funds	$1,231,171	$1,226,600	2,457,771
Total Cost	$1,393,799	$1,584,583	2,978,382
Cost per Mile	$7,984	$5,714	$6,591
Relocation			
Number Of Miles	17	46	63
Federal Funds	$243,936	$213,422	457,358
Total Cost	$272,084	$270,509	542,593
Cost per Mile	$16,062	$5,924	$8,668
Reconstruction-Added Capacity			
Number Of Miles	536	331	867
Federal Funds	$2,206,338	$1,330,439	3,536,778
Total Cost	$2,680,896	$1,674,158	4,355,055
Cost per Mile	$5,001	$5,062	$5,024
Major Widening			
Number Of Miles	307	192	499
Federal Funds	$1,086,999	$800,507	1,887,507
Total Cost	$1,273,760	$1,041,609	2,315,369
Cost per Mile	$4,152	$5,429	$4,643
Total			
Number Of Miles	1,034	846	1,880
Federal Funds	$4,768,445	$3,570,968	8,339,413
Total Cost	$5,620,539	$4,570,860	10,191,398
Cost per Mile	**$5,434**	**$5,406**	**$5,421**

Source: Based on FHWA 1996-2001, *Highway Statistics 1995-2000*, Table FA-10.

4.3 IMPACTS ON MODEL ESTABLISHMENTS

In this section EPA presents the methodology used to analyze the establishment-level impacts of the proposed rule. Section 4.3.1 outlines the impact analysis for a model establishment undertaking a model project. Section 4.3.2 generalizes and extends this model establishment analysis to estimate the industry-wide closure impacts and employment losses due to the proposed regulatory options. Finally, Section 4.3.3 analyzes whether the proposed rule could present a barrier preventing new firms from entering a market, thereby protecting existing firms from competition.

4.3.1 Model Establishment Analysis

This section presents the inputs to the model establishment analysis, discusses the development of balance sheet and income statement information, and develops the methodology for assessing potential regulatory impacts in terms of changes in model establishment financial ratios.

4.3.1.1 Inputs to the Model Establishment Analysis

EPA began by identifying data to characterize the typical financial conditions of model businesses in the construction and development industry. This data is used to develop a financial model of the firm, and to analyze the impacts of the regulatory options on firm financial conditions. The sections below present the methodology used to analyze financial impacts on a model firm, and then extend the methodology to project facility closures and employment losses.

The Bureau of the Census recently published a profile of the residential homebuilding industry that allows analysts and others to examine data in ways that were not previously available (Rappaport and Cole 2000). In particular, the study presents data by size of builder, where the builder's size is defined in terms of the number of housing units completed (previously such breakdowns were available only on the basis of employment size or revenue size). EPA used this profile to develop financial snapshots of typical residential home builders.

From the profile, EPA determined the average value of construction work (revenues) completed by builders of various sizes based on the number of housing units started in 1997. EPA combined the average construction revenue data for such builders with more detailed financial data on the homebuilding industry from Dun and Bradstreet (2000) (D&B). The D&B data was then scaled to the size of the builder in the Census profile, using the ratio of revenues to total assets.

4.3.1.2 Balance Sheet and Income Statement for Model Establishment

Table 4-6 presents the balance sheet and income statement for a model firm in the single-family residential construction sector. EPA constructed the model firm financial statement using D&B's *1999 - 2000 Industry Norms and Key Business Ratios,* and the Census special report on the homebuilding industry. The basic approach was to calculate the ratio of key components of the balance sheet and income statement to net sales, and then scale the value of these components to the size of the model firm. The model firm financials shown in Table 4-6 are based on a firm with $1.99 million in revenues, which is the average for homebuilders in the 10 to 24 home per year size class (one of the size classes defined in the Census report).

For the single-family and multifamily residential construction sectors, EPA constructed a series of model facilities, one for each housing unit starts class. A financial statement for each model firm was generated from these revenue estimates using the method discussed above and illustrated in Table 4-6. The Census special study covers the single-family and multifamily construction sectors, but does not cover the commercial and industrial building construction sectors. To construct model facilities for these sectors, EPA used 1997 Census of Construction data which is available by employment size class. First, EPA determined the employment class in each sector corresponding to the median sized firm in terms of revenues. This employment class became the basis for a single model facility for each sector. For both the commercial and industrial sectors, median revenues were in the 50 to 99 employee class. Within that employment class, EPA then calculated revenues, employment, and costs per establishment in order to further characterize the model facility.

For the four construction sectors analyzed, EPA used D&B's "typical" establishment balance sheet data from the following four-digit SIC industries:[15]

- Single-family residential construction: SIC 1531
- Multifamily residential construction: SIC 1522
- Manufacturing and industrial building construction: SIC 1541
- Commercial and institutional building construction: SIC 1542
- Highway and street construction: SIC 1611

For the model establishment presented in Table 4-6, revenues were determined from Census data. All other components are determined by the percentages taken from the D&B "typical" balance sheet for SIC 1531. The ratio of revenues (net sales) to total assets is used to determine total assets (and therefore total liabilities); the dollar value of the remaining components are derived using the percentages in the right hand column.

[15] Although most of the data used in this economic analysis is reported on an NAICS basis, the most recent D&B report still uses the SIC system for reporting purposes. EPA believes the SIC-based data from D&B can be applied to the corresponding NAICS industries, since there is a high degree of overlap in the industry definitions.

Table 4-6. Model Single-Family Residential Construction Firm Financial Data

Line Item		Dollars	Percent
Assets			
	Cash	$163,390	11.9%
	Accounts Receivable	$122,199	8.9%
	Notes Receivable	$9,611	0.7%
	Inventory	$417,399	30.4%
	Other Current	$303,438	22.1%
	Total Current Assets	**$1,016,037**	**74.0%**
	Fixed Assets	$216,938	15.8%
	Other Non-current	$140,049	10.2%
	Total Assets	**$1,373,023**	**100.0%**
Liabilities			
10	Accounts Payable	$112,588	8.2%
11	Bank Loans	$23,341	1.7%
12	Notes Payable	$201,834	14.7%
13	Other Current	$391,312	28.5%
14	**Total Current Liabilities**	**$729,075**	**53.1%**
15	Other Long Term	$162,017	11.8%
16	Deferred Credits	$10,984	0.8%
17	Net Worth	$470,947	34.3%
18	**Total Liabilities & Net Worth**	**$1,373,023**	**100.0%**
Operating Income			
19	**Net Sales**	**$1,987,009**	**100.0%**
20	Gross Profit	$453,038	22.8%
21	Net Profit After Tax	$23,844	1.2%
22	Working Capital	$286,962	

Sources: D&B 2000; Census 2000c; CCH 1999.

4.3.1.3 Methodology for Analysis of Regulatory Impacts on Model Establishment

For each model firm, EPA examined the economic impacts of each regulatory option on four different financial ratios: (1) Gross Profit, (2) Current, (3) Debt to Equity, and (4) Return on Net Worth. Industry publications cite these financial ratios as particularly relevant to the construction industry

(Kone, 2000; Benshoof, 2001). Two of the ratios examined are based on operating income (gross profit, and return on net worth), and two are based on the balance sheet statement (current, and debt to equity).

Based on literature reviews, industry focus group input, and econometric evidence, EPA believes the level of CPT to customers to be high in the construction industry. Complete, or 100 percent CPT implies zero direct impacts on the construction industry. Complete CPT in the residential sector, for example, essentially results in all compliance costs being capitalized into the cost of the house, which is then assumed to be paid for over 30 years as part of the homebuyer's mortgage. In this analysis, EPA has taken a conservative approach that results in a "worst-case" scenario, and is based on the opposite extreme – zero CPT. That is, EPA assumed all compliance costs are borne by the developer-builder.

EPA also examined more realistic scenarios incorporating the effects of partial CPT on the builder. EPA used a market model approach to estimate CPT (i.e., the ratio of the increase in market price to incremental compliance costs) for each of the four construction sectors analyzed. EPA's estimates of CPT range from a low of 85 percent for the manufacturing and industrial building sector to a high of 92 percent for the multifamily residential housing sector. Assuming positive CPT, builders incur compliance costs multiplied by one minus the CPT percentage; the remaining costs are passed through to customers in the form of higher prices.[16] Thus, for each compliance cost estimate, EPA examines impacts two ways: first assuming zero CPT, second, assuming positive CPT.

EPA assumes that compliance costs affect each model firm's balance sheet in the following manner. Construction costs are typically financed with a short term construction loan. The value of the loan tends to run about 80 percent of the value of the project, with the developer providing the remainder of the capital. The simplified balance sheet presented in Table 4-7 illustrates how a construction loan equal to $Q affects the construction firm's balance sheet if the lending institution requires the builder to finance 20 percent of the cost of the loan.

[16] Assume, for example, that the market analysis shows that housing prices increase by $0.80 of every dollar in increased construction costs per unit built, then CPT is 80 percent. If the proposed regulation adds $200 in construction costs per house, the builder incurs impacts from $40 in increased costs not offset by increased revenues [(1 - 0.8)*$200], while the house buyer pays an additional $160 (0.8*$200) for the house.

The loan reduces current assets by the amount of capital the builder is required to pay but increases noncurrent assets by the total value of the project; long term debt is increased by the amount of the loan (0.80Q). The baseline balance sheet financial ratios for the model firm will be calculated on the basis of the center column, while the post-regulatory financial ratios will be calculated on the basis of the right hand column. The value of Q was set equal to the incremental capital compliance costs of the proposed rule. EPA used the same framework for all four sectors analyzed.

Table 4-7. Impact of Compliance Costs on Developer-Builder's Balance Sheet

Line item	Baseline	Post Loan
Current Assets	$A	$A - .20Q
Noncurrent assets	$B	$B + Q
Total Assets	$A + $B	$A + $B + .80Q
Current Liabilities	$D	$D
Long Term Debt	$E	$E + .80Q
Net Worth	$F	$F
Debt plus Equity	$D + $E + $F	$D + $E + $F + .80Q

Note: Q equals incremental compliance costs.

4.3.1.4 Analysis of Financial Ratios for Model Establishment

Few financial ratios have clearly defined critical values that indicate whether a firm is performing well or poorly. Furthermore, analysts often find that a firm can perform well in one financial category (debt management, for example), yet poorly in another (perhaps rate of return). Lacking such hard and fast rules for interpreting financial ratios, analysts tend to emphasize trends over time, comparisons among competitors, or comparisons between industries, rather than a single critical value for any particular ratio. The sections below briefly describe the four ratios examined for this analysis.

Gross Profit Ratio

The gross profit ratio measures the ratio of pretax operating profit to revenues:

$$\text{gross profit ratio} = \frac{\text{gross profit}}{\text{net sales}} = \frac{(\text{net sales} - \text{operating costs})}{\text{net sales}}$$

Gross profits are line item 20 on the model firm balance sheet and income statement (Table 4-6) while net sales are line item 19. This ratio measures the decline in pretax operating income relative to the firm's volume of business. Under the worst-case scenario (zero CPT), the post compliance gross profit ratio for the model firm would be:

$$\text{gross profit ratio} = \frac{(\text{net sales} - \text{operating costs} - \text{pre-tax compliance costs})}{\text{net sales}}$$

An increase in compliance costs decreases the value of the gross profit ratio; the firm is relatively worse off.

Return on Net Worth

Return on net worth measures the rate of return from the firm relative to the owner's investment:

$$\text{return on net worth} = \frac{\text{net profit after tax}}{\text{net worth}}$$

Net profit after tax is line item 21 on the model firm balance sheet and income statement (Table 4-6) while net worth is line item 17. Should the rate of return on this line of business fall too much, then investors have better opportunities for their capital; they would start investing their capital in other industries instead of construction, and the construction industry would contract. Compliance costs reduce net profit, and therefore reduce return on net worth:

$$\text{return on net worth} = \frac{(\text{net profit after tax} - \text{post-tax compliance costs})}{\text{net worth}}$$

EPA multiplied compliance costs by one minus the effective tax rate to estimate post-tax compliance costs. To determine the effective tax rate, EPA assumed taxable income was equal to gross profit (line item 20 on Table 4-6); EPA used Federal corporate tax rates plus the average state corporate tax rate (6.6 percent) for the specified level of taxable income. Note that return on net worth is a much more sensitive ratio than the other ratios considered above because it is calculated on a post-tax basis. As can be observed in line item 21, post-tax profits are a much smaller percent of net sales than gross profit.

Current Ratio

The current ratio is defined as:

$$\text{current ratio} = \frac{\text{current assets}}{\text{current liabilities}}$$

Current assets are line item 6 on the model firm balance sheet and income statement (Table 4-6) while current liabilities are line item 14. The current ratio is a liquidity ratio that measures the availability of cash and near cash assets to meet short-term obligations. Clearly if current liabilities exceed current assets (i.e., the current ratio is less than one), the firm cannot meet all its short-term financial obligations. Although the current ratio has a well defined critical threshold, detrimental financial impacts can occur before the ratio falls below one. Again, using EPA's conservative worst-case assumption to estimate the impact of the proposed rule on the model firms's finances, the post-regulatory current ratio is:

$$\text{current ratio} = \frac{(\text{current assets} - .20 \times \text{pre-tax compliance costs})}{\text{current liabilities}}$$

An increase in compliance costs decreases the value of the current ratio; the firm is relatively worse off.

Debt Management

The debt to equity ratio is a ratio that measures how much a firm's financing has been borrowed from creditors:

$$\text{debt to equity ratio} = \frac{\text{total debt}}{\text{owner equity}}$$

Total debt is the sum of line items 14 (current liabilities), 15 (other long term liabilities), and 16 (deferred credits) on the model firm balance sheet and income statement (Table 4-6), while owner equity is line item 17 (net worth). The debt to equity ratio presents amount of capital borrowed relative to that supplied by the owners. If, for example, the debt to equity ratio is 1.9, then \$1.90 has been borrowed for every \$1 of capital provided by the owners. If the debt to equity ratio becomes too high, creditors would be reluctant to lend further capital unless the owners provide more equity. Incremental compliance costs mean that the builder would increase long term debt by the amount of the loan (0.80 × capital cost). Thus the post compliance debt to equity ratio is calculated as:

$$\text{debt to equity ratio} = \frac{(\text{total debt} + 0.80 \times \text{pre-tax compliance costs})}{\text{net worth}}$$

An increase in compliance costs increases the value of the debt to equity ratio and the firm is relatively worse off.

4.3.1.5 Compliance Cost Inputs into Financial Ratio Analysis

EPA estimated engineering compliance costs based on project size, climatic, geographical, and other characteristics. To project economic impacts using these costs, EPA determined the costs incurred by each model establishment, then converted these compliance costs to costs per establishment based on the following formula:

$$\text{costs per establishment} = (\text{costs per acre}) \times (\text{acres per start}) \times (\text{starts per establishment})$$

EPA estimated average compliance costs per acre based on project size. These are a weighted average of engineering costs by environmental region (see section 4.4.3 for details of the weighted average of compliance costs per acre calculation, and section 4.6.2. for discussion of regional characteristics and compliance costs).

For the single-family residential, commercial, and manufacturing construction sectors, the estimated number of units started per establishment is essentially identical to the number of buildings started. For the multifamily residential construction sector, however, Census reports the number of units started, but each building contains a number of units. EPA therefore estimated the average number of units per building to convert units started to buildings started.

Using data from 1999 and 2000, EPA examined the number of units built in various building classes (e.g., 35,500 units in buildings containing 2 to 4 units, 48,000 units in buildings containing 5 to 9 units) to construct a weighted average (U.S. Census Bureau 2000b). Assuming the midpoint of each building class interval represents the average number of units per building in each class (e.g., apartment buildings in the 2 to 4 units per building class contain an average of 3 apartments per building), EPA divided total units per class by the midpoint of the class to estimate the number of multi-unit buildings in each class. EPA then calculated a weighted average of units per building using the class midpoints weighted by the estimated number of buildings constructed in each class. Using this approach, EPA estimated an overall average of 10.8 units per multi-family residential building nationwide.

EPA used a variety of sources to estimate average acres per start. For single-family residential construction, EPA based its estimate of acres per start on the median lot size from the Census report *Characteristics of New Housing* (U.S. Census Bureau, 2000a). For multifamily residential, commercial, and industrial sectors, EPA combined data on the typical "building" footprint from R.S. Means (2000) with the ratio of building footprint to site size from the Center for Watershed Protection (CWP, 2001) to estimate average acres per start.

For the model highway and street construction contractor, EPA used data from Dun & Bradstreet, the 1997 *Census of Construction*, and the 1995-2000 editions of the Federal Highway Administration's (FHWA's) *Highway Statistics* publication. EPA used 1997 *Census* data to construct a model highway and street construction establishment based on median revenues for establishments in

NAICS 234110. Using the same methodology EPA developed distributions of financial ratios for Dun & Bradstreet data for SIC 1611 (highway and street construction). To estimate the number of acres disturbed, and hence, total establishment compliance costs, ERG estimated miles of highway constructed per year by dividing model establishment revenues by the estimated cost per mile constructed, $5.4 million, which was derived in Table 4-5.[17]

4.3.2 Extension of Model Facility Analysis to Project Industry Closures

EPA extended the model facility framework described here to project closures and employment losses resulting from the proposed regulation. The primary analysis, based upon analysis of financial ratios, is presented in Section 4.3.2.1. EPA also conducted a sensitivity analysis, comparing the results of the primary analysis to an estimate of closures and employment losses using an alternative approach based on cashflow changes. This alternative approach is outlined in Section 4.3.2.2. The results of the primary analysis are in Section 5.5, while the sensitivity analysis is presented in Appendix 5B. Before explaining these methodologies, however, EPA first presents information on how the number of affected establishments and employees was determined for use in this analysis.

4.3.2.1 Estimation of Affected Establishments and Employment

The proposed rule contains three regulatory options, each of which would apply to sites of varying sizes. Option 1 applies to sites of one acre or larger, Option 2 applies to sites of five acres or larger, and Option 3 (no regulation option) applies to all sites. To accurately reflect the number of entities affected under each option, EPA has adjusted the closure and employment loss methodology to account for the number of establishments affected under each option. This section describes the process used to make these adjustments.

EPA again used data from the Census special study of the home building industry (Rappaport and Cole, 2000) to obtain the number of establishments by housing unit starts class. EPA concluded that

[17] As described in Section 4.2.7, EPA estimated that one mile of highway will disturb 10.67 acres of land.

this data provided the best source for estimating the number of establishments and employees potentially affected under each option. Using the estimated density of 2.67 single-family housing units per acre (see Table 4-2), establishments starting between one and four single-family housing units per year were excluded under Option 1 because they are unlikely to disturb more than one acre on a given project.[18] Establishments in both the 1-4 and 5-9 housing unit starts per year categories were similarly excluded under Option 2, since the maximum number of housing units, nine, equates to only 3.3 acres.[19] This makes it unlikely many builders in these size classes disturb more than five acres on an individual project basis. The Census report estimates that 50,661 single-family builders start between one and four housing units per year, while another 12,708 builders start between five and nine units per year. EPA further concluded that 1,904 multifamily builders starting between two and nine multifamily units per year are unlikely to disturb more than five acres on a given project, and excluded these from the universe of establishments potentially affected under Option 2. Affected employment is determined in the same manner as affected establishments. The Census study reports the number of employees in each housing unit start category, and this number is subtracted as above under each option.

The adjustments above were made for the residential construction industries only. There are two reasons for this: (1) the Census special study only covers single-family and multifamily residential construction establishments; and (2) EPA believes that commercial and industrial building establishments are overall more likely to disturb five acres or more during the course of each project. Therefore, no adjustments are made to the nonresidential building establishment and employment counts.

Table 4-8 shows the establishment count adjustment for each option, while Table 4-9 shows the adjustment to employment.

[18] Using the density of 2.67 units per acre, four housing units per year equates to a maximum of 1.5 acres. This makes it unlikely a large percentage of establishments in the 1-4 housing units per year category disturb more than one acre at a time on a regular basis.

[19] Again, this would be the maximum land area disturbed in a year. The maximum disturbed on an individual project could be even less.

Table 4-8. Number of Establishments in the Construction and Development Industry Adjusted for Regulatory Option Coverage

Industry	Baseline [a]	Option 1: Adjustment for 1 acre exclusion	Option 1: Adjusted Number	Option 2: Adjustment for 5 acre exclusion	Option 2: Adjusted Number
Single-family	84,731	(50,661)	34,070	(12,708)	21,362
Multifamily	4,603	--	4,603	(1,904)	2,699
Commercial	39,810	--	39,810	--	39,810
Industrial	7,742	--	7,742	--	7,742
Potentially affected establishments	**136,886**		**86,225**		**71,613**

[a] Previously adjusted for remodeling establishments and land development establishments. See Section 2.3.5 for discussion of this adjustment.
Figures may not add to totals due to rounding.
Source: Rappaport and Cole (2000) and EPA estimates.

Table 4-9. Employment in the Construction and Development Industry Adjusted for Regulatory Option Coverage

Industry	Baseline [a]	Option 1: Adjustment for 1 acre exclusion	Option 1: Adjusted Number	Option 2: Adjustment for 5 acre exclusion	Option 2: Adjusted Number
Single-family	340,874	(128,940)	211,933	(41,940)	169,993
Multifamily	35,160	--	35,160	(6,064)	29,096
Commercial	549,567	--	549,567	--	549,567
Industrial	148,861	--	148,861	--	148,861
Potentially affected employees	**1,074,462**		**945,521**		**897,517**

[a] Previously adjusted for remodeling establishments and land development establishments. See Section 2.3.5 for discussion of this adjustment.
Figures may not add to totals due to rounding.
Source: Rappaport and Cole (2000) and EPA estimates.

4.3.2.2 Closure and Employment Impacts Based on Financial Ratio Analysis

To assess the impacts on firm closures, EPA first selected a criterion for determining when a facility is considered "impacted" by the proposed rule. As discussed above, financial ratios rarely have well-defined thresholds that correlate with financial health or distress. On previous effluent guidelines (e.g., MP&M), EPA has defined the critical value for financial stress as that value of a financial ratio that defines the poorest performing 25 percent of firms (i.e., the lowest quartile). EPA then assumes that a facility is financially stressed if its pre-regulatory financial ratio lies above the lowest quartile for that ratio, but its post-regulatory ratio falls in that lowest quartile range.[20]

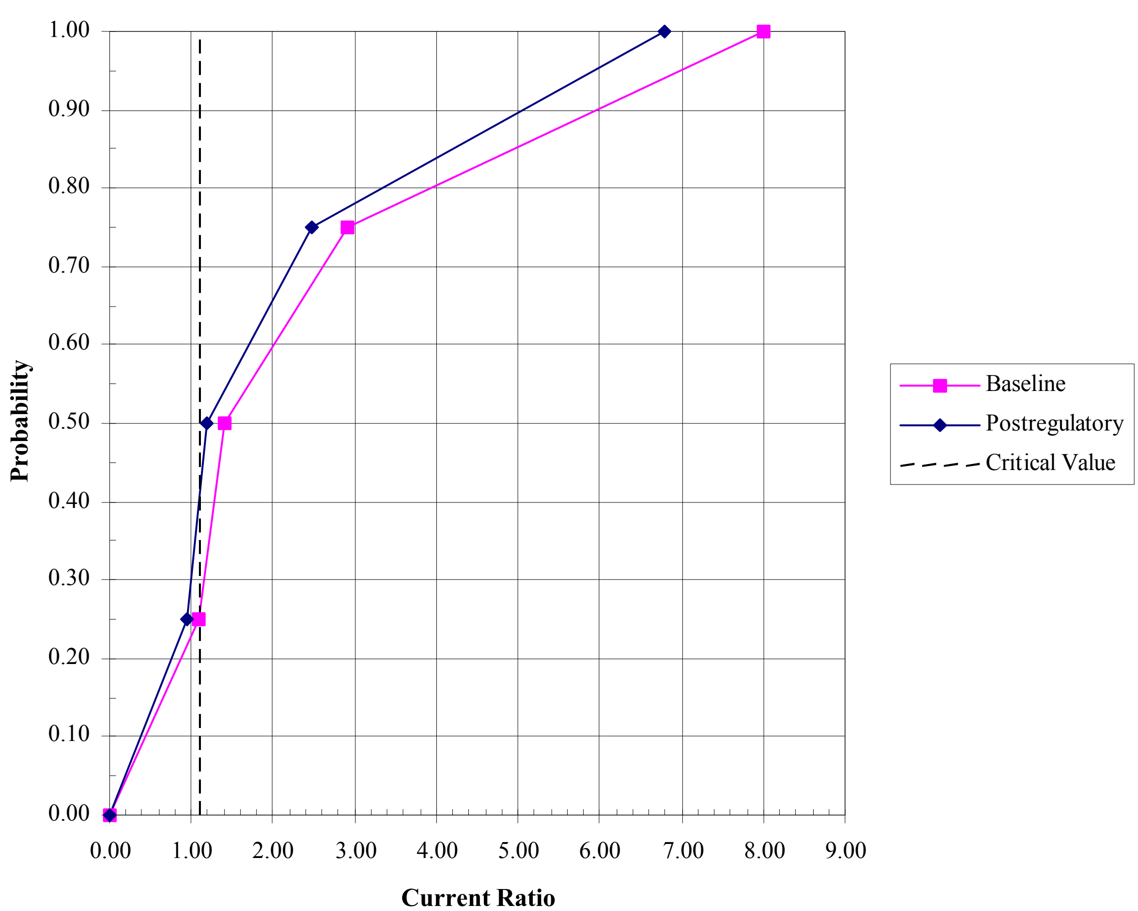
To estimate the number of establishments in each industry that would be financially distressed by the proposed regulation, EPA first approximated a cumulative distribution function for each financial ratio based on D&B data. Figure 4-1 illustrates the current ratio cumulative distribution function for SIC 1531, used to analyze single-family residential construction. The baseline curve represents the pre-regulatory cumulative distribution function. This curve indicates that 25 percent of establishments have a current ratio below 1.1 (1.1 thus becoming the critical value for determining financial distress), 25 percent of establishments have a current ratio greater than 1.1 but less 1.4 (the median), 25 percent have a current ratio greater than 1.4 but less than 2.9, and 25 percent have a current ratio greater than 2.9.[21]

[20] For example, according to D&B, 25 percent of establishments in SIC 1531 have a current ratio less than 1.1, and 75 percent have a current ratio greater than 1.1. If an establishment's pre-regulatory current ratio is greater than 1.1, but its post-regulatory current ratio is less than 1.1, EPA would classify the firm as financially distressed.

[21] The minimum and maximum values for the current ratio are not provided by D&B. For completeness EPA selected "reasonable" values to represent the end points of the curve. This has no effect on the analysis because the lowest and highest ranges are not used in the analysis.

EPA then calculates the post-regulatory current ratio for the quartile values. This shifts the cumulative distribution function for the current ratio to the left. Using the post-regulatory curve in this example, approximately 40 percent of establishments now have current ratios less than or equal to the critical value of 1.1. Thus, about 15 percent of establishments in this sector incur incremental financial

Figure 4-1
Pre- and Post-regulatory Cumulative Distribution Function for Current Ratio
SIC 1531: Operative Builders



distress due to compliance costs (i.e., 40 percent below 1.1 on the post regulatory curve minus 25 percent below 1.1 in the baseline).

A firm that exhibits or experiences financial distress under a single measure of financial performance would not necessarily always shut down. Therefore, EPA constructed similar cumulative distribution functions for the debt to equity, and return on net worth ratios, then estimated the probability of incremental financial distress under each measure.[22] To assess the economic achievability of the proposed rule, EPA assumes that the probability of establishment closure due to incremental compliance costs is equal to the average probability of incremental financial distress under each of the three financial ratios: current, debt to equity, and return on net worth. Multiplying this probability by the number of establishments in the sector, EPA obtains an estimate of the number of establishments projected to close due to the proposed regulation. Intuitively, EPA is making an implicit assumption that establishments incurring financial distress under one ratio are also incurring distress under the other two ratios. If an establishment is distressed under multiple measures of financial health, it is highly likely the establishment will close.[23] Employment losses are estimated by multiplying the number of establishments projected to close by the average number of employees per establishment.

Finally, to project sector-wide impacts, EPA aggregated closure and employment impacts over all combinations of model establishments and project sizes examined. Thus, closures for a single sector are calculated as a weighted average where the weights are determined by: (1) the relative frequency of establishments represented by each model in the sector, and (2) the relative frequency of a particular project size among all projects performed by the sector. EPA also adjusted the universe of affected establishments to reflect the regulatory coverage of each option. Thus, for Option 1 (which applies to sites of one acre or greater) EPA excluded establishments in the 1-4 housing starts category on the assumption that few of these small builders are likely to disturb more than one acre per project. Similarly, where Option 2 would apply to sites of five acres or more, EPA excluded establishments in both the 1-4

[22] D&B does not provide quartile values for the gross profit ratio.

[23] A strict interpretation of this implicit assumption would result in EPA always selecting the smallest probability of incremental financial distress from among the three measure. However, EPA determined this was not analytically desirable because the results would always be determined by the least sensitive measure of distress. Therefore, EPA selected an average of the three probabilities to measure closure rates. Note that in reality, establishments may incur distress under one ratio, but not under another, thus being less likely to close. It is possible that the set of establishments incurring distress under the current ratio, for example, is completely separate from the set of establishments incurring distress under the debt to equity ratio. However, EPA has no information on which to base an estimate of such joint probabilities. Assuming the sets of establishments incurring distress are identical results in a more conservative estimate of closures.

and 5-9 housing starts class. Assuming the national average of density of 2.67 houses per acre (see Table 4-2) a five acre site would support an average of 13.3 housing units.

4.3.2.3 Closure and Employment Impacts Based on Cashflow Analysis

As a check on the financial ratio-based approach to projecting establishment closure impacts, EPA developed a cashflow model and constructed a statistical distribution of establishments around each representative model. This allowed EPA to estimate the probability that establishments would have insufficient cashflow to afford the estimated compliance costs.

Modern financial theory states that an investment should not be undertaken if cashflow is expected to be negative after the investment is undertaken (Brealy and Myers, 1996; Brigham and Gapenski, 1997). In the context of this proposed rule, if compliance costs exceed cashflow, then post-regulatory cashflow would be negative. Under these circumstances EPA projects that the establishment would close; EPA has used this standard for projecting establishment closures for a number of past effluent guidelines (e.g., Transportation Equipment Cleaning, Industrial Laundries, Iron and Steel).

Basing the cashflow analysis on the model facilities only means that all establishments represented by a particular model would be projected to remain open if the model establishment earns cashflow exceeding compliance costs, and all would close if the model establishment's cashflow is less than estimated compliance costs. In reality, the model establishment represents a family of establishments, some with greater cashflow than the model, some with less cashflow than the model. Thus, there is some probability that establishments would close due to compliance costs even if the model establishment's cashflow exceeds compliance costs. By developing a probability distribution for each model establishment's cashflow with known mean and variance, EPA can estimate this probability. Multiplying the probability that compliance costs exceed cashflow (i.e., that post-regulatory cashflow is negative) by the number of establishments represented by the model, EPA obtains the projected number of closures for that option. To develop the cashflow distribution, EPA first estimated the mean and variance of cashflow associated with each model establishment. EPA based its estimate of mean cashflow on the 1997 Census of Construction. EPA calculated average revenues, payroll, material costs, and work subcontracted out to others within each model class (starts class for single and multifamily residential, employment class for commercial and manufacturing sectors) by dividing each Census value by the number of establishments in the class. EPA then estimated taxable income per model establishment as: revenues minus payroll, material costs, and work subcontracted out to others. Adjusting taxable income for taxes and interest payments results in estimated model establishment cashflow. EPA applied Federal corporate tax rates, plus the average state corporate tax rate to establishment income. EPA assumed interest payments comprise 25 percent of taxable income.

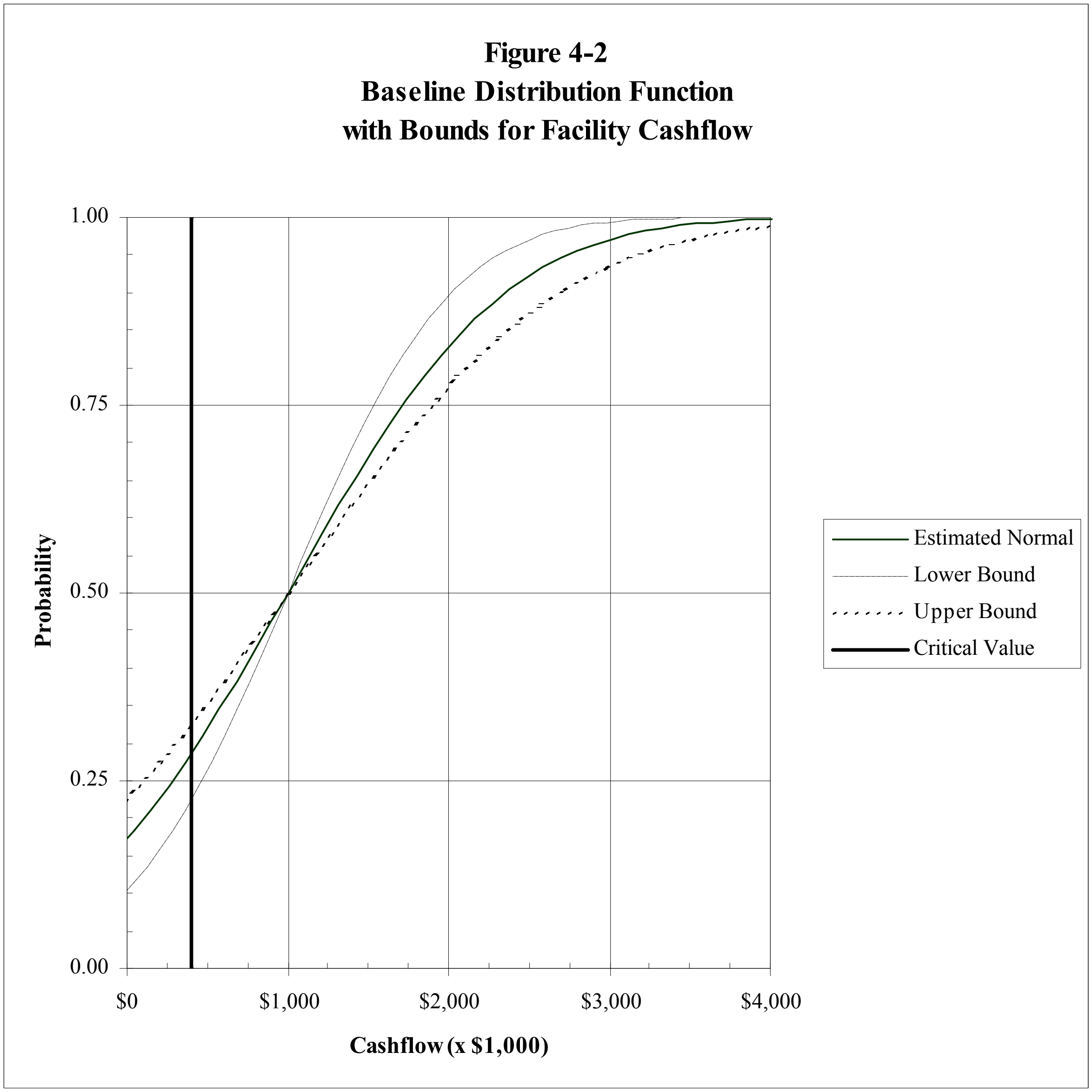
EPA based its estimate of the variance of each model establishment's cashflow distribution on the U.S. Small Business Administration's "births and deaths" database, a special tabulation prepared for SBA by Census (SBA 1999). EPA calculated the ratio of establishment closures to total establishments for the 1989 to 1998 time period at the four-digit SIC level from this database.[24] Assuming these establishments were closing because their cashflow was less than zero, EPA used the model mean and the assumption of a normal distribution to estimate the variance for the distribution that would result in a probability of zero cashflow (or less) equal to the closure rate estimated from the births and deaths database.

With estimated mean, variance, and assumed distribution of cashflow for each model establishment, it is a straightforward exercise to estimate the probability of closure due to the proposed rule. Figure 4-2 illustrates how this analysis was conducted. The "estimated normal" curve represents the distribution of a model establishment with mean cashflow of $1 million, and a variance set so that the probability of cashflow less than zero is about 17 percent (as determined from SBA's "births and deaths" database). The critical value is equal to estimated compliance costs — in this example set equal to $400,000.[25]

Figure 4-2 shows that based on this distribution, about 27 percent of establishments earn cashflow less than estimated compliance costs. However, 17 percent of establishments had negative cashflow prior to incurring the compliance costs (i.e., the "baseline closures"). Therefore, about 10 percent of establishments in this example would be projected to close due to the regulation (e.g., 27

[24] Note that the level of detail in the database was sufficient to allow EPA to estimate separately the closure rates for small and large business establishments.

[25] This large estimated compliance cost was selected only for the purposes of making the figure clear and does not reflect actual anticipated compliance costs.



percent with cashflow less than compliance costs minus the 17 percent with cashflow less than zero). If 150 establishments are in this model class, and the average employment per establishment is 20 workers in this class, than EPA would project 15 establishments would close and 300 employees would lose their jobs due to the regulation.

Because of the uncertainties inherent in estimating cashflow and variance for this analysis, EPA estimated a range of closure and employment impacts. EPA created upper and lower bounds to its estimated cashflow distribution by multiplying the distribution's variance by plus/minus 25 percent. This creates the bands observed around the estimated normal distribution in Figure 4-2. Therefore, although the methodology follows the logic outlined above, EPA reports an upper and lower bound for projected closures based on bands around the actual estimated variance of cashflow. The results of this analysis are presented in Appendix 5A.

4.3.3 Analysis of Barriers to Entry

Barriers to entry are typically assumed to occur if the cost of complying with a regulation substantially increases the firm start-up costs. For example, if a rulemaking required that all facilities invest substantially in a wastewater treatment system, then an entrepreneur might be discouraged from starting an enterprise. The increased capital cost serves as a barrier to new entry to the industry.

The situation in the construction industry is somewhat different than that outlined above. In terms of the capital expense needed to start a firm, the proposed rule has little direct impact. The proposed rule does not require a firm to purchase and install any capital equipment, and thus the level of capital expenditures required to start up a firm are not directly affected by the proposed rule.

Landis (1986; see section 2.4.1.4.2 for details) identifies two significant classes of barrier to entry specific to the construction industry that are not related to capital equipment: (1) entry costs to participate in a given market (e.g., local development fees or abnormally high land costs), and (2) input cost differentials (e.g., the new entrant must pay a higher price for inputs than existing firms). These barriers to entry, however, also appear unaffected by the proposed rule. To the extent that either of these barriers already exist in any given market, they would not be differentially impacted by the proposed rule.

As the model establishment analysis shows, the proposed rule might increase borrowing to finance building projects. This could affect a potential industry entrant indirectly in that it may need marginally more start-up capital in order to obtain the somewhat larger short-term construction loan to undertake a project. Once again, however, the new entrant would still face essentially the same requirements that existing firms face to secure a loan. Thus, new entrants should not be differentially affected by the proposed rule in such a way that they would be unable to compete effectively with existing firms.

To examine the potential for barriers to entry, EPA calculated the ratio of estimated compliance costs to each model establishment's current assets and total assets. If these ratios are small, then EPA concludes that the proposed rule would have little effect on the ability of a new entrant to find financing for a project. Note that in this analysis EPA compares total compliance costs to assets. This step probably overestimates impacts. It is more likely that a new entrant would need to provide only 20 percent of the incremental compliance costs and would obtain the remaining 80 percent from conventional construction loan financing sources (see Section 4.3.1.3) — as would an existing firm.

4.4 NATIONAL COMPLIANCE COSTS

As noted above, EPA developed engineering costs for four categories of land use (single-family residential, multifamily residential, commercial, and industrial) and six project size categories (1, 3, 7.5, 25, 70, and 200 acres). Estimates of the national costs of the effluent guidelines regulations are obtained by multiplying the per-acre costs developed for each land use and size class combination by the number of acres of each type estimated to be developed each year; taking into account the applicability of each option in terms of site size.

Estimates of the number of acres developed nationally per year are available from the U.S. Department of Agriculture's (USDA's) National Resources Inventory (NRI). This source does not, however, identify the type of development or subsequent nature of the land use, nor the distribution of acreage by site size. The following sections describe the NRI estimates and EPA's approach to distributing the developed acreage by type of development and site size.

4.4.1 National Estimates of Disturbed Acreage

The NRI, a program of the USDA's Natural Resources Conservation Service, is designed to track changes in land cover and land use over time. The inventory, conducted every five years, covers all non-

Federal land in the United States (75 percent of the U.S. total). The program captures land use data from some 800,000 statistically selected locations. From 1992 to 1997, an average of 2.24 million acres per year was converted from nondeveloped to developed status (USDA, 2000). Table 4-10 shows the allocation of this converted land area by type of land or land cover. As seen, land previously classified as forest land accounted for 41.9 percent of the total, while land previously classified as cropland accounted for 25.6 percent and land previously classified as pastureland accounted for 17.4 percent. No further breakdown by type of converted land use is available.

EPA assumes that some of the 2.24 million acres converted from an undeveloped to developed state each year would be exempt from the requirements of the proposed rule due to small-site or low-soil-loss-potential waivers. Based on the engineering analysis of sites likely to be eligible for such waivers, EPA has reduced the acreage subject to active construction controls to 2.18 million acres (U.S. EPA, 2002).

In the following section EPA develops estimates of the distribution of this acreage by type of development and by project size. EPA also estimates the amount of acreage potentially excluded from coverage under the site size exclusions specified for Option 1 and Option 2 (i.e., below one and below 5 acres, respectively). With the resulting estimates of acreage distributed by project type and size class, EPA can then apply the appropriate per-acre engineering costs to obtain estimates of national costs.

4.4.2 Distribution of Acreage by Project Type

To allocate the NRI acreage, EPA has estimated the distribution of acres developed by type of development in the following way. In the first step, EPA multiplied the number of building permits issued annually by estimates of the average site size. Thus for single-family residential construction, EPA multiplied the number of new single-family homes authorized by building permit by the average lot size for new single-family construction. Estimates for other types of construction are based on extrapolations from the Census permit data and EPA estimates of average project size. In the second step, EPA adjusts the estimates of acres converted to reconcile any differences between the total number of acres accounted for using this approach and the total acres developed estimated by the NRI. Finally, EPA allocates the total by type of construction, site size, and region and adjusts each regional value to an integer to ensure that only whole sites are considered.

Table 4-10. Acres Converted from Undeveloped to Developed State[a] (1992-1997)

Type of land	Acres Converted to Development 1992-1997 (000) annual average	Percent contribution by type of land
Cropland	574.8	25.6%
Conservation Reserve Program land	1.5	0.1%
Pastureland	391.2	17.4%
Rangeland	245.9	11.0%
Forest land	939	41.9%
Other rural land	89.1	4.0%
Water areas and federal land	1.8	0.1%
Total	**2,243.4**	**100.0%**

[a] NRI defines *developed land* as a combination of the following land cover/use categories *large urban and built-up areas*, *small built-up areas*, and *rural transportation land*. These are defined as follows:

- *Large urban and built-up areas*. A land cover/use category composed of developed tracts of at least 10 acres—meeting the definition of urban and built-up areas.[b]
- *Small built-up areas.* A land cover/use category consisting of developed land units of 0.25 to 10 acres, which meet the definition of urban and built-up areas.[b]
- *Rural transportation land.* A land cover/use category which consists of all highways, roads, railroads and associated right-of-ways outside urban and built-up areas; also includes private roads to farmsteads or ranch headquarters, logging roads, and other private roads (field lanes are not included).

[b] *Urban and built up areas* are in turn defined as:

- *Urban and built-up areas.* A land cover/use category consisting of residential, industrial, commercial, and institutional land; construction sites; public administrative sites; railroad yards; cemeteries; airports; golf courses; sanitary landfills; sewage treatment plants; water control structures and spillways; other land used for such purposes; small parks (less than 10 acres) within urban and built-up areas; and highways, railroads , and other transportation facilities if they are surrounded by urban areas. Also included are tracts of less than 10 acres that do not meet the above definition but are completely surrounded by Urban and built-up land. Two size categories are recognized in the NRI: areas of 0.25 acre to 10 acres, and areas of at least 10 acres.

Source: USDA, 2000.

Single-family residential

Census data indicate that in recent years the number of new single-family housing units authorized has averaged just over 1.0 million units per year (see Table 4-11). As seen in Table 4-12, the average lot size for new single-family housing units is 13,553 square feet, or 0.31 acres (1 acre = 43,560 square feet). Using the average lot size, however, would underestimate the total acreage converted for single-family residential projects because this acreage does not include common areas of developments that are not counted as part of the owner's lot—streets, sidewalks, parking areas, storm water management structures, and open spaces.

To account for this, EPA examined data obtained from a survey of municipalities conducted in support of the Phase II NPDES storm water rule (EPA, 1999). This survey identified 14 communities that consistently collected project type and size data as part of their construction permitting programs.[26] EPA's review of permitting data from these communities covered 855 single-family developments encompassing 18,134 housing units. The combined area of these developments was 11,460 acres. This means that each housing unit accounted for 0.63 acres (11,460 acres ÷ 18,134 units = 0.63 acres per unit). This estimate, essentially double the average lot size, appears to more than account for the common areas and undeveloped areas in a typical single-family residential development. For this reason, EPA averaged the Census estimate of the national average lot size (0.31 acres) and the Phase II NPDES storm water estimate of 0.63 acres per unit to arrive at an estimate of 0.47 acres per unit. This number was multiplied by the average number of single-family housing units authorized by building permit, 1.04 million, to arrive at an estimate of 490,231 acres (see Table 4-15).

Table 4-11. New Single-Family and Multifamily Housing Units Authorized, 1995-1997

Year	All Housing Units	Single-Family Housing Units	Multifamily Housing Units
1995	1,332,549	997,268	335,281
1996	1,425,616	1,069,472	356,144
1997	1,441,136	1,062,396	378,740
1995-1997 avg	**1,399,767**	**1,043,045**	**356,722**

Source: Census 2000b. Series C40 New Privately Owned Housing Units Authorized.

[26] The communities were: Austin, TX; Baltimore County, MD; Cary, NC; Ft. Collins, CO; Lacey, WA; Loudoun County, VA; New Britain, CT; Olympia, WA; Prince George's County, MD; Raleigh, NC; South Bend, IN; Tallahassee, FL; Tuscon, AZ; and Waukesha, WI.

Table 4-12. Average and Median Lot Size for New Single-Family Housing Units Sold, 1995-1997

Year	Average Lot Size (Square Feet)	Median Lot Size (Square Feet)
1995	13,290	9,000
1996	13,705	9,100
1997	13,665	9,375
1995-1997 avg	**13,553**	**9,158**

Source: Census 2000a. Series C25 Characteristics of New Housing:

Multifamily Residential

For residential construction other than single-family housing, EPA divided the average number of units authorized over 1995-1997 (356,722, from Table 4-11) by the average number of units per new multifamily building. The average number of units per building was obtained by examining the distribution of units by unit size class in Census data (U.S. Census Bureau, 2000b). This report shows the number of units by building size class (2 to 4 units, 5 to 9 units, 10 to 19 units, 20 or more units).[27] EPA estimated the number of buildings in each size class (using data for 1999 and 2000) by dividing the number of units in each class by the average number of units. The total number of units were then divided into the estimated number of buildings to arrive at the average number of units across all building size classes. When this was done, the average number of units was estimated to be 10.8.

EPA next examined data on the average site size for multifamily residential developments. The Center for Watershed Protection reports estimates from one survey in which the footprint for multifamily buildings occupied an average of 15.6 percent of the total site (CWP, 2001). EPA assumed that the average-sized multifamily building (10.8 units) would have two floors and that each unit occupies the national average of 1,095 square feet (NAHB, 2002). The total square footage accounted for by living space is thus 11,826 square feet. Multiplying by a factor of 1.2 to account for common areas and other non-living space (utility rooms, hallways, stairways), and dividing by 2 to reflect the assumption of a 2-

[27] The average number of units was derived using data for 1999 and 2000, since data for prior years was not available at this level of building size detail.

story structure, EPA obtained a typical building footprint of 7,096 square feet (11,826 x 1.2 ÷ 2 = 7,096). Combining this with the CWP estimate of the building footprint share of total site size (15.6 percent), the average site size was estimated to be 42,485 square feet (7,096 ÷ 0.156 = 45,487), or just over one acre (1.04 acres).

EPA compared the average site size obtained using this approach with data from the 14 community study referenced above. That study's review of permitting data identified 286 multifamily developments covering a total of 3,476 acres. The average site size, 12.1 acres, is considerably higher than that obtained above. EPA has no indication that the permits reviewed in these communities are for projects of a larger than average size. For purposes of this analysis, EPA has taken the midpoint of the estimates, 6.5 acres, as the average size of multifamily projects. This number was multiplied by the average number of multifamily housing developments authorized by building permit, 35,672, to arrive at an estimate of 231,868 acres (see Table 4-15).

Nonresidential construction

EPA lacked current data on the number of nonresidential construction and development projects authorized annually because the Census Bureau ceased collecting data on the number of permits issued for such projects in 1995. EPA therefore used regression analysis to forecast the number of nonresidential building permits issued in 1997, based on the historical relationship between residential and nonresidential construction activity (see Section 4.5.3). Using this approach, EPA estimates that a total of 426,024 nonresidential permits were issued in 1997. These represent a variety of project types, including commercial and industrial, institutional, recreational, as well as nonresidential, nonbuilding projects such as parks and road and highway projects.

EPA first combined a number of nonresidential project types into a larger "commercial" category, which included hotels and motels, retail and office projects, and religious, public works, and educational projects.[28] EPA's reasoning for including the latter categories under the commercial category

[28] The commercial category included: hotels/motels, amusement, religious, parking garages, service stations, hospitals, offices, public works, educational, stores, other nonresidential buildings.

is based on engineering judgment that storm water management practices would be similar across each project type. The total estimated number of commercial permits in 1997 was 254,566 (59.7 percent of the nonresidential total). EPA retained the industrial category, which totaled 12,140 permits (2.8 percent), separately. Storm water management practices for such sites generally differ from those for commercial or residential sites. The residual, 159,318 permits (37.4 percent), are nonbuilding, nonresidential projects that include parks, bridges, roads, and highways. EPA accounts for these projects in the steps described further below.

For the commercial and industrial categories, EPA reviewed the project size data collected from the 14-community study referenced earlier (EPA, 1999). This study identified 817 commercial sites occupying 5,514 acres and 115 industrial sites occupying 689 acres. The average site size is 6.75 and 5.99 acres, respectively.

EPA also reviewed estimates from CWP (2001) on the average percent of commercial and industrial sites taken up by the building footprint. These percentages, 19.1 and 19.6 respectively, were multiplied across the model project site sizes of 1, 3, 7.5, 25, 70, and 200 acres to estimate the size of building on each site, assuming single-story buildings in each case. These estimates are shown in Table 4-13.

Table 4-13. Average Building Square Footage

Project Size (Acres)	Commercial	Industrial
1	8,320	8,555
3	24,960	25,666
7.5	62,400	64,164
25	207,999	213,880
70	582,397	598,863
200	1,663,992	1,711,037

Estimates were obtained by multiplying the site size in square feet by the percentage of the site estimated to be occupied by the building footprint, based on data from CWP (2001).
Source: EPA estimates.

As seen in the table, the average building size corresponding to the 6- to 7- acre sites estimated from the 14-community study are in the 60,000 square feet range. EPA next examined R.S. Means (2000), which provides cost data for "typical" commercial and industrial buildings. As part of the cost data, Means identifies the typical range of building sizes based on a database of actual projects. Table 4-13 shows the typical size and size range for a variety of building types that would fall into either the commercial or industrial categories. While some of the building types correspond with the estimated average of 60,000 square feet, these appear high for other categories, such as low-rise office and supermarkets, warehouses, and elementary schools. EPA believes generally that there are more small projects than large ones. As a result, EPA inferred that this approach would suggest an average building size of 25,000 square feet, which implies an average site size of 3 acres, based on Table 4-14.

Table 4-14. Typical Building Sizes and Size Ranges by Type of Building

Building Category/Type	Typical Size (Gross Square Feet)	Typical Range (Gross Square Feet)	
		Low	High
Commercial - Supermarkets	20,000	12,000	30,000
Commercial - Department Store	90,000	44,000	122,000
Commercial - Low-Rise Office	8,600	4,700	19,000
Commercial - Mid-Rise Office	52,000	31,300	83,100
Commercial - Elementary[a]	41,000	24,500	55,000
Industrial - Warehouse	25,000	8,000	72,000

[a] For purposes of this analysis EPA combines a number of building types, including educational, under the commercial category.
Source: R.S. Means (2000).

To reconcile the estimates obtained from the two approaches, EPA has taken the midpoint of the estimates. For commercial development, EPA assumes an average site size of 4.87 acres (the average of 6.75 and 3.0 acres) and for industrial development EPA assumes an average site size of 4.50 acres (the average of 5.99 and 3.0 acres).

The resulting average project sizes were then multiplied by the estimated number of commercial and industrial permits to obtain an estimate of the total acreage developed for these project categories.

Table 4-15 shows the results of this "bottom-up" approach to estimating the number of acres of land developed. The overall estimate of the amount of land developed is 2.01 million acres per year. Residential single-family development accounts for 24.4 percent of the total, multifamily development for 11.5 percent of the total, commercial for 61.4 percent, and industrial for 2.7 percent.

Table 4-15. National Estimates of Land Area Developed Per Year, Based on Building Permit Data

Type of Construction		Permits		Average Site Size[a]	Acres Disturbed	
		Number	Pct. of Total		Number	Pct. of total
Residential	Single-family	1,043,045	77.5%	0.47	490,231	24.4%
	Multifamily	35,672	2.7%	6.5	231,868	11.5%
Nonresidential	Commercial[b]	254,566	18.9%	4.9	1,234,645	61.4%
	Industrial	12,140	0.9%	4.5	54,630	2.7%
Total		**1,345,423**	**100.0%**	**--**	**2,011,374**	**100.0%**

[a] For single-family residential, this is the average of the average lot size for new construction in 1999 (Census 1999) and the average obtained in EPA (1999). For all other categories, the site sizes are EPA assumptions based on representative project profiles contained in R.S. Means (2000) and the 14-community survey conducted in support of the Phase II NPDES storm water rule (EPA 1999). See also Tables 4-7 and 4-8.
[b] A number of project types were grouped together to form the "commercial" category, including: hotels/motels, amusement, religious, parking garages, service stations, hospitals, offices, public works, educational, stores, other nonresidential buildings.

The estimate of total acreage developed, 2.01 million acres, can be compared with the estimate provided by the NRI. From Table 4-10, NRI estimates that a total of 2.24 million acres are converted from undeveloped to developed status each year. As noted above, some acreage would not be covered by the proposed rule or site size limitations due to waivers. The estimated acreage subject to the proposed rule 2.18 million acres.[29]

EPA considers the estimate of 2.01 million acres (Table 4-15) to be close to the estimates obtained from NRI. Areas not accounted for in EPA's estimates include those converted as a result of

[29] This is technically the acreage covered under Option 1, which affects sites of one acre or more in size. Estimates of the acreage covered under Option 2, which affects sites of five acres or more, are made in Section 4.4.4.

road, highway, bridge, park, monument, and other nonbuilding construction projects.[30] EPA has not developed engineering costs applicable to these types of projects, but assumes that the builders and developers of these areas would face compliance costs, i.e., the acres should not be excluded from the analysis. For the purpose of developing national compliance costs, therefore, EPA has allocated the entire NRI acreage, adjusted for waivers, according to the distribution shown in the final column of Table 4-16.[31]

Table 4-16. National Estimates of Land Area Disturbed Based on National Resources Inventory Totals

Type of Construction		Acres Based on Permits Data		Adjusted NRI Acreage[b]
		Number[a]	Pct. of Total	
Residential	Single-family	490,231	24.4%	533,878
	Multifamily	231,868	11.5%	252,182
Nonresidential	Commercial[c]	1,234,645	61.4%	1,332,476
	Industrial	54,630	2.7%	57,523
Total		**2,011,374**	**100.0%**	**2,176,058**

[a] From Table 4-15.
[b] This column distributes the total acreage estimated in NRI to be converted on an annual basis (adjusted for waivers) according to the distribution by type of development estimated through analysis of permits data. See also Tables 4-11 through 4-14.
[c] A number of project types were grouped together to form the "commercial" category, including: hotels/motels, amusement, religious, parking garages, service stations, hospitals, offices, public works, educational, stores, other nonresidential buildings.

4.4.3 Distribution of Acreage by Project Size

The next step in the national compliance cost analysis is to allocate the number of acres in each of the four land use categories according to project size. The project size distribution is based on the survey of municipalities conducted in support of the Phase II NPDES storm water rule (EPA, 1999). This survey identified 14 communities that consistently collect project type and size data as part of their

[30] As noted above, EPA estimates there are approximately 159,000 such projects permitted each year.

[31] This distribution implies that the acres not accounted for from the NRI (see Table 4-10) will be costed at the weighted average cost across the single-family residential, multifamily residential, commercial, and industrial categories.

construction permitting programs. Table 4-17 shows the distribution by project size for each land use category.

Following allocation to project size class, EPA also allocated the acreage to one of 19 eco-regions, based on geographical information system (GIS) modeling. Non-linearity of installation costs made it inaccurate to consider partial sites. So, these totals were adjusted to ensure that only whole sites would be considered for each category of type, site size, and region. Further detail on this step in the analysis can be found in the Development Document (U.S. EPA, 2002).

The final step in the national compliance cost analysis is to multiply the number of acres in each eco-region, size class, and land use category by the applicable cost per acre. These costs are shown in Chapter Five.

4.4.4 Estimates of Acreage Covered by Option 2

Table 4-16 above shows the distribution of acreage affected under Option 1 of the proposed rule, which would apply to sites of one acre or larger. The additional acreage excluded under the site size limitations of Option 2 (five acres) was obtained by estimating the acreage in sites above one acre and below five acres in size. The 3-acre size class represents projects greater than 1 acre and less than 5 acres. This category was subtracted from the matrix of acreage by region, type, and size class as allocated by the GIS. As shown in Table 4-17, the 14-community study (EPA, 1999) found that 6.0 percent of acreage developed for single-family housing was assigned to sites in the 3-acre size class. EPA estimated that, after rounding, roughly 6.1 percent of acreage converted to single-family housing units would be excluded under Option 2. EPA made similar estimates of the acreage converted to multi-family, commercial, and industrial uses that would be excluded under Option 2. Table 4-18 shows the distribution of acreage affected under Option 2 of the proposed rule.

Table 4-17. Distribution of Permits by Site Size

Site Size (Acres)	No. of Permits	Acres by Size	Pct. Acres by Size
Single-Family Residential			
1	266	266	2.3%
3	228	684	6.0%
7.5	138	1,035	9.0%
25	175	4,375	38.2%
70	30	2,100	18.3%
200	15	3,000	26.2%
Total	852	11,460	100.0%
Multifamily Residential			
1	43	43	1.2%
3	100	300	8.6%
7.5	61	458	13.2%
25	71	1,775	51.1%
70	10	700	20.1%
200	1	200	5.8%
Total	286	3,476	100.0%
Commercial			
1	266	266	4.8%
3	356	1,068	19.4%
7.5	86	645	11.7%
25	91	2,275	41.3%
70	16	1,260	22.9%
200	0	0	0.0%
Total	815	5,514	100.0%
Industrial			
1	39	39	5.7%
3	55	165	23.9%
7.5	10	75	10.9%
25	8	200	29.0%
70	3	210	30.5%
200	0	0	0.0%
Total	115	689	100.0%

Table 4-17. Distribution of Permits by Site Size

Site Size (Acres)	No. of Permits	Acres by Size	Pct. Acres by Size
Total			
1	614	614	2.9%
3	739	2,217	10.5%
7.5	295	2,213	10.5%
25	345	8,625	40.8%
70	59	4,270	20.2%
200	16	3,200	15.1%
Total	2,068	21,139	100.0%

Based on permitting data from the following municipalities or counties: Austin, TX; Baltimore County, MD; Cary, NC; Ft. Collins, CO; Lacey, WA; Loudoun County, VA; New Britain, CT; Olympia, WA; Prince George's County, MD; Raleigh, NC; South Bend, IN; Tallahassee, FL; Tuscon, AZ; and Waukesha, WI (EPA, 1999).
Source: EPA estimates.

Table 4-18. Estimates of Acreage Affected Under Proposed Rule Option 2

Type of Construction		Acreage Affected Under Option 1[a]	Percent Excluded Under Option 2[b]	Acreage Affected Under Option 2
Residential	Single-family	533,878	6.1%	501,100
	Multifamily	252,182	8.8%	229,958
Nonresidential	Commercial[c]	1,332,476	20.4%	1,061,108
	Industrial	57,523	25.7%	42,733
Total		**2,176,058**	**--**	**1,834,898**

[a] From Table 4-15.
[b] Based on analysis of site size distributions found in EPA (1999).
[c] A number of project types were grouped together to form the "commercial" category, including: hotels/motels, amusement, religious, parking garages, service stations, hospitals, offices, public works, educational, stores, other nonresidential buildings.
Source: EPA estimates.

4.4.5 Operation and Maintenance Costs

For any incremental ESC requirements triggered under Option 2, EPA estimated the percentage of capital costs of each technology that would be required annually to operate and maintain the facilities. Those facilities with a limited useful life were assigned percentages sufficient to replace them at the appropriate time. These were converted to costs per acre for each option. The O&M costs are assumed to be incurred for a one-year period during the active phase of construction.

4.5 IMPACTS ON THE NATIONAL HOUSING MARKET

4.5.1 Description of National Housing Market Model

EPA takes three complementary approaches to estimating the market impacts of the proposed rule. Two treat the nation as a single market; the third treats each city as a distinct housing market. The first approach assumes all of the costs of compliance with the regulation are passed through to the home buyer. If the home is more costly, fewer households would be able to qualify for a mortgage to purchase it. This change in market size is an indicator of the impact of the proposed regulation. In the second approach, the costs of compliance shift the national housing supply curve in a linear partial equilibrium model. A portion of the increased costs raises the price of new housing while the balance is absorbed by the builder. Higher prices and lower quantities change the welfare of participants in the housing market. The third approach estimates a linear partial equilibrium model, like the national model, for 215 metropolitan statistical areas (MSAs) based on local measures of residential construction activity. This approach measures changes in affordability in terms of the Housing Opportunity Index (HOI), a well publicized measure of housing availability. The following sections explain each model in detail.

4.5.1.1 Complete Cost Pass Through and Housing Affordability

Landis' (1986) and Luger and Temkin's (2000) surveys suggest that all of the additional costs of compliance with new storm water regulations would be passed through to new home buyers in the form of higher prices for a unit of a given quality. The quantity of new housing built would not change because demand is driven by demographics more than marginal price considerations, i.e., demand is inelastic, and competition in supply is limited because of oligopolistic markets in many areas and infinitely elastic supply in others. An increase in the price of a home increases the income necessary to qualify for a home mortgage to purchase the home, and so reduces the number of households able to afford it. One measure of the impact of the regulation is the change in the number of households that can afford the new home.

EPA developed its market model parameters from the previously described model projects, Census data, and the housing economics literature. Simple assumptions about expected proportionate profit margins, borrowing, and contingencies discussed in Section 4.2 indicate that added incremental compliance costs are multiplied by a factor of 1.5 to 1.8 in the final consumer price. Luger and Temkin (2000) report a compliance cost multiplier of 2 to 6 times actual compliance costs. The higher multiplier may reflect a tight housing market in high growth regions. The median house price, from the industry profile, is taken as the baseline price. The median price, P_0, with the additional compliance costs, C, multiplied by a factor for added time and borrowing, m, equals the new price, P_N, which is the starting point for calculating the effect of the proposed regulation on affordability, welfare measures, and other market model results:

$$P_N = P_0 + mC \qquad (1)$$

where:

$$\begin{aligned} P_N &= \textit{New Price with ESC Compliance Costs} \\ P_0 &= \textit{Median New Home Price} \\ m &= \textit{Cost Multiplier} \\ C &= \textit{ESC Compliance Costs} \end{aligned}$$

The monthly payment for principal, interest, taxes, and insurance (PITI) for the new home is based on the new price:

$$PI = \frac{F P_N \left(\frac{r}{12}\right)}{1 - \left(1 + \frac{r}{12}\right)^{-360}} \qquad (2)$$

$$T = t \frac{P_N}{1{,}000} \qquad (3)$$

$$I = s \frac{P_N}{1{,}000} \qquad (4)$$

$$PITI = PI + T + I \qquad (5)$$

where:

$$\begin{aligned}
PI &= \textit{Monthly Principal and Interest} \\
F &= \textit{Proportion of New Home Cost that is financed} \\
r &= \textit{Annual Mortgage Interest Rate} \\
T &= \textit{Monthly Tax Payment} \\
t &= \textit{Monthly Tax Rate per Thousand Dollars Value} \\
I &= \textit{Monthly Insurance Premium} \\
s &= \textit{Monthly Insurance Rate per Thousand Dollars Value} \\
PITI &= \textit{Principal, Interest, Taxes, and Insurance}
\end{aligned}$$

Fannie Mae guidelines limit borrowers' PITI payments to no more than 28 percent of their gross income. The value for F, 0.774, and r, 0.0752, the mortgage terms, are national averages for the typical 30-year fixed rate, private mortgage in the base period (FHFB, 2001). Values for t, \$1/\$1,000 value, and s, \$0.25/\$1,000 value, are from a recent study of housing affordability (Savage, 1999). The gross income necessary to qualify for the mortgage at the new price, under this criterion, Y, is given by:

$$Y = \frac{12\ PITI}{0.28} \qquad (6)$$

Table 4-19 illustrates the calculations using Option 2 costs. In Chapter Five, EPA uses this approach to estimate the number of households priced out of the new housing market as a result of each regulatory option or combination of options.

Table 4-19. Change in Housing Affordability—Sample Calculation

Data element	Baseline	Option 2
Average per lot cost difference from baseline	$0	$111
Difference in cost per lot times multiplier	$0	$201
Home price	$288,397	$288,598
Principal and interest	$1,564	$1,565
Real estate taxes	$288	$289
Homeowner's insurance	$72	$72
Total principal, interest, taxes, and insurance	$1,924	$1,926
Income necessary to qualify for mortgage	$82,472	$82,529
Change in income necessary	$0	$58
Number of households shifted (thousands)	0	-29
Percent change in number of qualified households	0.0%	-0.15%

Source: EPA estimates.

The change in the number of households who qualify for a mortgage to finance the baseline home price but cannot afford the home with the added compliance costs is imputed from Census Bureau statistics of household income. The Census Bureau, Current Population Survey, reports the money income of households in 21 income classes from zero to over $100,000 (U.S. Census Bureau 2000d). Table 4-20 shows the Census distribution. Each income class, except the top one, spans $5,000 in annual income. If households are evenly distributed within each class, then a change of $1,000 from the baseline income necessary to qualify to the new income necessary excludes one fifth of the members of the income class from qualifying for the new mortgage level. Since the incremental costs of compliance are relatively small, the new price usually falls within the same income class as the baseline price and the number of households per $1,000 change in price is adequate to find the change in number of qualifying households. If the qualifying income for the baseline price is in a different income class than the qualifying income for the new price, the number of households per $1,000 change in price in each class is calculated and the number of households disqualified calculated in parts.

Table 4-20. Household Information for Imputing Changes in Ownership Possibilities

Current Population Survey			**American Housing Survey**		
Annual Household Income ($1,000)	**Households (1,000)**	**Households That Own Home[a] (1,000)**	**Percent Owned for Income Class**	**Total Housing Units (1,000)**	**Owner-Occupied Units (1,000)**
<5	3,010	1,456	48.4%	5,839	2,824
5-9	6,646	3,051	45.9%	6,728	3,089
10-14	7,661	3,906	51.0%	7,780	3,967
15-19	7,482	3,935	52.6%	7,037	3,701
20-24	7,238	3,946	54.5%	7,369	4,017
25-29	6,890	4,000	58.1%	6,867	3,987
30-34	6,381	3,891	61.0%	7,469	4,555
35-39	6,016	3,794	63.1%	5,951	3,753
40-44	5,565	3,875	69.6%	9,778	6,808
45-49	4,958	3,452	69.6%	”	”
50-54	4,789	3,674	76.7%	8,184	6,278
55-59	4,064	3,118	76.7%	”	”
60-64	4,112	3,360	81.7%	11,985	9,793
65-69	3,380	2,762	81.7%	”	”
70-74	2,927	2,392	81.7%	”	”
75-79	2,903	2,372	81.7%	”	”
80-84	2,526	2,227	88.2%	6,548	5,774
85-89	2,023	1,784	88.2%	”	”
90-94	1,736	1,531	88.2%	”	”
95-99	1,568	1,383	88.2%	”	”
100>	12,832	11,674	91.0%	11,267	10,250
Total	104,707	70,071	66.9%	102,802	68,796

[a] Calculated from proportion of owner-occupied to total housing units multiplied by number of households in income class.
Source: Household Income: U.S. Census Bureau, Current Population Reports, P60-209, Money Income in the United States: 1999, U.S. GPO: Washington, 2000; Housing: U.S. Census Bureau, American Housing Survey for the United States: 1999, Table 2-12 Income Characteristics of Occupied Units, http://www.census.gov/hhes/www/housing/ahs/ahs99/tab212.html

The proportion of households in the marginal income class that already own their home indicates the size of the market possibly affected. According to the Census Bureau’s American Housing Survey, in

1999, 48.4 percent of households with less than $5,000 income owned their own home while 91 percent of those with income over $100,000 annually own their home. Overall, 66.9 percent of households own their home.[32] The rate of home ownership for the larger income classes from the housing survey was applied to all of the income classes of the population survey within the same range (indicated by the ditto marks in Table 4-20). The total number of households with income greater than that required to qualify for the baseline home is the total number of households that could afford the baseline home. Since this is the group that may be in the market for a new home, substantial changes in the proportion of this group that can afford it may represent large changes in the size of the market for new homes attributable to the construction and development regulation.

4.5.1.2 National Partial Equilibrium Modeling

Another approach to evaluating the impact of the proposed regulation on housing markets is based on a household production function partial equilibrium model. Empirical studies find a highly elastic supply and a somewhat inelastic demand for new housing (DiPasquale, 1999). These estimated elasticities and the assumption that compliance costs of new environmental regulations result in only marginal changes in prices and quantities allow the market to be modeled with a simple linear partial equilibrium market model similar to the ones used in other recent EPA regulations (U.S. EPA, 2001b).

The modeling situation is similar to that used by Montgomery (1996) to forecast wood product demand. The linear partial equilibrium model can be viewed as a reduced form of a more complex structural model. We can assume, for example, that all of the instrumental variables are the same in both the baseline and alternatives, i.e., the regulation does not change U.S. population growth, carpenters' wages, wood product prices, and so forth. Montgomery's (1996) modeling equation (equation 12 in the paper) is simply a linear supply curve and equations 6, 8, and 10 reduce to a linear demand curve. The simpler model will provide the same results as the more complex structural model given small marginal changes in costs and unchanging long run assumptions.

[32] The American Housing Survey uses fewer income groups than the Current Population Survey.

National statistics of residential housing starts from the Census of Construction establish the baseline quantity for the model. The baseline price is the median new home price derived from the project cost model. This combination is the baseline market equilibrium where supply equals demand. To indicate highly elastic supply, EPA assumes a price elasticity of supply of 4.0. DiPasquale (1999) cites studies with estimates for new housing supply elasticity from 0.5 to infinity but the majority of the long run estimates are in the 3 to 13 range. Housing demand elasticity is equally controversial. EPA assumes a price elasticity of demand of -0.7 to indicate a somewhat inelastic demand function. Sensitivity tests of these assumptions are shown in Appendix 5B.

Given a baseline equilibrium point (P_0, Q_0) and these elasticities, EPA identified a linear supply curve.

$$Q = \alpha + \beta P \qquad (7)$$

Where:

$$Q = \textit{Number of residential building permits issued}$$

$$P = \textit{Price of new home}$$

$$\alpha = \textit{Intercept calibrated from baseline equilibrium}$$

$$= Q_0 - \beta P_0$$

$$\beta = \textit{Coefficient on price}$$

$$= E_s \times \frac{Q_0}{P_0}$$

$$E_s = \textit{Supply elasticity of new homes} > 0$$

A linear demand curve was derived similarly.

$$Q = F + \gamma P \tag{8}$$

Where:

$$F = \textit{Intercept calibrated from baseline equilibrium}$$
$$= Q_0 - \gamma P_0$$
$$\gamma = \textit{Coefficient on price}$$
$$= E_d \times \frac{Q_0}{P_0}$$
$$E_d = \textit{Demand elasticity of new homes} < 0$$

EPA assumes the baseline condition is in equilibrium so these two equations are equal. The increased costs of compliance raise builders' costs and shift the supply curve upward to the left. The change in prices and quantities depends on the relative slopes of the supply and demand curves. EPA chose to model the increased costs as a slope-preserving change in the supply curve intercept, α, rather than an elasticity-preserving change in slope. The new intercept is calculated as:

$$\begin{aligned} \alpha_s &= \textit{Shocked intercept} \\ &= Q_0 - \beta(P_0 + ESC) \end{aligned} \tag{9}$$

where ESC is the per unit costs of compliance with the proposed regulation. The new price is given by:

$$P_N = \frac{\alpha_S - F}{\gamma - \beta} \tag{10}$$

Equilibrium prices and quantities are then recalculated using the new price and shocked intercept.

Unlike the complete cost pass through method described above, some of the costs of compliance in the partial equilibrium model may be absorbed by the builder. The proportions flowing to consumers and builders depends on the relative elasticities of supply and demand. The literature suggests cost pass through rates are very high in this industry (DiPasquale, 1999). With the supply and demand elasticities selected as representative of the literature, E_s=4 and E_d=-0.7, the cost pass through is 85 percent. Thus, the industry absorbs 15 percent of the costs of compliance and passes the remainder on to home buyers as a price increase.

The partial equilibrium model has a number of implications for the welfare of society. When the supply curve shifts following introduction of incremental compliance costs, consumers lose some of their benefits from the product in absorbing those compliance costs. This results in a loss of consumer surplus. How the consumer surplus is lost is irrelevant from a welfare economics perspective. Consumers may choose cheaper options in the construction of their new homes such as lower quality carpets or cabinets. They may accept less expensive, smaller homes. Or, they may just pay the higher price and forego other spending. In any case, the home would provide less utility than it might have without the ESC costs. Different choices would affect which industries feel the impact in the regional economy. Changes in housing options would impact builders and suppliers. Decreased overall spending would impact a wide range of consumer goods industries. For simplicity, EPA assumed that consumers would reduce other spending in response to the price change. The reduction in home sales volume and consumer spending in other sectors reduces employment in construction and all other parts of the economy. Indirect effects of the regulation on the whole economy are estimated using Regional Input-Output Modeling System (RIMS) multipliers published by the U. S. Department of Commerce. The multiplier analysis indicates the ultimate changes in gross domestic output and employment attributable to the new regulation.

4.5.1.3 Regional Partial Equilibrium Modeling and the Housing Opportunity Index

Each of the approaches described above treats housing as a national market with the same demand elasticities applying across the country. In reality, however, market conditions can vary widely from region to region, state to state, and city to city. Markets vary both in the level of activity and the structure of the industry. Costs of compliance would undoubtedly be easier to pass through to consumers in a hot housing market than in a depressed market. EPA’s third modeling approach captures such regional variation by setting up a partial equilibrium model for each Metropolitan Statistical Area (MSA) and using statistics of the level of activity in the MSA to select the parameters of the model.

The Census Bureau collects information about housing starts as well as the size of the existing housing stock at the MSA level. EPA infers that where housing built during the 1990s represents a large proportion of the total current housing stock, the new housing market is active and demand would be expected to be less elastic than in areas with slower growth. As discussed above, the long run supply of new housing is assumed to be quite elastic overall. These facts provide the basis for selecting elasticities to represent housing markets at the MSA level.

EPA developed separate partial equilibrium models for each MSA. Like the national models described above, EPA used building permit and median new home price data to establish the baseline equilibrium point for each MSA. Demand elasticities were estimated based on the ratio of new housing units authorized to housing stock over the period 1990 to 1996 (Census, 1998). EPA mapped regions where this ratio is lowest to the most elastic estimates of demand found in the literature and those where the ratio is highest to the least elastic demand elasticity estimates. EPA believes this approach captures the relative differences in demand elasticity between active and depressed housing markets around the country.

Each MSA model is shocked with the estimated compliance costs for the median new home in the region. The model then estimates changes in prices, quantities, and welfare measures for each MSA. As there are more than 200 MSAs, it is not practical to report all of the individual results. Instead, all of the MSAs in a Census division are averaged together to give a sense of the effect of compliance costs on each region of the nation.

Affordability is a significant concern for some stakeholders. The National Association of Home Builders (NAHB) publishes the Housing Opportunity Index (HOI) for 180 MSAs. HOI measures the proportion of the housing stock a family with the median income can afford. NAHB compares the median family income to the actual distribution of home prices in the MSA. EPA does not have access to such detailed price information. Instead, EPA assumes home prices are normally distributed about the median with standard deviation of 1. Thus, our rough HOI (RHOI) is the cumulative probability of homes with prices less than the maximum PITI that the median income can afford.

Algebraically:

$$RHOI = Z_{(1,1)}\left(\frac{\int_0^{30} (Median\ Income \times 0.28)e^{rt}dt}{Median\ Sales\ Price}\right) \qquad (11)$$

The numerator represents the present value of the maximum PITI payment that the median income can afford at the prevailing mortgage rate, r, over a typical 30-year fixed rate loan. The denominator is simply the median sales price. When this ratio is equal to one, the median income family can afford the median sales price home or, equivalently, half the families can afford the median sales price home. The normal cumulative density function with mean of one and variance of one, is represented by $Z_{(1,1)}(\cdot)$. Thus, if the median income family can afford more than the median sales price home, the ratio will be greater than one, and the $Z_{(1,1)}(\cdot)$ function will indicate the proportion of homes the family can afford.

For MSAs with HOIs reported by NAHB, EPA adjusts the variance of the normal curve so that RHOI yields the NAHB baseline HOI index (NAHBHOI). The variance scaling factor is:

$$V = \left|\frac{Z^{-1}_{(0,1)}(RHOI)}{Z^{-1}_{(0,1)}(NAHBHOI)}\right| \qquad (12)$$

where $Z_{(0,1)}^{-1}$ is the inverse of the standard normal cumulative distribution. Changing the variance of $Z_{(1,1)}$ from one to V causes RHOI to equal NAHBHOI at the observed median family income. In those MSAs where NAHB does not calculate HOI, unadjusted RHOI is reported. [33] To assess the impact of the regulation, the adjusted HOI is calculated with the new sales price from the market model. The percent change in adjusted HOI is an indicator of the added stress of compliance costs on the housing market.

Like the full pass through model discussed above, the MSA HOI model shows how changes in costs affect home buyers. This approach has the advantage of recognizing local market differences and

[33] In 13 MSAs, the distribution of home prices is so different from normal that RHOI cannot approximate NAHBHOI with the variance adjustment. These MSAs were deleted from the results.

applying them within the model. Average HOI among MSAs in Census divisions before and after compliance costs are reported in Chapter Five.

4.5.2 Inputs to the National Housing Market Model

The analysis uses the average price of the model home worked out in Section 4.2, $284,632, as a starting point. Buyers in 2000 financed an average of 77.4 percent of the home purchase price at an interest rate of 7.52 percent (FHFB, 2001). EPA assumes a 30-year conventional fixed rate mortgage for ease of calculation. EPA also assumes a monthly real estate tax rate of $1 per $1,000 of home value and insurance payment of $0.25 per $1,000 of home value (Savage 1999). These assumptions are applied to the revised home price to derive an estimate of the monthly principal, interest, taxes, and insurance (PITI) payment generally required to purchase a new home.

In Chapter Five EPA uses this approach to estimate the number of households priced out of the new housing market as a result of each regulatory option.

4.5.3 Multifamily and Non-Residential Construction Market Models

EPA developed three market models of the multifamily and non-residential construction industry. All three are similar to the residential regional partial equilibrium model. They treat each state as a separate market with adjusted demand elasticities. Each model produces estimates of changes in prices, quantities, and welfare measures.

The commercial market is highly disaggregated into regional markets. Office rents for similar buildings (Class A space) range from $17/square foot/year in Wichita to more than $60/square foot/year in San Francisco (Grubb & Ellis 2001). This disparity shows that arbitrage among markets is not possible and space in each area should be considered a different commodity. Many real estate companies maintain data on conditions in regional markets. Typically, activity in the market is measured in terms of the vacancy rate and asking rents. EPA developed a market model for office space similar to the regional partial equilibrium models developed for residential construction to indicate the effects on commercial construction.

The Census Bureau discontinued collection of non-residential building permit information in 1994. To estimate non-residential building permits issued in later years, EPA regressed non-residential building permits on residential building permits, the value of non-residential buildings put in place (VPIP), and a time trend. Since the relationship among these variables differs from state-to-state, regressions were estimated at the state level. Three different regressions were estimated. Several states showed a distinct shift in building permits data when the Census sample changed from 17,000 permit-granting jurisdictions to 19,000 jurisdictions in 1983. In states where this difference was apparent, only observations after 1983 were used in the final projection. In addition some states had strong trends which were correlated with residential building permits. Since this multicollinearity reduced the influence of residential building permit data in later projection years, a regression was also estimated without the trend variable. The three regressions are:

- 1980-1994 data;
- 1983-1994 data; and
- 1980-1994 data estimated without the trend variable.

Each regression was also estimated using only data through 1993 to test their ability to forecast the next year outside of the sample, i.e., 1994. The regression which gave the best out of sample projection to 1994 and/or had the highest correlation coefficient for the state was selected to be used for that state's projection. Thus, each state projection uses the model that best predicts its pattern of non-residential development. EPA allocates the number of non-residential building permits estimated for each state to commercial, industrial, and other projects based on the number of permits issued for each type of project in the 1994 building permit data. The commercial category is a catch-all which includes public buildings, hotels, amusements, and educational buildings, in addition to office and retail buildings. EPA implicitly assumes that these projects would employ best management practices that are similar to those required for office or retail space. A separate category for industrial projects and a third category for non-building permits are also allocated from the 1994 data.

In the partial equilibrium model, the quantity of construction in each category is measured by the number of building permits issued. Rental rates, in dollars per square foot per year, are closely watched indicators of demand for commercial space and serve as our price. Rents and activity reports for 35 retail space markets around the country from a recent real estate marketing firm report (Grubb and Ellis, 2001) provide the baseline information for the market model. Like the ratio of new building permits to housing stock in the residential model, EPA used the activity reports to create a scale of demand intensity which was then used to map to each market an appropriate demand elasticity from a range of possible market elasticities.

Demand for office and retail space is relatively insensitive to small changes in price. Since non-residential construction activity tends to be driven by interest rates, job growth, and locational factors rather than building costs, cost pass through is very high. Huffman (1988), for example, found that impact fees were largely passed on to end users in the long run. EPA therefore applies a range of elasticities from -0.01 to -0.80 to represent relatively inelastic demand for commercial space. In regions with many vacancies, lessees can be more sensitive to price so a more elastic demand curve is used. In regions with tight markets, lessees have fewer options and generally have little choice but to pay the asking price, so demand is less elastic. Builders can pass on a higher proportion of their costs in tight markets than in soft markets. Even in the softest market, however, 83 percent of costs are passed through to consumers with these assumptions.

The number of non-residential building permits was projected at the state level while the Grubb and Ellis commercial data is from 35 selected cities. Since there is insufficient building permit data to model each city, EPA models each state as a separate market with the average rent and activity rate for the cities within the state representing the state market. The assumption is reasonable where state office and retail markets are concentrated in one city, or one city is representative of general statewide market conditions. The assumption is less defensible in large states with many population centers, since market conditions may vary from city to city within such states. Almost half of the states were not represented by cities in the Grubb and Ellis data. For these states, the average rent and activity values for cities within the Census division containing the state were used to indicate state market conditions.

The industrial space market model is similar to the commercial model. It uses the vacancy rate for industrial space as an indicator of market activity and the rental rate for warehouse space as the price. Industrial space users are considerably more mobile and price sensitive than commercial or residential space consumers so demand for industrial space is more elastic. The range used in this analysis is -0.2 to -1.5.

The multifamily housing market model uses the same format as the non-residential models. The activity measure is the proportion of the housing stock built in the 1990 to 1996 time period. Separate price series or rental rates for multifamily housing are not reported so the single-family housing prices were taken as a near substitute. EPA assumed that elasticities of demand are also similar to those for single-family housing.

The multifamily and non-residential models apply equations 7 through 10 above to estimate supply and demand curves. Compliance costs are converted to the same units as the rental rates, given the model project. The increase in cost shifts the supply curve to the left and upward. Market results may be reported in terms of changes in rents and building permits, as well as changes in consumer and producer surplus, and can be converted to changes in indirect employment using the RIMS II multiplier.

4.6 NET ECONOMIC IMPACTS

Environmental regulations, while imposing costs on the regulated industry, may also provide a stimulus to firms that make or install environmental controls, or provide other services related to reglatory compliance. The output and jobs created by new spending in the environmental industry offsets, to some extent, the loss of output in the affected industry. In the case of C&D, the same firms that now do much of the site preparation work would also be charged with implementing ESCs, and likely, conducting ESC certification and inspection. Contractors would be hired to build sedimentation ponds, improve grades, and construct any incremental ESCs triggered by the proposed regulation. Thus, while the regulation is costly in one sense, much of that cost flows directly back into the industry, stimulating more activity, output, and employment.

4.6.1 Welfare Effects

In terms of the welfare effects discussed in Section 4.5.1, both the consumer and producer surpluses are converted to costs of production. Consumer surplus represents income that would have been used by consumers to purchase other products or for enjoyment. Producer surplus would have flowed to the owners of the firm and probably to consumption or investment in other industries. Both quantities thus flow out of the construction sector. Only to the extent that the compliance costs that would be absorbed are greater than the sum of production loss plus the consumer surplus lost would the regulation result in a net increase in activity in the construction sector.

Both the loss and the gain in employment are estimated by applying RIMS II multipliers to the changes in output derived from the market models. Construction activity generates approximately 37.8 jobs per million dollars of output while general consumer spending generates only 27.3 jobs per million dollars of spending. Shifting spending from consumers to construction would increase overall employment. As some readers may be interested in both the losses and gains in construction employment, both aspects are shown in Chapter Five, as well as the loss in employment from lost consumer spending.

4.6.2 Regional Impacts

For this analysis, EPA examines the potential impacts to specific regions by assessing whether the proposed C&D regulations could have community or regional level impacts. Such impacts could alter the competitive position of the C&D industry across the nation or lead to growth or reductions in C&D activity (in- or out-migration) in different regions and communities. Traditionally, the distribution of C&D establishments has echoed the general regional distribution of U.S. population, with some parts of the industry responding to short or long term shifts in population distribution.

EPA does not expect that the proposed C&D regulations would have a significant impact on where construction and development takes place, or the regional distribution of construction and development activity. On the one hand, regulatory costs would be lower in regions with lower rainfall and reduced soil erodibility. This would tend to favor projects being developed in such regions. At the same time, however, a project located in a low rainfall region would rarely be a perfect substitute for the same project in a high rainfall region. So many factors go into a locational decision that few homeowners, companies, or industrial firms are likely to make their decision on where to build based solely upon the relative costs of storm water controls. Thus, EPA does not expect the proposed C&D regulations to significantly influence the prevailing pattern of construction and development activity.

EPA's market model accounts for regional market influences by creating state and MSA level partial equilibrium models for each sector. These models are used to quantify the regional impacts in terms of output and employment. Like the national employment effects, state employment changes are calculated using RIMS II multipliers. Regional multipliers were not available for this analysis so the national multipliers were used. The results, therefore, overstate the employment impacts within the region but indicate the effect of changes within the region on the nation as a whole. Tables summarizing state impacts are included in Chapter Five.

4.6.3 International Trade

As part of its economic analysis, EPA has evaluated the potential for changes in U.S. trade (imports, exports) of construction and development related goods and services. A significant component of the U.S. construction and development industry operates internationally, and in addition numerous foreign firms operate in the U.S. EPA judged, however, that the potential for U.S. construction and development firms to be differentially affected by the proposed rule is negligible. The proposed rule would be implemented at the project level, not the firm level, and would affect only projects within the U.S. All firms undertaking such projects, domestic or foreign, would be subject to the proposed rules. U.S. firms doing business outside the U.S. would not be differentially impacted compared to foreign firms, nor would foreign firms doing business in the U.S.

The proposed rule may stimulate or depress demand for some construction-related goods. To the extent that the proposed rule acts to depress the overall construction market, demand for conventional construction-related products may decline. This decline may be offset by purchase of goods and services related to storm water management. Overall, EPA does not anticipate that any shifts in demand for such goods and services resulting from the proposed regulation would have significant implications for U.S. and foreign trade.

4.7 GOVERNMENT IMPACTS

4.7.1 Administrative Costs

EPA has analyzed the administrative costs to governments associated with the proposed rule. EPA assumes that the majority of construction-related regulatory costs would be associated with processing general permits. As noted previously, EPA assumes that the majority of NPDES Phase I and Phase II NPDES storm water permit programs are fully implemented, and that any new regulatory requirements would be superimposed upon these programs.

Under Option 1, EPA assumes that no incremental costs would be imposed on governmental units. Under Option 2, EPA estimates that each state would incur costs to revise existing regulations to reflect the shift of regulatory coverage from Part 122 to Part 450. Based on the assumption that all states would change their storm water programs to include certification of sedimentation basins and other aspects of the proposed rule, EPA estimated the costs of establishing such a program. The costs are based on assumptions about the number of labor hours states would allocate to amending such programs, and the applicable labor rate. Further details on these assumptions and costs can be found in the Development Document (EPA, 2002).

4.7.2 Compliance Costs

EPA estimates that government entities (federal, state, and local) commission as much as one quarter of the total value of construction work completed in the U.S. each year. As final owner of a substantial amount of the industry output, governments would bear some of the compliance costs associated with the proposed rule, assuming these costs are passed on from developers and builders. In Chapter Five, Section 5.8, EPA allocates the government share of compliance costs based on the government share of industry output. Further details about government costs can also be found in Chapter Ten.

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APPENDIX 4A

Data and Modeling Assumptions for Model Project Analysis

Table 4A-1. Model Parameters and Data Sources

	Single-family Residential		Multifamily Residential		Small Commercial (Shopping Center)		Industrial Building	
Parameters	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**
Size of parcel	1, 3, 7.5, 25, 70, and 200 acres	EPA assumption	1, 3, 7.5, 25, 70, and 200 acres	EPA assumption	1, 3, 7.5, 25, 70, and 200 acres	EPA assumption	1, 3, 7.5, 25, 70, and 200 acres	EPA assumption
Cost of raw land	$40,000 per acre	NAHB Chicago focus groups, based on experience of the Chicago-area participants. See Appendix B for further discussion.	$40,000 per acre	NAHB Chicago focus groups, based on experience of the Chicago-area participants. See Appendix A for further discussion.	$297,545 per acre	Urban Land Institute (ULI) Market Profiles 2000: North America. Median land cost for nonregional shopping centers (cost ranges for individual MSAs were averaged before taking the median)	$137,500 per acre	Urban Land Institute (ULI) Market Profiles 2000: North America. Median land cost for industrial parks (cost ranges for individual MSAs were averaged before taking the median).
Average Lot Size	0.33 acres	Census Report C25 (Characteristics of New Housing, 1999) reports an average lot size for new single-family homes sold of 12,910 square feet, which represents a density of close to 3 lots per acre. (The median lot size is 8,750 square feet, which implies a density of almost 5 lots per acre).	N/A		N/A		N/A	
Approximate Density (number of lots per acre)	2.67	Calculated based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygons," to account for impervious surfaces not associated with individual lots. Total number of lots is rounded to nearest whole number.	N/A		N/A		N/A	

Table 4A-1. Model Parameters and Data Sources

	Single-family Residential		Multifamily Residential		Small Commercial (Shopping Center)		Industrial Building	
Parameters	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**
Due diligence	$2,500 per acre	Based on $100,000 for a hypothetical 40-acre development discussed by the NAHB Chicago focus group participants. See Appendix B for further discussion.	$2,500 per acre	See Single-family Residential Data Source for details.	$2,500 per acre	See Single-family Residential Data Source for details.	$2,500 per acre	See Single-family Residential Data Source for details.
Land development costs	$25,000 per lot	Estimate from NAHB Chicago focus groups. This figure includes any construction activities related to land development (e.g. infrastructure costs).	$75,000 per acre	Scaled estimate based on $25,000 per lot from NAHB Chicago focus groups. This figure includes any construction activities related to land development (e.g. infrastructure costs).	$75,000 per acre	Scaled estimate based on $25,000 per lot from NAHB Chicago focus groups. This figure includes any construction activities related to land development (e.g. infrastructure costs).	$75,000 per acre	See Small Commercial Data Source for details.
Engineering costs, as percent of land development costs	6%	Estimate from NAHB Chicago focus groups.	6%	Estimate from NAHB Chicago focus groups.	6%	Estimate from NAHB Chicago focus groups.	6%	Estimate from NAHB Chicago focus groups.
Overhead costs, as percent of development costs	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.
Contingency, as percent of land development costs prior to impact fees	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.	10%	Estimate from NAHB Chicago focus groups.
Impact fees	$15,000 per lot	Estimate from NAHB Chicago focus groups. See Appendix B for further discussion.	$45,000 per acre	Scaled estimate based on $15,000 per residential lot from NAHB Chicago focus groups. See Appendix A for further discussion.	$45,000 per acre	See Multifamily Data Source for details.	$45,000 per acre	See Multifamily Data Source for details.

Table 4A-1. Model Parameters and Data Sources

	Single-family Residential		Multifamily Residential		Small Commercial (Shopping Center)		Industrial Building	
Parameters	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**
Real estate and marketing fees, as percent of sales price of building	7%	Estimate from NAHB Chicago focus groups.	7%	Estimate from NAHB Chicago focus groups.	7%	Estimate from NAHB Chicago focus groups.	7%	Estimate from NAHB Chicago focus groups.
Average size of building	2,310 square feet	From Census Report C25, the average size of new single-family homes sold in 1999 and conventionally financed was 2,310 square feet.	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."
Cost of building construction	$53.80 per sq.ft.	From NAHB's website, construction costs for a generic single-family house are $124,276. $124,276 ÷ 2,310 = $53.80. See Appendix B for further discussion.	$54.05 per sq. ft.	R.S. Means Building Construction Cost Data median construction cost per square foot for a "typical" low-rise (1-3 stories) apartment building.	$53.85 per sq.ft.	R.S. Means Building Construction Cost Data median construction cost per square foot for a "typical" supermarket	$36.15	R.S. Means Building Construction Cost Data median construction cost per square foot for a "typical" industrial warehouse.
Total Paved Surface Area (Parking, Driveways, and Roads)	N/A		Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."
Paving Cost (Parking, Driveways, and Roads)	N/A		$1.44 per sq. ft.	R.S. Means Heavy Construction Cost Data	$1.44 per sq. ft.	R.S. Means Heavy Construction Cost Data	$1.44 per sq. ft.	R.S. Means Heavy Construction Cost Data
Total Sidewalk Area	N/A		Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."	Varies	Scaled to site size based on impervious surface ratios from "Chesapeake Bay Watershed Impervious Cover Results by Land Use Polygon."

Table 4A-1. Model Parameters and Data Sources

	Single-family Residential		Multifamily Residential		Small Commercial (Shopping Center)		Industrial Building	
Parameters	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**
Sidewalk Construction Cost	N/A		$4.66 per sq. ft.	R.S. Means Heavy Construction Cost Data	$4.66 per sq. ft.	R.S. Means Heavy Construction Cost Data	$4.66 per sq. ft.	R.S. Means Heavy Construction Cost Data
Percent of total land cost that a developer can finance for land acquisition	65%	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix B for further discussion.	65%	See Single-family Residential Data Source for details.	65%	See Single-family Residential Data Source for details.	65%	See Single-family Residential Data Source for details.
Percent of total land cost that a developer can finance for land development	70%	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix B for further discussion.	70%	See Single-family Residential Data Source for details.	70%	See Single-family Residential Data Source for details.	70%	See Single-family Residential Data Source for details.
Percent of total building construction cost that a builder can finance	80%	Loan-to-value ratio as written in the Real Estate Lending Rules. See Appendix B for further discussion.	80%	See Single-family Residential Data Source for details.	80%	See Single-family Residential Data Source for details.	80%	See Single-family Residential Data Source for details.
Loan interest rate for builder/developer	7.5%	EPA estimate.	7.5%	EPA estimate.	7.5%	EPA estimate.	7.5%	EPA estimate.
Term of land acquisition loan, years	3	EPA assumption. Assumes that the land acquisition loan is paid off over the life of the project, which in this case is 3 years.	3	See Single-family Residential Data Source for details.	3	See Single-family Residential Data Source for details.	3	See Single-family Residential Data Source for details.
Term of land development loan, years	1	EPA assumption. Assumes that the land development loan term is equal to the length of the development phase of the project, which in this case is 1 year.	1	See Single-family Residential Data Source for details.	1	See Single-family Residential Data Source for details.	1	See Single-family Residential Data Source for details.

Table 4A-1. Model Parameters and Data Sources

	Single-family Residential		Multifamily Residential		Small Commercial (Shopping Center)		Industrial Building	
Parameters	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**	**Value**	**Data Source**
Term of building construction loan, years	1	EPA assumption. Assumes that the construction loan term is equal to the length of the construction phase of the project, which in this case is 1 year.	1	See Single-family Residential Data Source for details.	1	See Single-family Residential Data Source for details.	1	See Single-family Residential Data Source for details.
Assumed pre-tax profit on land development	10%	NAHB Chicago focus group estimated 12-14 percent; 10 percent is an EPA assumption. See Appendix B for further discussion.	10%	See Single-family Residential Data Source for details.	10%	See Single-family Residential Data Source for details.	10%	See Single-family Residential Data Source for details.
Assumed pre-tax profit on construction	10%	NAHB Chicago focus groups estimated 8 to 12 percent pre-tax at time of sale. R.S. Means uses 10 percent as a profit assumption in their Cost Data book series.	10%	See Single-family Residential Data Source for details.	10%	See Single-family Residential Data Source for details.	10%	See Single-family Residential Data Source for details.

APPENDIX 4B

Detailed Description of Model Parameters and Assumptions

Cost of Raw Land

Land prices tend to vary by region of the country, and even within particular regions, depending on the exact location of the parcel (e.g., urban proximity). For this generic single-family project cost model, a value of $40,000 per acre is used based on the estimate provided by participants in the Chicago NAHB focus group morning session. The participants in the NAHB Dallas focus group meetings confirmed that even within one state lot prices can range dramatically. Prices per lot were reported to range from near $10,000 in El Paso, TX, to nearly $1 million in Austin (for lake-front property). (Note, these costs cited were per lot, not per acre). The single-family development land cost estimate was also used in the multifamily residential project model due to lack of other data.

Land prices for the commercial and industrial models were taken from the Urban Land Institute's (ULI) Market Profiles 2000: North America, which lists average land costs for shopping centers and industrial parks for selected Metropolitan Statistical Areas (MSAs) depending on data availability. The median land cost for each project type was calculated from a list of MSA average land costs and used in the models as a national estimate proxy.

Due Diligence

As described previously, due diligence refers to the work done by the developer prior to taking ownership of a parcel. During this time the developer conducts a variety of environmental and engineering assessments to identify any potential obstacles to the successful completion of the proposed development. At this time the only estimates for due diligence costs are based on a $100,000 estimate provided by the Chicago NAHB focus group participants for a 40-acre project. This figure was converted to $2,500 per acre on the assumption that these costs would fluctuate depending on the size of the project.

Impact Fees

The NAHB's Chicago focus group estimated the impact fees on new residential construction to average $15,000 per lot. This figure was converted to $45,000 per acre for use in the multifamily, commercial, and industrial project models.

This is one of many estimates that may be found in the literature. In their book *Red Tape and Housing Costs*, Michael Luger and Kenneth Temkin interviewed numerous builders and developers in New Jersey and North Carolina, and received several estimates for impact fees in North Carolina. Estimates ranged from approximately $2,800 to $6,547 per unit in Cary, NC, and from $1,300 to $2,765 in Durham, NC. Even the highest estimate in these ranges is significantly lower than the estimate from the focus group meeting. These fees represent approximately 1 to 2 percent of the final sale price of a house in the area.

In a cost breakdown of a single-family home provided by NAHB on their website,[34] impact fees were estimated at $1,182 per unit (approximately 1 percent of total construction cost). A study by the Sierra Club (Sierra Club 2000) estimates that impact fees range from under $1,000 per unit to approximately $6,140 per single-family unit. These figures are based on local observations. Finally, Ross and Thorpe (1992) report that a survey conducted in 1990 in Orange County, California (one of the most expensive housing markets in the country), found at least three cities in that county with impact fees exceeding $20,000 per unit. This estimate is closest to the assumption currently in the models.

At this time, EPA is unaware of any single national estimate for the average impact fee imposed on developers and builders and has chosen to use the NAHB estimate for this analysis.

Building Construction Costs

The approach used in the model project for estimating average building construction costs for the single-family project is to take total construction costs for a new single-family house, provided by NAHB on their website ($124,276) (NAHB 2001b), and divide that figure by the average square footage of a new, conventionally financed, house as reported by Census (2,310 square feet; Characteristics of New Housing). This calculation yields an average construction cost of $53.80 per square foot. NAHB focus group participants estimated that building construction costs ranged from $50 to $75 per square foot, at least in the Chicago area. The national estimate is within the range provided by NAHB members at the focus group meeting.

[34] http://www.nahb.com/housing_issues/balance_2.htm

Building construction costs for the remaining projects – multifamily, commercial, and industrial – were taken from R.S. Means *Building Construction Cost Data*. The costs used were median costs for the "typical" sized building for each project type, based on the projects detailed in the R.S. Means project database. While the building costs may fluctuate some with overall building size, the median cost was used as a proxy for national-level building costs and was used regardless of site or building size. Building size for these three project types was assumed to fluctuate with site size. Size estimates for each site size were determined using the building to site area ratio from the Center for Watershed Protection. Multiplying this ratio by each site size (1, 3, 7.5, etc. acres) gave EPA an estimate of building footprint. Since multifamily building construction costs were based on low-rise apartment buildings 1 to 3 stories in height, an average of 2 stories per apartment building was used to calculate total building square footage from the footprint. Commercial and industrial buildings were assumed to be 1 story; therefore the building footprint equaled total building area.

Impervious Surface Estimates

Estimates for impervious surface area and construction costs were calculated for the multifamily, commercial, and industrial model projects. The impervious surface area for roads, driveways, parking, and sidewalks was calculated by multiplying the impervious surface area to site size ratio (CWP 2001) by the site size. R.S. Means cost estimates for paving and sidewalk construction were used to estimate impervious surface construction costs. The paving cost estimate ($1.44 per square foot) was multiplied by the combined surface area for roads, driveways, and parking while the sidewalk cost estimate ($4.66 per square foot) could be directly multiplied to the sidewalk surface area estimate.

Financing Requirements

A December 28, 1999, memo from ERG to EPA ("Real Estate Development Financing") cites the typical land acquisition loan duration is 2 years, whereas the models currently use a duration of 3 years. It is not clear if the 2 year loan term includes the same activities as assumed for the model projects. Similarly, the duration for the land development loan is cited as approximately 2 years (comparable to that for the land acquisition loan). The average duration of the construction loan is not cited in the memo, although it may be assumed that the duration of the loan would vary with project size.

Loan-to-value ratios under the Real Estate Lending Rules declined from approximately 80 percent for all phases of project development to the following breakdown after the Savings and Loan Crisis:

- 65 percent for land acquisition
- 75 percent for land development
- 80 percent for construction

The memo also states that the typical land acquisition loan rate is 1-4 points above the prime rate. No further detail for the remaining project stages is given, but they are assumed to be within the same range. The models currently use a loan rate of 7.5 percent.

Profit Assumptions

Profit on both land development and building construction are assumed to be 10 percent, based on conversations with NAHB and reality-checked against the assumptions used in the R.S. Means Cost Data series. Note that there would not be a separate profit for the land development phase of the project because the developer-builder would retain ownership of the project through building construction (land development profit is only realized when a developer sells finished lots to individual builders). The profit rate with 100 percent CPT is based on the assumption that any additional costs incurred by the developer-builder (i.e., additional storm water control costs) would be passed through to the consumer, and that none of the additional costs would be borne by the developer-builder as decreased profit. The profit rate with zero CPT depends on the level of costs.

Overhead Assumptions

EPA assumes that developers apply an overhead charge to all costs incurred during the land development phase, and that a further overhead charge is levied by the builder on all costs incurred during the building phase, including the cost of lot acquisition. These overhead charges represent, in part, payment to the owner for capital tied up to secure development and construction loans as well as compensation for managing and overseeing the work of subcontractors and other professionals (engineers, architects, designers).

The estimated overhead rate of 10 percent at the development stage and 10 percent at the building phase was based on input from NAHB. EPA has separately calculated the "opportunity cost of capital" based on actual financing needs, loan conditions, and loan terms. In the model projects, therefore, the actual percentage applied as an overhead factor has been adjusted downwards.

APPENDIX 4C

Characteristics of Model Establishments

Table 4C-1. Model Establishment Characteristics Based on Census Data[1]

	Class	Number of Establishments	Average Starts	Average Revenue	Average Employment	Cashflow
	1-4	17,107	2.3	$492.2	2.5	$46.3
Single	5-9	7,589	6.4	$1,088.6	3.3	$104.9
Family	10-24	6,262	14.6	$1,987.0	4.3	$177.3
	25-99	3,018	41.9	$4,923.5	8.6	$4,229.0
	100-499	833	191.7	$24,030.7	32.1	$2,187.6
	500+	122	864.5	$109,032.6	160.0	$9,192.5
	2-9	486	4.3	$644.8	3.2	$29.4
Multifamily	10-24	398	16.5	$1,381.6	5.1	$99.6
	25-99	383	55.1	$3,499.7	8.0	$320.1
	100-499	593	191.7	$7,410.0	13.5	$566.6
	500+	39	959.0	$43,844.4	64.7	$938.8
Commercial	50-99	41,356	13.2	$23,799	67.5	$927.5
Industrial	50-99	8,042	9.5	$18,470	67.7	$627.3

[1] Dollar values in thousands

Table 4C-2 Model Establishment Characteristics Based on Dun And Bradstreet Data

	Single Family (SIC 1531)		Multifamily (SIC 1522)		Commercial (SIC 1542)		Industrial (SIC 1541)	
Line Item	**Scaled Value [1]**	**Percent**	**Scaled Value [1]**	**Percent**	**Scaled Value [1]**	**Percent**	**Scaled Value [1]**	**Percent**
Cash	$82,229	11.9%	$55,752	18.4%	$61,705	21.5%	$57,682	19.1%
Accounts Receivable	$61,499	8.9%	$81,204	26.8%	$101,598	35.4%	$108,116	35.8%
Notes Receivable	$4,837	0.7%	$3,939	1.3%	$2,009	0.7%	$2,718	0.9%
Inventory	$210,064	30.4%	$12,726	4.2%	$5,740	2.0%	$4,530	1.5%
Other Current	$152,711	22.1%	$67,569	22.3%	$60,270	21.0%	$58,588	19.4%
Total Current Assets	**$511,340**	**74.0%**	**$221,190**	**73.0%**	**$231,322**	**80.6%**	**$231,634**	**76.7%**
Fixed Assets	$109,178	15.8%	$58,176	19.2%	$41,041	14.3%	$52,246	17.3%
Other Non-current	$70,482	10.2%	$23,634	7.8%	$14,637	5.1%	$18,120	6.0%
Total Assets	**$691,000**	**100.0%**	**$303,000**	**100.0%**	**$287,000**	**100.0%**	**$302,000**	**100.0%**
Accounts Payable	$56,662	8.2%	$73,023	24.1%	$87,248	30.4%	$79,124	26.2%
Bank Loans	$11,747	1.7%	$2,424	0.8%	$1,435	0.5%	$604	0.2%
Notes Payable	$101,577	14.7%	$18,483	6.1%	$6,888	2.4%	$7,248	2.4%
Other Current	$196,935	28.5%	$102,414	33.8%	$52,521	18.3%	$57,984	19.2%
Total Current Liabilities	**$366,921**	**53.1%**	**$196,344**	**64.8%**	**$148,092**	**51.6%**	**$144,960**	**48.0%**
Other Long Term	$81,538	11.8%	$29,997	9.9%	$15,498	5.4%	$22,348	7.4%
Deferred Credits	$5,528	0.8%	$1,212	0.4%	$574	0.2%	$302	0.1%
Net Worth	$237,013	34.3%	$75,447	24.9%	$122,836	42.8%	$134,390	44.5%
Total Liabilities & Net Worth	**$691,000**	**100.0%**	**$303,000**	**100.0%**	**$287,000**	**100.0%**	**$302,000**	**100.0%**
Net Sales	**$1,000,000**	**100.0%**	**$1,000,000**	**100.0%**	**$1,000,000**	**100.0%**	**$1,000,000**	**100.0%**
Gross Profit	$228,000	22.8%	$190,000	19.0%	$159,000	15.9%	$184,000	18.4%
Net Profit After Tax	$12,000	1.2%	$35,000	3.5%	$30,000	3.0%	$34,000	3.4%
Working Capital	$144,419	--	$24,846	--	$83,230	--	$86,674	--
Gross Profit Ratio		0.228		0.190		0.159		0.184
Return on Net Worth Ratio		0.051		0.464		0.244		0.253
Current Ratio		1.394		1.127		1.562		1.598
Debt to Equity Ratio		1.915		3.016		1.336		1.247

[1] Values scaled according to $1,000,000 net sales for comparative purposes

Table 4C-3 Financial Ratio Data by Quartile

Sector	Ratio	Upper Quartile	Median	Lower Quartile
Single Family	Current	2.900	1.400	1.100
	Debt to Equity	0.724	1.796	4.928
	Return on Net Worth	0.335	0.168	0.066
Multifamily	Current	2.500	1.500	1.100
	Debt to Equity	0.595	1.280	3.179
	Return on Net Worth	0.589	0.227	0.061
Commercial	Current	2.200	1.500	1.200
	Debt to Equity	0.660	1.456	2.823
	Return on Net Worth	0.369	0.164	0.055
Industrial	Current	2.500	1.600	1.200
	Debt to Equity	0.527	1.300	2.723
	Return on Net Worth	0.386	0.151	0.055

CHAPTER FIVE
ECONOMIC IMPACT ANALYSIS RESULTS

5.1 OVERVIEW OF ECONOMIC IMPACT ANALYSIS METHODOLOGY

This chapter presents the projected economic impacts of the regulatory options discussed in Chapter Three on the construction and development (C&D) industry. In this chapter, EPA evaluates the impacts of these costs using the methodology, models, data, and approaches described in Chapter Four.

The economic impact methodology uses several methods to assess economic impacts on the industry. These include models that analyze impacts at the level of the individual construction project, individual firm, national construction market, and the economy as a whole. The analysis considers impacts on C&D firms that would be complying with the regulations. It also considers the impacts on those who purchase the output of the C&D industry, including prospective new home buyers; owners of new multifamily, commercial, and industrial properties; and public entities responsible for building roads, schools, and other public facilities.

The chapter is organized as follows:

- **Section 5.2** presents EPA's analysis of the economic impacts of the proposed rule on model C&D projects. These results are based on the financial analyses developed for representative projects in Chapter Four.

- **Section 5.3** presents EPA's estimates of the national costs of the proposed rule. EPA determined those costs by multiplying the per-acre compliance costs by estimates of the number of acres subject to the proposed effluent guidelines annually.

- **Section 5.4** presents the results of EPA's analysis of the impacts of the proposed rule on model C&D establishments. This section examines the impact of the incremental compliance requirements on the financial condition of representative establishments, using data on their present financial condition as a starting point.

- **Section 5.5** presents EPA's analysis of closures and employment losses. These impacts are based on the model establishment described in Section 5.4.

- **Section 5.6** presents EPA's analysis of the proposed rule's impacts on barriers to entry—that is, how the incremental costs of the proposed rule could affect the ability of new businesses to enter the market.

- **Section 5.7** presents EPA's market model analysis. This section considers the impact of the incremental compliance requirements on national construction markets and the economy as a whole.

- **Section 5.8** presents EPA's analysis of potential impacts on government units. This section considers the various costs to government associated with the proposed rule.

- **Section 5.9** presents EPA's analysis of additional impacts of the proposed rule. This section discusses regional impacts, social costs, and unfunded mandates.

5.2 ANALYSIS OF IMPACTS ON MODEL PROJECTS

Chapter Four defines a series of model projects. In this section, EPA uses those models to analyze the impact of the proposed rule on two alternative targets: the developer-builder (assuming that they absorb the incremental costs) and the consumer (assuming that the same costs are passed on to the buyer). EPA has developed model projects for each of the following:

- A residential development of single-family homes
- A residential development of multifamily housing units
- A commercial development (enclosed shopping center)
- An industrial development (industrial park)

For each type of model project, EPA has analyzed costs and impacts for a range of project sizes: 1, 3, 7.5, 25, 70, and 200 acres. The model projects incorporate all of the baseline costs associated with developing a site and completing construction of all housing units or buildings on the site. Accordingly, it is assumed that the baseline costs include the costs of complying with existing Phase I and Phase II NPDES storm water regulations as they would apply to the site. The model then allows EPA to assess the incremental impact of additional requirements imposed under the proposed rule. Chapter Four provides a detailed description of the model project characteristics, assumptions, and data sources, including an itemized listing of project cost elements.

5.2.1 Cost Pass Through Considerations

The model projects are calibrated to allow analysis under varying assumptions about the degree of cost pass through (CPT) from the builder-developer to the buyer.[1] Costs for the models have been estimated under two extreme assumptions, 100 percent CPT and zero CPT. Under 100 percent CPT, all incremental regulatory costs resulting from the proposed rule are passed through to end consumers. Under this approach, the costs are also assumed to be marked up to the same degree as any other project costs.[2] Consumers feel the impact of the regulations in the form of a higher price for each new building or housing unit. With zero CPT, the incremental regulatory costs are assumed to accrue entirely to the builder-developer, and appear as a reduction in profits. EPA determines this reduction by fixing the final sales price of the housing units and calculating the builder's profit once the regulatory costs are absorbed.

Existing literature and industry information suggests that, in the important single-family home market, at least, pass through of regulatory costs in the new housing market is close to 100 percent (e.g., Luger and Temkin, 2000), but the actual incidence of regulatory costs would depend closely on local market conditions. To illustrate the range of possible impacts, EPA has calculated its models under the extreme conditions of 100 percent and zero percent CPT. Accordingly, for each sector modeled there are two sets of results reported below.

5.2.2 Model Project Baseline Performance

Under the baseline assumptions and conditions, the sales price for each housing unit (or model commercial or industrial building) is calculated, and the baseline builder-developer profit level is

[1] Cost pass-back to the landowner is possible, but it occurs infrequently. See Section 4.1.2. Since EPA lacks data on the actual incidence and extent of cost pass-back, it is not analyzed in detail.

[2] The cost markup assumptions are built into the model and are explained in Chapter Four.

determined based on the sales price. Builder-developer pre-tax profit is assumed to be approximately 10 percent of the building sales price. Table 5-1 shows the baseline sales price and profit for each model project type and each project size. Data and assumptions underlying these estimates are derived in Chapter Four. The model results presented later in this section show changes from these baseline values under each regulatory option.

Table 5-1. Baseline Sales Price and Profit Conditions for the Model Projects

Project Type and Size (acres)	Calculated Building Sales Price	Builder-Developer Pre-tax Profit
Single-Family Residential		
1 acre	$279,903	$27,990
3 acres	$283,093	$24,251
7.5 acres	$283,093	$28,309
25 acres	$282,951	$28,295
70 acres	$283,042	$28,304
200 acres	$283,058	$28,306
Multifamily Residential		
1 acre	$1,375,074	$137,507
3 acres	$4,125,374	$412,537
7.5 acres	$10,313,438	$1,031,344
25 acres	$34,378,235	$3,437,823
70 acres	$96,259,030	$9,625,903
200 acres	$275,025,887	$27,502,589
Commercial		
1 acre	$1,498,800	$149,880
3 acres	$4,496,399	$449,640
7.5 acres	$11,240,999	$1,124,100
25 acres	$37,469,920	$3,746,992
70 acres	$104,915,760	$10,491,576
200 acres	$299,759,358	$29,975,936
Industrial		
1 acre	$950,949	$95,095
3 acres	$2,852,899	$285,290
7.5 acres	$7,132,197	$713,220
25 acres	$23,773,989	$2,377,399
70 acres	$66,567,119	$6,656,712
200 acres	$190,191,761	$19,019,176

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.2.3 Results of Model Project Analyses

Table 5-2a contains the results under the 100 percent CPT assumption, while Table 5-2b contains identical results under the assumption of zero CPT. In Table 5-2a (100 percent CPT), the impacts of the regulatory options are shown as the percentage increase in the sales price of each model project unit. In Table 5-2b (zero CPT), the impacts of the regulatory options are shown as the percentage decrease in builder profits.

100 Percent Cost Pass-Through

Under the *100 percent CPT* assumption, the impacts range from a minimum of 0.00 percent (i.e., there is no incremental impact on sales price) for all project types to a range of maximum impact values (where the percent listed indicates an increase in sales price of that amount): 0.09 percent for single-family residential, 0.05 percent for multifamily residential, 0.05 percent for commercial, and 0.07 percent for industrial. All of the maximum impacts occur under Option 2.

Zero Cost Pass-Through

Under the *zero CPT* assumption, the impacts range from a minimum of 0.00 percent for all project types under various option combinations (indicating no impact to builder profit) to a range of maximum impact values, all under one percent. Maximum impacts all occur with Option 2 as shown below:

- Single-family residential: -0.80 percent
- Multifamily residential: -0.45 percent
- Commercial: -0.41 percent
- Industrial: -0.64 percent

Table 5-2a. Impact of Regulatory Options on Model Project Financials—100 Percent Cost Pass Through, All Project Sizes

	Percent Change in Project Price to Buyer							
	Single-Family		Multifamily		Commercial		Industrial	
Option	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1	0.00%	0.04%	0.00%	0.02%	0.00%	0.02%	0.00%	0.03%
2	0.00%	0.09%	0.00%	0.05%	0.00%	0.05%	0.00%	0.07%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-2b. Impact of Regulatory Options on Model Project Financials—Zero Percent Cost Pass Through, All Project Sizes

	Percent Change in Builder-Developer Profit							
	Single-Family		Multifamily		Commercial		Industrial	
Option	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1	0.00%	-0.37%	0.00%	-0.19%	0.00%	-0.17%	0.00%	-0.27%
2	0.00%	-0.80%	0.00%	-0.45%	0.00%	-0.41%	0.00%	-0.64%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.2.4 Nonbuilding Project Analysis Results

This section presents the results of the model nonbuilding project analysis described in Section 4.2.7. As indicated in that section, EPA has not developed actual engineering costs for projects such as roads and highways. As a result, EPA has simulated the impact of the proposed rule on such projects using worst-case (i.e., highest) estimates of the per-acre engineering costs estimated for building projects.

Due to the lack of engineering costs for this project type, EPA used a "worst-case" assumption of $378 per acre in compliance costs. This figure is based on the highest per-acre compliance cost estimated for a 7.5-acre building project. EPA elected to use the compliance costs for a 7.5-acre project because the model one-mile new highway construction project encompasses 10.67 acres. EPA estimates that the baseline costs of construction for one mile of typical road or highway is $5.4 million (see Section 4.2.7). Using $378 per acre, the worst-case estimate of compliance costs associated with one mile of new road or highway construction (10.67 acres) is $4,033. This equates to less than 0.1 percent of baseline costs, indicating even under worst-case assumptions regarding compliance costs, the proposed rule is unlikely to have a significant impact on representative nonbuilding construction projects.

5.3 ANALYSIS OF NATIONAL COMPLIANCE COSTS

EPA has calculated the national compliance costs associated with the proposed rule by multiplying the compliance costs per acre (by project type and size) by estimates of the number of acres developed per year. EPA used data from the USDA National Resources Inventory (NRI) to estimate the number of acres developed per year. According to this source, approximately 2.2 million acres of undeveloped land are converted to a developed state every year. EPA has adjusted this total to account for waivers and differences in regulatory coverage between Option 1 and Option 2.[3] As described in Chapter Four, both the 14-Community Study (conducted in support of the Phase II NPDES storm water rule development) and building permits data from Census were used to allocate the developed acreage by project type and size.

Table 5-3 contains EPA's estimates of the national costs of the regulatory options. The national costs of the proposed rule range from $0.00 for each project type (Option 3) to a maximum of $121.5 million for single-family residential construction, $59.4 million for multifamily residential construction, $277.3 million for commercial construction, and $11.0 million for industrial construction (all Option 2).

The combined national compliance costs across all sectors are shown in the final rows of Table 5-3a. The national compliance costs under Option 1 are $118.1 million while the national compliance costs under Option 2 are $469.2 million.

[3] Option 1 applies to sites of one acre or more in size while Option 2 applies to sites of five acres or more in size.

Table 5-3a. Estimated National Cost of Storm Water Control Options (All Dollar Amounts in Constant, Pre-tax, 1997 Dollars)

Option	**Compliance Costs per Acre($)**	**Estimated National Costs ($ Millions)**
Single-Family Residential		
Option 1	$57.0	$24.1
Option 2	$305.0	$121.5
Option 3	$0.0	$0.0
Multifamily Residential		
Option 1	$59.0	$11.9
Option 2	$319.0	$59.4
Option 3	$0.0	$0.0
Commercial		
Option 1	$74.0	$78.4
Option 2	$312.0	$277.3
Option 3	$0.0	$0.0
Industrial		
Option 1	$81.0	$3.7
Option 2	$303.0	$11.0
Option 3	$0.0	$0.0
Total		
Option 1	**--**	**$118.1**
Option 2	**--**	**$469.2**
Option 3	**--**	**$0.0**

NOTE: Compliance costs per acre are weighted national averages for each option over all site size classes.
Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-3b. Calculation of Total Cost per Unit
(All Dollar Amounts Are in Constant, Pre-tax, 1997 Dollars)

	Single	Multi-Family	Commercial	Industrial	Total
Option 1					
Total Costs	$24,099,340	$11,892,936	$78,415,033	$3,733,824	$118,141,133
Total Acres	533,878	252,182	1,332,476	57,523	2,176,058
Cost per Acre	$45.14	$47.16	$58.85	$64.91	
Units per Acre	2.67	13,591	8,320	8,555	
Cost per Unit	$16.91/house	$0.003/sq ft	$0.007/sq ft	$0.008/sq ft	
Option 2					
Total Costs	$121,470,785	$59,391,699	$277,280,636	$11,016,368	$469,159,488
Total Acres	501,100	229,958	1,061,108	42,733	1,834,898
Cost per Acre	$242.41	$258.27	$261.31	$257.80	
Units per Acre	2.67	13,591	8,320	8,555	
Cost per Unit	$90.79/house	$0.019/sq ft	$0.031/sq ft	$0.030/sq ft	

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-3b shows the calculation of cost per unit for Options 1 and 2. Units are “dollars per house” for single-family residential construction and “dollars per square foot” for all other categories. Total costs are the estimated national costs as shown in Table 5-3a. Option 2 applies only to sites disturbing 5 acres or more, so this option encompasses less acreage than Option 1. In addition, several states have enacted regulations equivalent to the proposed standards and so would not incur incremental costs from the proposed rule. These equivalent states are included in the storm water control costs per acre in Table 5-3a but removed in the estimated national costs in the same table. Table 5-3b recalculates the cost per acre with the costs attributable to states with equivalent programs removed. With this adjustment, the cost per unit is calculated by dividing by the number of houses per acre, or number of rentable square feet per acre, which is derived from Census and R. S. Means data.

The cost to build a new single-family home increases by $17 under Option 1 and $91 under Option 2. Costs per square foot increase by less than 1 cent for Option 1 and 2 to 3 cents for Option 2. The impacts of these cost increases on the markets for new construction are explored in Section 5.7.

5.4 ANALYSIS OF IMPACTS ON MODEL ESTABLISHMENTS

As described in Chapter Four, EPA developed a set of representative model projects as one basis for analyzing the impacts of the proposed rule on the construction industry. EPA has examined the impacts of the compliance costs associated with these model projects on a series of model establishments that characterize the financial conditions of "typical" businesses in each of the four major industry sectors (single-family residential, multifamily residential, commercial, and industrial; see Section 4.3).

The model firm analysis simulates the impact of the incremental compliance costs on the balance sheet and cash flow of the model establishments, and expresses the impacts in terms of changes in meaningful business financial ratios. The ratios used in the analysis include:

- Gross profit ratio
- Return on net worth
- Current ratio
- Debt to equity ratio

These ratios are reviewed in Chapter Four, which also presents a discussion of their significance as indicators of financial performance.

5.4.1 Building Construction

This section presents the results of simulations of firm performance under the regulatory options being considered by EPA. As indicated in Chapter Four, the simulations have been run under two CPT scenarios: (1) zero CPT from the developer-builder to the consumer and (2) an estimated actual CPT, where a "realistic" share of the compliance costs are passed though to consumers in the form of higher prices. EPA has estimated a separate CPT factor for each market sector individually. The zero CPT results presented in this section represents the "worst case" scenario; impacts under the more realistic CPT assumption are much smaller than those shown below.

Table 5-4 shows sample results for a firm in the single-family residential construction industry (SIC 1531) completing between 10 and 24 housing starts per year, based on costs for 7.5-acre projects. Impacts are most severe on the return on net worth ratio, a recurring outcome throughout EPA's model firm analysis. Return on net worth is the most sensitive ratio because it is based on net profit after taxes, which makes up 1.2 percent of revenues for the "typical" establishment in SIC 1531 according to D&B data. Impacts are much less severe under the other financial ratio measures.

Table 5-5a provides a summary of the results for each sector by regulatory option, over all project sizes and under the zero CPT scenario. The results are broadly similar to the detailed example presented in Table 5-4 for the single-family residential sector. Table 5-5b provides the same summary of financial ratios under the estimated actual cost pass through scenario. In both scenarios the most severe impacts are observed when measured by impact on return on net worth, followed by the gross profit, debt to equity, and current ratios. The largest impact over both scenarios is a 5.85 percent decline in the return on net worth ratio for the single-family residential sector under Option 2 with zero CPT. With the exception of return on net worth, the remainder of the results under zero CPT are at or below 1.0 percent for all project types. The results under the estimated actual CPT scenario indicate impacts of less than 1.0 percent for all financial ratios and all four project types, with most of the impacts being less than 0.10 percent (with the exception of return on net worth).

Table 5-4 Impact of Regulatory Options on Financial Performance for Model Firm Single-family Residential Construction, 10-24 Housing Units Starts Class

Impact	Regulatory Option		
	Option 1	**Option 2**	**Option 3**
Cost Impact			
Incremental Costs per Acre Per Year	$64	$371	$0
Incremental Costs per Establishment Per Year	$354	$2,034	$0
Impact on Financial Performance			
Gross Profit Ratio	0.2278%	0.2270%	0.2280%
Percent change from baseline	-0.0780%	-0.4490%	--
Return on Net Worth	0.0502%	0.0481%	0.0506%
Percent change from baseline	-0.8810%	-5.0680%	--
Current Ratio	1.3935%	1.3930%	1.3936%
Percent change from baseline	-0.0070%	-0.0400%	--
Debt to Equity Ratio	1.9161%	1.9189%	1.9155%
Percent change from baseline	0.0310%	0.1800%	--

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-5a. Impact of Regulatory Options on Model Firm Financial Performance Zero Cost Pass Through

Construction Industry and Regulatory Option	Percent Change in Financial Ratios, From Baseline[a]							
	Gross Profit		Return on Net Worth		Current Ratio		Debt to Equity	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Single-family residential								
Option 1	0.000%	-0.230%	0.000%	-2.540%	0.000%	-0.020%	0.000%	0.900%
Option 2	0.000%	-0.520%	0.000%	-5.850%	0.000%	-0.050%	0.000%	0.210%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Multifamily residential								
Option 1	0.000%	-0.310%	0.000%	-0.990%	0.000%	-0.050%	0.000%	0.200%
Option 2	0.000%	-0.950%	0.000%	-3.070%	0.000%	-0.160%	0.000%	0.640%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Commercial								
Option 1	0.000%	-0.170%	0.000%	-0.530%	0.000%	-0.020%	0.000%	0.130%
Option 2	0.000%	-0.400%	0.000%	-1.250%	0.000%	-0.050%	0.000%	0.310%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Industrial								
Option 1	0.000%	-0.140%	0.000%	-0.430%	0.000%	-0.020%	0.000%	0.120%
Option 2	0.000%	-0.320%	0.000%	-1.020%	0.000%	-0.050%	0.000%	0.280%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%

[a] Ranges (minimum and maximum) reflect results across model firms of varying sizes.
Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-5b. Impact of Regulatory Options on Model Firm Financial Performance Estimated Actual Cost Pass Through

Construction Industry and Regulatory Option	Percent Change in Financial Ratios, From Baseline[a]							
	Gross Profit		Return on Net Worth		Current Ratio		Debt to Equity	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Single-family residential								
Option 1	0.000%	-0.034%	0.000%	-0.379%	0.000%	-0.003%	0.000%	0.013%
Option 2	0.000%	-0.077%	0.000%	-0.872%	0.000%	-0.007%	0.000%	0.031%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Multifamily residential								
Option 1	0.000%	-0.026%	0.000%	-0.083%	0.000%	-0.004%	0.000%	0.017%
Option 2	0.000%	-0.080%	0.000%	-0.259%	0.000%	-0.014%	0.000%	0.054%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Commercial								
Option 1	0.000%	-0.017%	0.000%	-0.054%	0.000%	-0.002%	0.000%	0.013%
Option 2	0.000%	-0.040%	0.000%	-0.126%	0.000%	-0.006%	0.000%	0.031%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Industrial								
Option 1	0.000%	-0.021%	0.000%	-0.066%	0.000%	-0.003%	0.000%	0.018%
Option 2	0.000%	-0.048%	0.000%	-0.155%	0.000%	-0.008%	0.000%	0.042%
Option 3	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%

[a] EPA applied the following estimated cost pass through factors: Single-family residential, 85.10%; Multifamily residential, 91.55%; Commercial, 89.87%; Industrial, 84.75%.
[b] Ranges (minimum and maximum) reflect results across model firms of varying sizes.
Source: EPA estimates based on the methodologies presented in Chapter Four.

5.4.2 Nonbuilding Construction

EPA has analyzed the potential impacts of the proposed rule on nonbuilding construction establishments based on Census data and the cost data presented in Section 5.2.4. As previously discussed, this analysis focuses on highway and street construction contractors (NAICS 23411) due to the lack of financial data for other segments of the heavy construction industry group (NAICS 234).

The model establishment analysis for heavy construction, although somewhat simplified, follows the basic methodology outlined in Section 4.3 for establishments in the commercial and industrial construction industries. EPA has determined that the median highway construction establishment (NAICS 23411), based on revenues, is in the 50 to 99 employee size classification category as defined by Census (U.S. Census 2000). Within this employment size class, EPA calculated average establishment revenues, employment, and costs as discussed in Section 4.3.1.2.

For the model establishment, EPA examined the economic impacts of the worst-case compliance cost impacts on the same four financial ratios analyzed above for the residential, commercial, and industrial construction industries. Due to the lack of actual engineering cost estimates for highway construction, the compliance costs used in this analysis do not correspond to a particular regulatory option or combination of options. Compliance costs for 7.5-acre projects were chosen for this analysis because they are closest in size to the model highway construction project assumed to be undertaken by the model establishment, which encompasses 10.67 acres.

Table 5-6 shows the results of this analysis for the model highway construction firm (50-99 employment size class). Overall, the impacts are not large, with only one estimate above one-quarter of one percent. As with the model establishments in the building construction industries, the impacts are largest for the return on net worth ratio.

Table 5-6. Impact of Proposed Rule on Model Firm Financials - Highway Construction

Cost Pass Through Assumption	Gross Profit		Return on Net Worth		Current		Debt to Equity	
	Ratio	Percent Change from Baseline	Ratio	Percent Change from Baseline	Ratio	Percent Change from Baseline	Ratio	Percent Change from Baseline
Zero Cost Pass Through								
Baseline	0.223000	--	0.198344	--	1.629629	--	1.061856	--
Worst-Case	0.222256	-0.33%	0.196307	-1.03%	1.628681	-0.06%	1.064601	0.26%
90 Percent Cost Pass Through								
Baseline	0.223000	--	0.198344	--	1.629629	--	1.061856	--
Worst-Case	0.222926	-0.03%	0.198141	-0.10%	1.629534	-0.01%	1.062131	0.03%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Under a zero cost pass through (CPT) assumption, the largest impact is on return on net worth, which declines by just over 1.0 percent. Impacts under an estimated CPT value of 90 percent are all at or below 0.10 percent.

5.5 ANALYSIS OF IMPACTS ON CLOSURES AND EMPLOYMENT LOSSES

As discussed in Chapter Four, EPA used two approaches to estimate potential facility closures and employment losses resulting from the proposed rule. The primary approach was to analyze changes in key financial ratios that occur as firms' costs increase in response to the proposed rule. To estimate closures, EPA examined a weighted average of changes in the current ratio, debt to equity ratio, and return on net worth ratios. EPA then constructed a cumulative distribution function for each ratio to estimate the percent of establishments that would likely fall below "critical" values after incurring compliance costs. That percent falling below this critical value, multiplied by the number of facilities represented by the model under evaluation, resulted in a projected number of closures. Employment losses were calculated by multiplying the number of establishments projected to close by employment estimates for the model facility representing those closures.

EPA's alternative approach, which analyzed estimated model facility cash flow, was used as a check on the financial ratio analysis described above. Results from this analysis are contained in Appendix 5-A.

5.5.1 Facility Closures

Table 5-7a shows closure analysis results using the financial ratio method under a zero CPT assumption — the worst case scenario. Results under a calculated CPT assumption are presented in Table 5-7b. The largest number of establishment closures is projected to occur in the commercial sector (43 projected closures), followed by the single-family residential sector (13 closures). Facility closures as a percent of total facilities are less than one percent under all proposed options and for all industry sectors. As seen in Table 5-7b, closure impacts are even smaller when CPT is accounted for.

Table 5-7a. Estimated Facility Closures
Zero Cost Pass Through

	Single-Family		Multifamily		Commercial	
Option	**Number**	**Pct. of Total**	**Number**	**Pct. of Total**	**Number**	**Pct. of Total**
1	4	0.005%	1	0.022%	11	0.028%
2	13	0.015%	3	0.065%	43	0.108%
3	0	0.000%	0	0.000%	0	0.000%
	Industrial		**Heavy**		**TOTAL**	
Option	**Number**	**Pct. of Total**	**Number**	**Pct. of Total**	**Number**	**Pct. of Total**
1	2	0.026%	0	0.000%	18	0.012%
2	7	0.090%	26	0.230%	92	0.063%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-7b. Estimated Facility Closures
Estimated Cost Pass Through

Option	Single-Family		Multifamily		Commercial	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	1	0.001%	0	0.000%	1	0.003%
2	2	0.002%	0	0.000%	4	0.010%
3	0	0.000%	0	0.000%	0	0.000%
Option	Industrial		Heavy		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	0	0.000%	0	0.000%	2	0.001%
2	1	0.013%	3	0.027%	10	0.007%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.5.2 Employment Losses

Table 5-8a presents employment loss analysis results for the financial ratio method under a zero CPT assumption to show the worst case scenario. Results under a calculated CPT assumption are presented in Table 5-8b.

Employment impacts as a percent of each sector's total employment are roughly the same as closure impacts. This is to be expected, because EPA estimated employment impacts by multiplying projected closures by the number of employees per establishment. Note that in the multifamily sector, the percentage of employment losses is slightly larger than the percentage of closures. This is because the model establishments most affected by the proposed rule account for a disproportionately high percentage of sector employment.

Table 5-8a. Estimated Employment Losses Zero Cost Pass Through

Option	Single-Family		Multifamily		Commercial	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	34	0.016%	12	0.034%	162	0.029%
2	145	0.067%	61	0.173%	603	0.110%
3	0	0.000%	0	0.000%	0	0.000%

Option	Industrial		Heavy		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	43	0.029%	0	0.000%	251	0.021%
2	133	0.089%	647	0.233%	1,589	0.130%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-8b. Estimated Employment Losses Estimated Cost Pass Through

Option	Single-Family		Multifamily		Commercial	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	5	0.001%	1	0.003%	16	0.003%
2	22	0.006%	5	0.014%	61	0.011%
3	0	0.000%	0	0.000%	0	0.000%

Option	Industrial		Heavy		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	7	0.005%	0	0.000%	29	
2	20	0.013%	65	0.023%	173	
3	0	0.000%	0	0.000%	0	

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.6 ANALYSIS OF BARRIER TO ENTRY

This section presents the results of EPA's barrier to entry analysis. As discussed in Section 4.3.3, EPA examined the ratio of compliance costs to current and total assets to determine if new market entrants would find it more difficult to obtain construction loans to start a project than would existing firms. As discussed in more detail in that section, this methodology is conservative by design because it does not account for the fact that a firm would typically be expected to finance 20 percent of the incremental compliance costs to obtain the loan— not the full amount as assumed here.

5.6.1 Building Construction

As shown in Table 5-9a, compliance costs represent a maximum of 0.82 percent of a model establishment's current assets (0.60 percent of total assets) across all options and project types. These maximum projected impacts occur in the multifamily sector. For the industrial and commercial sectors, compliance costs are less than 0.30 percent of current assets, while in the single-family sector, costs are less than 0.25 percent of current assets. Table 5-9b shows the barrier to entry analysis results under an estimated CPT scenario. As shown, the impacts are smaller than under the zero CPT scenario, with the maximum impact on both current assets and total assets at less than 0.10 percent.

Table 5-9a. Barrier to Entry Analysis—Zero Cost Pass Through

Option	Compliance Costs Divided by:			
	Current Assets		Total Assets	
	Min	Max	Min	Max
Single-Family Residential				
1	0.000%	0.100%	0.000%	0.070%
2	0.000%	0.230%	0.000%	0.170%
3	0.000%	0.000%	0.000%	0.000%
Multifamily Residential				
1	0.000%	0.260%	0.000%	0.190%
2	0.000%	0.820%	0.000%	0.600%
3	0.000%	0.000%	0.000%	0.000%
Commercial				
1	0.000%	0.120%	0.000%	0.090%
2	0.000%	0.270%	0.000%	0.220%
3	0.000%	0.000%	0.000%	0.000%
Industrial				
1	0.000%	0.110%	0.000%	0.080%
2	0.000%	0.250%	0.000%	0.190%
	0.000%	0.000%	0.000%	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-9b. Barrier to Entry Analysis—Cost Pass Through

Option	Compliance Costs Divided by:			
	Current Assets		Total Assets	
	Min	Max	Min	Max
Single-Family Residential				
1	0.000%	0.015%	0.000%	0.011%
2	0.000%	0.034%	0.000%	0.025%
3	0.000%	0.000%	0.000%	0.000%
Multifamily Residential				
1	0.000%	0.022%	0.000%	0.016%
2	0.000%	0.069%	0.000%	0.050%
3	0.000%	0.000%	0.000%	0.000%
Commercial				
1	0.000%	0.012%	0.000%	0.009%
2	0.000%	0.028%	0.000%	0.022%
3	0.000%	0.000%	0.000%	0.000%
Industrial				
1	0.000%	0.016%	0.000%	0.013%
2	0.000%	0.038%	0.000%	0.029%
3	0.000%	0.000%	0.000%	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.6.2 Nonbuilding Construction

The barrier to entry analysis also produced results in line with the results previously reported for the other four industries. Table 5-10 shows the results of this analysis. Under a zero CPT assumption, compliance costs are less than one percent of both current and total assets using the best estimate compliance cost. Using the worst-case estimate, compliance costs are slightly above 2.5 percent of current assets and nearly 1.5 percent of total assets. With cost pass through, these impacts are significantly lower.

Table 5-10. Barrier to Entry Analysis - Highway Construction

Compliance Cost Assumption	Compliance Costs Divided By:	
	Current Assets	Total Assets
Zero Cost Pass Through		
Baseline	0.00%	0.00%
Worst-Case	0.29%	0.17%
With 90 Percent Cost Pass Through		
Baseline	0.00%	0.00%
Worst-Case	0.03%	0.02%

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7 ANALYSIS OF IMPACTS ON NATIONAL CONSTRUCTION MARKETS

EPA used three approaches to estimate the potential impacts of the regulatory options on the national single-family housing construction market. This section presents the results of these analyses.

In the first approach, EPA analyzed the impacts of the proposed rule on consumers under the assumption that developers and builders pass on 100 percent of the costs to the new single-family home buyer. To assess these impacts, EPA developed a model that estimates the change in income needed to qualify for financing to purchase the (higher priced) housing unit, and then estimates the change in the number of households that would meet the higher income criteria. In theory, this provides an estimate of the change in new housing demand that could arise as a result of the proposed regulations.

EPA's second approach applies a partial equilibrium model to 220 metropolitan housing markets to estimate how compliance costs change the proportion of homes in the market that the median income household can afford, termed the Housing Opportunity Index (HOI). HOI is published quarterly by the NAHB. This index offers a similar estimate of the change in housing demand that may arise from the effluent guideline in terms of a familiar, widely publicized, indicator.

The third approach is a single national partial equilibrium model. Changes in prices and quantities from this model are used to derive the impacts on employment and social welfare.

EPA's methodology for these models is discussed more fully in Section 4.5.

5.7.1 Residential Construction Markets

5.7.1.1 Housing Affordability

Table 5-11 shows that the incremental costs of the proposed rule add a maximum of $58 to the $82,472 in income that is required to purchase the baseline model home. After this income change, between 5,200 and 29,000 households (0.03 percent to 0.15 percent of total qualifying households) would fail to qualify for a mortgage.

Table 5-11. Impact of Erosion and Sediment Control Costs on Housing Affordability (All Dollar Amounts are in Constant, Pre-tax, 1997 Dollars)

Option	**ESC Costs** ($/Unit)	**Total Change in Costs** ($/Unit)	**Income Needed To Qualify** ($)	**Change in Income Needed** ($)	**Number of Households Shifted** (Thousands)	**Percent of Households Shifted That Could Afford Baseline** (Percent)
1	$20	$36	$82,482	$10	-5.2	-0.03%
2	$111	$201	$82,529	$58	-29.1	-0.15%
3	$0	$0	$82,472			

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.1.2 Housing Opportunity Index

The HOI is an alternative measure of housing affordability. EPA estimated the change in HOI from its baseline value for 220 regional housing markets. Table 5-12 summarizes these results in terms of the average change calculated across each Census Bureau division. Since the HOI encompasses both existing and new housing, the results show the net effect for the entire housing market. The value of the HOI varies considerably by region. In the Pacific region, high real estate prices result in only one third of households having sufficient income to purchase the median-priced home. In the central regions, however, three-quarters of households can afford the median-priced home.

The proposed regulation has little effect on regional HOI. Table 5-13 shows the percentage change in HOI by Census division. Option 1 changes HOI by less than two-hundredths of one percent in all regions. Option 2 changes HOI by less than 0.2 percent. The largest changes occur in the South Atlantic region. These changes are much smaller in scale than annual changes that result from normal shifts in real estate market conditions and demography of the market areas.

Table 5-12. Single-Family Residential Average HOI by Census Division

	Census Division								
Option	1 New England	2 Middle Atlantic	3 East North Central	4 West North Central	5 South Atlantic	6 East South Central	7 West South Central	8 Mountain	9 Pacific
1	54.24	62.36	72.66	78.81	70.30	69.69	64.73	44.57	32.62
2	54.23	62.31	72.59	78.74	70.24	69.65	64.69	44.55	32.61
3	54.24	62.37	72.67	78.82	70.31	69.70	64.73	44.58	32.63

HOI indicates the percent of households in each region that can afford the median-priced house.
Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-13. Single-Family Residential Percentage Change in HOI by Census Division

	Census Division								
Option	1 New England	2 Middle Atlantic	3 East North Central	4 West North Central	5 South Atlantic	6 East South Central	7 West South Central	8 Mountain	9 Pacific
1	0.00%	-0.02%	-0.02%	-0.02%	-0.02%	-0.01%	-0.01%	-0.01%	-0.01%
2	-0.02%	-0.10%	-0.10%	-0.10%	-0.11%	-0.08%	-0.07%	-0.07%	-0.04%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

HOI indicates the percent of households in each region that can afford the median-priced house.
Source EPA estimates based on the methodologies presented in Chapter Four.

5.7.1.3 Single-Family Housing Prices and Quantities

Table 5-14 shows the results of EPA's analysis using the market model approach. The table shows the estimated changes in median single-family home prices from all combinations of the proposed options. The changes in costs range from $0 to $111. The market model recognizes that market conditions control how much of these costs can be passed through to consumers. Thus, the price increase is somewhat smaller than the related cost increase, reflecting the fact some costs would be borne by the builder-developer. The largest increase in price reduces the quantity that can be sold by about two-hundredths of one percent. The total loss in output to the construction industry ranges from $0 to $72 million.

Table 5-14. Single-Family Residential—Changes in Price and Quantity From the Baseline (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Change in Cost ($/Unit)	New Price ($/Unit)	Price Change ($/Unit)	Quantity Change (Units)	Quantity Change (Percent)	Loss of Output ($ Million)
1	$20	$288,414	$17	(44)	-0.00%	-$12.8
2	$111	$288,492	$95	(248)	-0.02%	-$71.6
3	$0	$288,397	$0	0	-0.00%	0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.1.4 Multifamily Housing Prices and Quantities

Table 5-15 shows the estimated changes in median price of a unit in a multifamily building from the proposed options. The changes in costs range from $0 to $40 per unit. Multifamily housing disturbs a smaller area per unit, so any ESC-related costs are spread over more units. The market model suggests a higher share of compliance costs in multifamily housing would be passed through to consumers, compared to single-family homes, so price changes are closer to the actual change in builder costs. The price changes passed through to consumers range from $0 to $40 per unit.

Table 5-15. Multifamily Residential—Changes in Price and Quantity From the Baseline (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Change in Cost ($/Unit)	New Price ($ 1,000/Unit)	Price Change ($/Unit)	Quantity Change (Units)	Quantity Change (Percent)	Loss of Output ($ Million)
1	$7	$132.53	$7	-7	0.00%	-$0.9
2	$40	$132.57	$40	-41	0.01%	-$5.2
3	$0	$132.53	$0	0	0.00%	-$0.0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.2 Non-Residential Construction Markets

5.7.2.1 Commercial Space

Rental prices for commercial space are typically quoted in dollars per square foot per year. Table 5-16 shows the estimated changes in median rental rate of a square foot of commercial space from the proposed options. The changes in costs range from $0 to $0.02 per square foot. Tenants of commercial space are considerably more price sensitive than residential buyers, so less of the change in costs can be passed through to tenants. The change in average price per square foot reflects this absorption of compliance costs by builders and building owners.

Price changes range from $0 to $0.02 per square foot. Quantity reductions are estimated to reach seven-hundredths of one percent for the most costly option. The total loss in output to the construction industry ranges from $0 to $67.1 million.

Table 5-16. Commercial—Changes in Price and Quantity From the Baseline (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Change in Cost ($/Sq. Ft.)	New Price ($/Sq. Ft.)	Price Change ($/Sq. Ft.)	Quantity Change (Units)	Quantity Change (Percent)	Loss of Output ($ Million)
1	$0.01	$14.67	$0.00	-36	-0.01%	-$14.7
2	$0.02	$14.69	$0.02	-163	-0.07%	-$67.1
3	$0.00	$14.66	$0.00	0	-0.00%	$0.0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.2.2 Industrial Space

Only 12,100 industrial projects are estimated to start in the base year. Rental prices for industrial space are typically quoted in dollars per square foot per year. Table 5-17 shows the estimated changes in median rental rate of a square foot of industrial/warehouse space from the proposed options. The changes in costs range from $0 to $0.02 per square foot. Buyers of industrial space are considerably more price sensitive than homeowners, so less of the change in costs can be passed through to the end-users. The change in average price per square foot reflects this absorption of compliance costs by builders and developers.

Price changes range from $0 to $0.02 per square foot. Quantity reductions are estimated to reach 0.3 percent for the most costly option, albeit on a small number of projects in the baseline. The total loss in output to the construction industry ranges from $0 to $17.8 million.

Table 5-17. Industrial—Changes in Price and Quantity From the Baseline (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Change in Cost ($/Sq. Ft.)	New Price ($/Sq. Ft.)	Price Change ($/Sq. Ft.)	Quantity Change (Units)	Quantity Change (Percent)	Loss of Output ($ Million)
1	$0.01	$5.17	$0.00	-11	-0.08%	-$4.4
2	$0.02	$5.18	$0.02	-46	-0.32%	-$17.8
3	$0.00	$5.16	$0.00	0	0.00%	$0.0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.3 Output and Employment

As discussed in Section 4.5, additional compliance costs reduce the output of the construction industry as the increased price reduces sales. The estimate of this effect is shown in the "Loss of Output" column of Table 5-18. Most of the losses are in the large single-family residential and catch-all commercial construction sectors. These losses are offset, however, by increases in output and employment in those industries associated with compliance, i.e., design, installation, and inspection of ESCs. The estimate of the amount of new work generated in these activities is shown in the "Stimulus from Added Work" column. The next two columns show the changes in jobs related to the loss in construction spending and (offsetting) increase in regulatory compliance spending. Under both options, the stimulus adds more jobs than the loss of output takes away, with the result that net employment change from construction impacts is a positive number. In the single-family sector, for example, under Option 1 there is a loss $12.8 million of output but an offsetting stimulus of $21.5 million. The loss represents 475 jobs, but the stimulus generates 797 jobs; the net result is that 322 more jobs are generated. Note that these job estimates apply to the entire economy, not just the construction sectors. They represent all of the impacts that result as changes in the construction industry ripple through other sectors.

The stimulus to the construction industry comes at the expense of consumer spending, as home buyers and other consumers devote more of their income to housing. EPA assumes that this loss of consumer surplus takes the form of reduced spending for other products, though it might also take the form of reduced amenities in housing construction. Removing this spending from the national economy reduces the employment that arises in response to consumer spending. The "Change in Employment From Consumer Spending" column shows this reduction in jobs, which offsets the stimulus to construction. When this effect is factored in, the net change in total employment is negative.

Total employment losses range from 0 to 1,400 jobs. These estimates do not consider how long individuals may be out of work, nor do they consider individuals' alternative opportunities. Because of this, such input-output analysis results are usually considered an over-estimate of the hardship initiated by the change to the economy.

Table 5-18. Changes in Output and Total Employment From the Baseline (All dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Loss of Output ($ Million)	Stimulus From Added Work ($ Million)	Change in Employment From Lost Output (Jobs)	Change in Employment From Stimulus (Jobs)	Net Change in Employment From Construction Impacts (Jobs)	Change in Employment From Consumer Spending (Jobs)	Net Change in Total Employment (Jobs)
Single-Family Residential							
1	($12.8)	$21.5	(475)	797	322	(498)	(176)
2	($71.6)	$120.2	(2,662)	4,467	1,805	(2,792)	(986)
3	$0.0	$0.0	0	0	0	0	0
Multifamily Residential							
1	($0.9)	$2.5	(34)	91	57	(67)	(10)
2	($5.2)	$13.7	(192)	509	317	(374)	(56)
3	$0.0	$0.0		0	0	0	0
Commercial							
1	($14.7)	$42.6	(546)	1,583	1,037	(1,062)	(25)
2	($67.1)	$194.7	(2,494)	7,234	4,740	(4,857)	(116)
3	$0.0	$0.0	0	0	0	0	0
Industrial							
1	($4.4)	$6.7	(164)	248	84	(152)	(68)
2	($17.8)	$26.9	(662)	1,001	338	(616)	(277)
3	$0.0	$0.0	0	0	0	0	0
Total							
1	($32.8)	$73.2	(1,219)	2,719	1,501	(1,780)	(279)
2	($161.7)	$355.5	(6,010)	13,212	7,201	(8,638)	(1,436)
3	$0.0	$0.0	0	0	0	0	0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.4 Changes in Welfare Measures

As discussed in Section 4.6, the proposed regulation shifts the supply curves for new construction in each sector. This shift alters the balance between consumers and producers. Each group contributes to the costs of complying with the regulation. As Table 5-19 indicates, consumers may lose from $0 to $316.6 million, depending on the option selected. Producers lose from $0 to $40.4 million. Almost all of this loss is shifted from consumers and construction firm owners to construction firms to pay the costs of complying with the regulation. As shown in the last section, the net effect on construction may be a stimulus. However, a small portion is utterly lost to society. This portion, termed the "deadweight loss," ranges from $0 to $200,000.

Table 5-19. Changes in Social Welfare Measures—All Sectors Combined (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars)

Option	Total Deadweight Loss ($ Million)	Total Consumer Surplus Loss ($ Million)	Total Producer Surplus Loss ($ Million)
1	$0.0	$65.2	$8.2
2	$0.2	$316.6	$40.4
3	$0.0	$0.0	$0.0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.7.5 Regional Effects

The multifamily housing and non-residential market models estimate impacts at the state level based on information about local real estate markets. The single-family housing market model estimates market effects at the MSA level, which can then be aggregated to the state level. Table 5-20 shows the loss in output to the construction industry, by state, from compliance with the more expensive Option 2. Loss of output largely follows the expected pattern of population and growth. Several states show zero loss for some categories because there is so little activity in that state that the effect could not be measured. For example, multifamily housing in Vermont. California, Pennsylvania, and several other states (indicated with an e) show no effect as current State regulations were deemed equivalent to the proposed regulations and so there was no incremental impact on firms operating in those states. Although the totals would be lower for Option 1, the pattern of losses would be similar.

Table 5-21 provides a similar state-by-state breakdown of the net change in employment as a result of compliance with the proposed regulation. In several states, multifamily housing, commercial, and industrial stimulus effects are greater than the losses, and the regulation causes a small net positive change in employment within those categories.

Table 5-20. Loss of Output to the Construction Industry by State and Use Category ($ Millions) (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars), Option 2

State	Single-Family	Multifamily	Commercial	Industrial
Alabama	(1.2)	0.0	(0.9)	(0.4)
Alaska	(0.2)	0.0	0.0	0.0
Arizona	e	e	e	e
Arkansas	(0.4)	0.0	(0.7)	(0.2)
California	e	e	e	e
Colorado	(3.6)	(0.3)	(1.2)	(0.5)
Connecticut	e	e	e	e
Delaware	(0.3)	0.0	(0.5)	0.0
District of Columbia	(4.8)	(0.2)	0.0	0.0
Florida	(7.4)	(1.0)	(15.3)	(0.9)
Georgia	(0.9)	(0.5)	(4.1)	(1.6)
Hawaii	(0.4)	0.0	0.0	0.0
Idaho	e	e	e	e
Illinois	e	e	e	e
Indiana	(3.6)	(0.1)	(1.6)	(1.5)
Iowa	(0.7)	0.0	(0.7)	(1.0)
Kansas	(0.5)	0.0	(0.9)	(0.5)
Kentucky	(1.1)	0.0	(1.3)	(0.8)
Louisiana	(1.8)	0.0	(1.8)	(0.2)
Maine	0.0	0.0	(2.4)	(0.1)
Maryland	(2.1)	0.0	(2.1)	(0.3)
Massachusetts	e	e	e	e
Michigan	(5.9)	(0.1)	(2.9)	(1.1)
Minnesota	(3.5)	(0.1)	(2.4)	(1.0)
Mississippi	(0.7)	0.0	(0.7)	(0.2)
Missouri	(3.1)	(0.1)	(2.0)	(0.6)
Montana	0.0	0.0	(0.3)	(0.1)
Nebraska	(0.6)	(0.1)	(0.8)	(0.2)
Nevada	4.0	(0.3)	(2.8)	(0.3)
New Hampshire	e	e	e	e
New Jersey	(3.9)	(0.1)	0.0	(0.1)
New Mexico	e	e	e	e
New York	(13.4)	(0.7)	(6.9)	(0.6)
		(0.4)	(3.3)	(1.5)

Table 5-20. Loss of Output to the Construction Industry by State and Use Category ($ Millions) (All Dollar Values Are in Constant, Pre-tax, 1997 Dollars), Option 2

State	Single-Family	Multifamily	Commercial	Industrial
North Dakota	(0.1)	0.0	(0.3)	(0.3)
Ohio	(6.8)	(0.2)	(1.1)	(1.2)
Oklahoma	e	e	e	e
Oregon	(1.0)	(0.1)	(2.2)	(0.8)
Pennsylvania	e	e	e	e
Rhode Island	(0.7)	0.0	(1.2)	0.0
South Carolina	e	e	e	e
South Dakota	e	e	e	e
Tennessee	e	e	e	e
Texas	e	e	e	e
Utah	e	e	e	e
Vermont	(0.1)	0.0	(1.2)	(0.1)
Virginia	e	e	e	e
Washington	(1.9)	(0.3)	(4.1)	(0.5)
West Virginia	e	e	e	e
Wisconsin	(1.8)	(0.2)	(1.2)	(1.3)
Wyoming	0.0	0.0	(0.2)	0.0
		(5.2)	**(67.1)**	**(17.8)**

Note: e indicates state has regulations equivalent to the proposed options.
Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5-21. Net Change in Total Employment by State and Use Category (Jobs) Under Proposed Rule Option 2

State	Single-Family	Multifamily	Commercial	Industrial
Alabama	(17)	0	(3)	(5)
Alaska	(3)	0	0	0
Arizona	e	e	e	e
Arkansas	(5)	0	(8)	(3)
California	e	e	e	e
Colorado	(50)	(3)	(4)	(4)
Connecticut	e	e	e	e
Delaware	(4)	0	(2)	0
District of Columbia	(66)	(3)	0	0
Florida	(102)	(16)	(15)	(15)
Georgia	(12)	(9)	(28)	(28)
Hawaii	(5)	0	0	0
Idaho	e	e	e	e
Illinois	e	e	e	e
Indiana	(50)	(1)	49	(30)
Iowa	(10)	0	(-3)	(23)
Kansas	(7)	0	(3)	(8)
Kentucky	(16)	(1)	(5)	(13)
Louisiana	(24)	0	(21)	(3)
Maine	0	0	(37)	0
Maryland	(28)	0	(7)	(4)
Massachusetts	e	e	e	e
Michigan	(81)	0	57	(9)
Minnesota	(49)	(1)	(8)	(17)
Mississippi	(10)	0	(3)	(3)
Missouri	(43)	(1)	(7)	(9)
Montana	0	0	(3)	(1)
Nebraska	(8)	(1)	(3)	(3)
Nevada	55	(7)	(44)	(4)
New Hampshire	e	e	e	e
New Jersey	(54)	0	24	1
New Mexico	e	e	e	e
New York	(184)	5	56	(2)
North Carolina	(44)	(7)	(12)	(29)
North Dakota	(1)	0	(1)	(5)
Ohio	(93)	(1)	34	(21)
Oklahoma	e	e	e	e
		(2)	(28)	(11)

Table 5-21. Net Change in Total Employment by State and Use Category (Jobs) Under Proposed Rule Option 2

State	Single-Family	Multifamily	Commercial	Industrial	Total
Pennsylvania	e	e	e	e	e
Rhode Island	(9)	0	(19)	0	(28)
South Carolina	e	e	e	e	e
South Dakota	e	e	e	e	e
Tennessee	e	e	e	e	e
Texas	e	e	e	e	e
Utah	e	e	e	e	e
Vermont	(2)	0	(18)	0	(21)
Virginia	e	e	e	e	e
Washington	(26)	(4)	(64)	(5)	(99)
West Virginia	e	e	e	e	e
Wisconsin	(25)	(3)	37	(20)	(10)
Wyoming	0	0	(3)	(1)	(3)
United States Total	**(986)**	**(56)**	**(116)**	**(277)**	**(1,436)**

Source: EPA estimates based on the methodologies presented in Chapter Four.

5.8 IMPACTS ON GOVERNMENTAL UNITS

As Section 4.8 discusses, EPA estimates that the proposed rule would impose some costs on governmental units involved in "codifying" the construction general permit. This section examines the costs imposed on governmental units associated with the proposed Option 2.

5.8.1 Construction Program Administration

EPA has analyzed the costs to governments under the assumption that the majority of construction-related regulatory costs would be associated with processing general permits. As noted previously, EPA assumes that the majority of NPDES Phase I and Phase II NPDES storm water permit programs are fully implemented, and that any new regulatory requirements would be superimposed upon these programs.

Based on the assumption that all states would change their storm water programs to include certification of sedimentation basins and other aspects of the proposed rule, EPA estimated the annual costs of establishing such a program. These costs are presented in Table 5-22. EPA estimates that states would experience $0.26 million in costs staying current with federal guidance, state guidance, and evolving industry practice (U.S. EPA 2002).

Table 5-22. Costs To Establish Construction Programs ($1997)

Element	**Value**	**Units**
Labor hours to review EPA regulation and modify state practices	200	Hours/Year
Labor cost	$26.02	$/Hour/State
State Cost per year	$5,203	$/Year/State
Number of States	50	States
Totals	$260,150	$/Year

Source: U.S. EPA. 2002.

In evaluating the annual costs, EPA assumed that the current trend — states taking the lead in implementing the regulation of construction activities — will continue in the future. EPA elected not to evaluate how to distribute its total estimated implementation cost between state and municipal agencies, and instead has attributed all costs to states.

5.8.2 Government Construction Costs

Government entities commission nearly a quarter of the value of construction put in place (Census, 2000). Government projects would need to comply with the proposed regulation so their costs would increase, just as private projects' would. Roughly one-half of government projects are maintenance or reconstruction of existing structures which does not entail new ground disturbance. EPA estimates that approximately 25 percent of total impacts would fall on government projects resulting in a $29.2 million additional cost to government entities under proposed Option 1 or a $115.9 million additional cost under proposed Option 2.[4] This effect is discussed in detail in the Unfunded Mandates Reform Act (UMRA) analysis in Chapter Ten.

5.9 OTHER IMPACTS

This section addresses Executive Order (EO) 12866, which directs federal agencies to assess the costs and benefits of each significant rule they propose or promulgate, as well as issues of environmental justice and children's health. Chapter Ten addresses the Unfunded Mandates Reform Act (UMRA). Section 5.9.1 describes the administrative requirements of EO 12866. Sections 5.9.2 and 5.9.3 describe EPA's analysis of environmental justice and children's health issues for the proposed rule. Another piece of legislation —the Unfunded Mandates Reform Act, or UMRA —also has requirements relevant to EPA's plans. Chapter Ten addresses UMRA.

Much of the information provided in this section is summarized from other documents that support this proposed rulemaking, as well as other sections of this report.

5.9.1 Requirements of Executive Order 12866

Under EO 12866 (58 FR 51735, October 4, 1993), the Agency is to determine whether a regulatory action is "significant" and therefore subject to OMB review and the directives of the EO. The Order defines a "significant regulatory action" as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

[4] Additional cost to government entities under the proposed ESC options includes costs potentially incurred by Federal, State, and local government entities.

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

EPA has determined that the proposed C&D rulemaking is a "significant regulatory action" under the terms of EO 12866, because the total costs of the proposed rule are estimated to exceed $100 million annually. As such, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

In addition to submission of the action to OMB, the principal directives of the EO are that the Agency perform an analysis comparing the benefits of the regulation to the costs that the regulation imposes, that the Agency analyze alternative approaches to the proposed rule, and that the reason for the proposed rule be identified. Wherever possible, the costs and benefits of the proposed rule are to be expressed in monetary terms. To address these directives, the following section describes the reasons why EPA is revising the existing regulations, and Chapters Eight and Nine present the estimated social costs, pollutant reductions, and monetary benefits of the proposed C&D regulations. Section 5.8 addresses the impacts of the proposed regulations on governmental units. An in-depth profile of the potentially affected industry sectors is presented in Chapter Two of this report.

Reason for the Regulation

Executive Order 12866 directs the Agency to identify the reason for the regulations being proposed. The reasons for proposing the C&D regulations are stated throughout this report (Chapters One and Six) and are presented in the preamble of the proposed rulemaking. These reasons are summarized briefly below:

- In spite of existing regulatory controls, there is continued runoff of sediment from construction sites and newly developed areas. Sediment entering public waterways imposes costs on water users in the form of additional demand for pre-treatment of water withdrawn and diminished value for in-stream uses. Users cannot identify and seek compensation from the construction sites causing the problem. So there is a market failure in terms of the environmental externality of sediment emissions. The proposed regulations are expected to address the impairment of many U.S. waterways and the associated human health and ecological risks.

- The existing regulation appears to be insufficient to protect or restore water quality. There exists an information asymmetry between builders and enforcement officials in which builders know their level of care with regard to erosion and sediment controls while officials may or may not know. The certification and inspection provisions of the proposed rule increase the level of information available to officials. The revisions would make the regulations apply more uniformly throughout the country and "raise the bar" for storm water control, in general.

Both UMRA and EO 12866 require the statutory authority for the rule to be cited. A detailed discussion of the objectives and legal basis for the proposed C&D regulations is presented in the preamble. A discussion of the UMRA is presented in Chapter Ten of this report.

5.9.2 Environmental Justice

According to EO 12898, *Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations*, federal agencies are to address potential environmental justice issues that may be triggered by proposed actions. Based on guidance in EPA's *Guidelines for Preparing Economic Analyses*, the potential effects of the proposed regulation on minority and low-income populations have been considered (U.S. EPA 2000). EPA has determined that the proposed rule would not have a disproportionately large effect on minority or low-income populations, nor would it have disproportionately high human health or environmental effects. Thus no further analysis on environmental justice issues has been conducted for this proposal.

5.9.3 Children's Health

Pursuant to EO 13045, *Protection of Children From Environmental Health Risks and Safety Risks*, EPA has considered whether this proposed rule would have any significant effects on children's health or safety (U.S. EPA 2000). EPA has determined, based on the information provided throughout this report, that the proposed rule would not have any significant effects on children's health or safety, and no further analysis has been conducted for this proposal.

5.10 REFERENCES

Tetra Tech. 2002. Personal Communication from J. Swanson, Tetra Tech, Inc., to J. Cantin, ERG, Inc. January 29.

U.S. Census Bureau 2000.1997 Economic Census: Construction: Subject Series. January.

U.S. EPA 2002. "Development Document for the Effluent Guidelines for the Construction and Development Point Source Category." Washington, D.C.: U.S. Environmental Protection Agency.

U.S. EPA 2000. "Guidelines for Preparing Economic Analyses." Washington, D.C.: U.S. Environmental Protection Agency, Report EPA 240-R-00-003, September.

APPENDIX 5A
Closure and Employment Loss Analysis Results
Cash Flow Method

Table 5A-1. Estimated Closures as Percent of Total Establishments
Zero Cost Pass Through
Cash Flow Method

Option	Single-Family			Multifamily			Commercial			Industrial		
1	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%
2	0.0%	-	0.0%	0.0%	-	0.0%	0.1%	-	0.2%	0.1%	-	0.1%
3	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%

Table 5A-2. Estimated Closures as Percent of Total Establishments
Cost Pass Through
Cash Flow Method

Option	Single-Family			Multifamily			Commercial			Industrial		
1	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%
2	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%
3	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%	0.0%	-	0.0%

Single family cost pass through: 85.10%
Multifamily cost pass through: 91.55%
Commercial cost pass through: 89.87%
Industrial cost pass through: 84.75%
Cost Pass Through Values Calculated by EPA.

Table 5A-3. Estimated Employment Losses as Percent of Total Employment
Zero Cost Pass Through
Cash Flow Method

Option	Single-Family	Multifamily	Commercial	Industrial
1	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%
2	0.0% - 0.0%	0.2% - 0.2%	0.1% - 0.2%	0.1% - 0.1%
3	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%

Table 5A-4. Estimated Employment Losses as Percent of Total Employment
Cost Pass Through
Cash Flow Method

Option	Single-Family	Multifamily	Commercial	Industrial
1	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%
2	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%
3	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%	0.0% - 0.0%

Single family cost pass through: 85.10%
Multifamily cost pass through: 91.55%
Commercial cost pass through: 89.87%
Industrial cost pass through: 84.75%
Cost Pass Through Values Calculated by EPA.

APPENDIX 5B
Sensitivity Analysis for the National Partial Equilibrium Model

5B.1 Introduction to Sensitivity Analysis

Elasticities of supply and demand are key parameters of the partial equilibrium market models which generate many of the results shown in Chapter 5. Values for these parameters are derived from a consensus of elasticity estimates appearing in the literature. Often differing databases and estimation methods generate different estimates, so the literature contains a wide range of elasticities. Table 5B-1 shows the impact on the results of selecting different sets of elasticities. The first line in each use category section is the cost pass through (CPT) and impact reported in Table 5-16a, Changes in Output and Total Employment from the Baseline, for the proposed Option 2. The succeeding lines show how the results change with the different combinations of supply and demand elasticities shown in the first two columns. (As the stimulus is virtually the same in all cases, the "Stimulus from Added Work" and "Change in Employment from Stimulus" columns in Table 5-16a are not shown here.) Except for single family housing, all of the categories were modeled at the state level so that local market conditions would drive the model. Thus, a range of demand elasticities is chosen as a parameter of the model but the actual elasticity used in each state model is calculated based on an indicator of state market activity. The sensitivity analysis for these categories was conducted by adjusting the range of possible demand elasticities.

As discussed in Section 4.5, housing supply is highly elastic which implies high CPT rates. The sensitivity analysis shows that when the elasticity of supply for single family housing is reduced from 4 to 0.5, the CPT falls from 85 percent to 42 percent. This reduces the change in the quantity of homes sold and the impact on consumers so much that the net effect of the proposed regulation is a creation of 1,800 jobs. Similar changes occur in other use categories. Reducing the elasticity of demand also reduces the impact of the regulation.

5B.2 Sensitivity Analysis Results

Overall, the sensitivity analysis shows that while the results can be changed by manipulation of the assumptions, the assumptions used yield reasonable estimates near the middle of the range of probable outcomes.

Table 5B-1. Sensitivity Tests with Alternative Elasticities

Supply Elasticity	Demand Elasticity	CPT (%)	Loss of Output ($Million)	Change in Employment from Lost Output	Net Change in Employment from Construction Impacts	Change in Employment from Consumer Spending	Net Change in Total Employment
Single Family Housing							
4	0.7	85.11	-71.6	-2,662	1,805	-2,792	-986
10	0.7	93.46	-78.7	-2,923	1,544	-3,066	-1,522
1	0.7	58.82	-49.5	-1,840	2,628	-1,930	698
0.5	0.7	41.67	-35.1	-1,303	3,165	-1,367	1,798
4	1.0	80.00	-96.2	-3,575	892	-2,624	-1,732
4	0.5	88.89	-53.4	-1,986	2,482	-2,916	-434
Multifamily Housing							
4	-0.8 - -0.2	91.54	-5.2	-192	317	-374	-56
10	-0.8 - -0.2	96.42	-5.5	-203	333	-394	-61
1	-0.8 - -0.2	73.35	-4.0	-150	257	-299	-42
4	-1.0 - -0.2	90.40	-5.9	-218	284	-369	-84
4	-0.5 - -0.2	93.34	-4.0	-150	369	-381	-12
4	-0.8 - -0.1	93.08	-4.2	-158	360	-380	-20
Commercial							
4	-0.8 - -0.01	89.87	-67.1	-2,494	4,740	-4,857	-116
10	-0.8 - -0.01	95.62	-71.5	-2,656	4,578	-5,119	-541
1	-0.8 - -0.01	70.17	-51.9	-1,930	5,306	-3,898	1,408
4	-1.0 - -0.01	87.73	-81.6	-3,034	4,199	-4,757	-558
4	-0.5 - -0.01	93.32	-44.0	-1,633	5,604	-5,015	588
4	-0.8 - -0.2	88.16	-83.5	-3,103	4,130	-4,744	-615
Industrial							
4	-1.5 - -0.2	84.75	-17.8	-662	338	-616	-277
10	-1.5 - -0.2	93.21	-20.0	-742	258	-682	-424
1	-1.5 - -0.2	59.11	-11.7	-436	567	-418	149
4	-2.0 - -0.2	81.43	-21.8	-810	190	-588	-399
4	-1.0 - -0.2	88.43	-13.4	-498	504	-646	-142
4	-1.5 - -0.01	86.91	-15.8	-585	416	-630	-214

APPENDIX 5C

Baseline Analysis

APPENDIX 5C
BASELINE ANALYSIS

5C.1 INTRODUCTION

The main portion of this economic analysis assumes that, in the baseline, the construction and development (C&D) industry is in full compliance with the existing Storm Water Phase I and Phase II regulations as they apply to construction activities. Since the final deadline for implementation of Phase II is not until March 10, 2003, some affected entities may not yet have adjusted to the Phase II requirements. Because of the overlap between the proposal of the effluent limitation guideline (ELG) and the implementation of the Phase II regulations, EPA has completed this alternate baseline analysis. The analysis presents the following:

- Combined national compliance costs and social costs of Phase II and the C&D Effluent Limitation Guideline (ELG)—This analysis simply adds together the compliance and government costs of the rules.
- Impact of the combined Phase II and ELG costs on representative model projects—This analysis would apply to projects that take place in jurisdictions not yet in compliance with Phase II.
- Impact of the combined Phase II and ELG costs on representative model firms—This analysis would apply to firms for whom 100 percent of operations take place in jurisdictions not yet in compliance with Phase II.
- Impact of the combined Phase II and ELG costs on facility closures and employment levels. *This part of the analysis is the most speculative* because we have no way of identifying how many firms and what share of their operations would be subject to both rules. To derive these estimates we have assumed that (1) firms within a certain size class are most likely to be affected (because Phase II applies only to sites of 1 to 5 acres in size), and (2) within this group we have estimated only those firms located in non Phase II compliant states would be affected. This second assumption ignores the fact that it is site location, not firm location, that would determine coverage under Phase II, and that many construction firms operate outside their home state.

Note that EPA has not assessed the potential combined *benefits* of the Phase II and effluent guidelines requirements. The Phase II rule EA indicated benefits from the construction part of the rule of $540 to $686 million per year (U.S. EPA 1999, Table 6-20).

5C.2 BASELINE ANALYSIS

Throughout the economic analysis of the proposed C&D effluent guidelines, EPA has assumed the industry is in full compliance with all applicable existing laws and regulations related to storm water management (see U.S. EPA 2002, Section 4.11). This includes the final storm water Phase II regulations, which were published on December 8, 1999 (64 FR 235; page 68794). The Phase II rules apply to sites between one and five acres in size.

While many permitting authorities have already begun implementing the Phase II requirements, the deadline for obtaining permit coverage is not until March 10, 2003. As a result, it is likely that the C&D industry is not uniformly compliant with these requirements at this time. One implication is that the economic baseline used to assess the impacts of the proposed effluent guideline may not reflect industry conditions once the Phase II regulations have been fully implemented. To account for this, EPA has conducted a supplemental analysis that includes the *combined* costs and impacts of meeting the Phase II requirements and the proposed effluent guidelines. This section describes the methodology used to conduct this analysis and presents the results.

5C.2.1 National Compliance Costs

The economic analysis for the construction component of the final Phase II storm water rule was based on engineering costs developed for three site size classes: 1-, 3-, and 5-acres. Within each site size class EPA developed costs for erosion and sediment control (ESC) specific to sites in low, medium, and high rainfall regions and with low, medium, and high slope conditions. Since EPA did not have a distribution of sites by rainfall region or slope condition, a simple average of the costs across all site types was used within each size class. Table 5C-1 shows the costs and costs per acre for the three site size classes, with costs updated to 1997 dollars.

Table 5C-1. Costs of Phase II Erosion and Sediment Control, by Site Size ($1997)

Site Size (Acres)	ESC Costs	ESC Costs per Acre
1	$1,187	$1,187
3	$4,524	$1,508
5	$8,569	$1,714

Source: Economic Analysis of the Final Storm Water Phase II Rules. U.S. EPA (1999); ENR (2001).

In addition to the ESC costs, EPA estimated the industry would incur $937.46 in administrative costs ($922.42 in $1997) for each permitted construction project. These include costs associated with the following elements: notification of intent, municipal notification, storm water pollution prevention plan, record retention, and notification of termination. Thus, the total costs to industry of compliance with the construction portion of the Phase II rules include the costs of ESC controls and the administrative costs.

The Phase II compliance costs were applied to EPA's estimate of the number of projects falling within the one to five acre size class. Projects in areas with equivalent programs were excluded, including 14 states covered by equivalent existing state programs and two states and parts of four other states covered by requirements equivalent to those implemented under the Coastal Zone Act Reauthorization Amendments (CZARA) (which covers nonpoint sources of pollution, including construction activities, in coastal regions). The national compliance costs of the Phase II rules were estimated in 1998 dollars to be $545 - $679 million.[1]

EPA added the Phase II compliance cost estimates to the compliance costs of the proposed ELG to obtain an alternate estimate of the compliance costs (and social costs) of the proposed rule under the alternative baseline. Table 5C-2 shows the national costs under the alternative baseline scenario, obtained by adding the national ESC and administrative costs from the Phase II analysis to the national compliance costs associated with the proposed effluent guidelines. The combined industry compliance costs are $539.3 million under Option 1 and $890.3 million under Option 2. Table 5C-3 indicates the combined social costs are $891.1 million for Option 2 (1997 dollars).

[1] Source: Phase II final EA, Table 4-18, p. 4-25.

Table 5C-2. Estimated National Costs of Erosion and Sediment Controls Alternative Baseline Scenario (No Phase II Compliance) ($1997 millions, pre-tax)

Option	National Costs by Type of Construction ($ millions)				Total
	Single-Family	Multifamily	Commercial	Industrial	
1	$64.6	$39.3	$413.4	$22.0	
2	$161.9	$86.8	$612.3	$29.3	
3	$0.0	$0.0	$0.0	$0.0	

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5C-3. Social Costs and Benefits Erosion and Sediment Controls Alternative Baseline Scenario (No Phase II Compliance) ($1997 millions, pre-tax)

Option	Installation, Design and Permitting	Operation and Maintenance	Government Costs	Deadweight Loss	Total Social Costs	Total Benefits[a]
1	$539.3	$0.0	$0.0	$0.1	$539.4	$9.7
2	$842.4	$48.0	$0.3	$0.4	$891.1	$20.6
3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

[a]Benefits do not include benefits of Phase II rule.
Source: EPA estimates based on the methodologies presented in Chapter Four.

5C.2.2 Economic Impacts

EPA assessed the economic impacts under the alternative baseline using a similar approach to that described in Chapter Four of the draft Economic Analysis (EA). The impacts on key financial ratios were assessed for model projects and model firms. The model firm impact analysis was then extended to estimate the number of firm closures and the associated employment losses.

5C.2.2.1 Analysis of Impacts on Model Projects

EPA assessed the impacts of the combined costs of the Phase II and proposed effluent guidelines requirements on model projects using the same approach described in Section 4.2. EPA developed a series of model C&D projects and flowed the incremental costs through these models to assess the impacts on project viability. The model project scenarios were analyzed under the alternative assumptions of 100 percent cost pass through (the end consumer bears all of the cost) and zero cost pass through (the developer-builder bears all of the cost). In the former case the impacts are reflected in a higher price for the finished product (home, apartment, commercial or industrial building) while in the latter case the impacts are reflected in reduced profits to the builder-developer.

Table 5C-4a shows the combined impact of the Phase II and proposed effluent guidelines costs on model project financials under the 100 percent cost pass through scenario. Table 5C-4b shows the same impacts under the zero percent cost pass through scenario.

Table 5C-4a. Impact of Combined Phase II and Proposed Effluent Guidelines Costs on Model Project Financials—100 Percent Cost Pass-Through and All Project Sizes

	Percent Change in Project Price to Buyer							
	Single-Family		Multifamily		Commercial		Industrial	
Option	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1	0.00%	0.47%	0.00%	0.26%	0.00%	0.24%	0.00%	0.37%
2	0.00%	0.44%	0.00%	0.24%	0.00%	0.22%	0.00%	0.34%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5C-4b. Impact of Combined Phase II and Proposed Effluent Guidelines Costs on Model Project Financials—Zero Cost Pass-Through and All Project Sizes

	Percent Change in Builder-Developer Profit							
	Single-Family		Multifamily		Commercial		Industrial	
Option	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
1	0.00%	-4.60%	0.00%	-2.35%	0.00%	-2.13%	0.00%	-3.36%
2	0.00%	-4.23%	0.00%	-2.15%	0.00%	-1.96%	0.00%	-3.09%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates based on the methodologies presented in Chapter Four.

For Option 1, under the alternate baseline, the maximum percent change in project cost to the buyer ranges from 0.24 percent (commercial project) to 0.47 percent (single-family project). This is higher than the range of maximum impact given in Table 5-2a of the draft EA, Chapter 5 (0.02 percent for a commercial project to 0.04 percent for a single-family project).

Impacts on builder profits are also greater under the alternate baseline assumption. As shown in Table 5C-4b, the maximum impacts range from -4.60 percent for a single-family project under Option 1, up to -1.96 percent for a commercial project under Option 2. This is 2 to 3 percent higher than the impacts shown in Chapter 5 of this EA, Table 5-2b, where the maximum impact ranges from -0.17 percent for a commercial project up to -0.80 percent for a single-family project.

5C.2.2.2 Analysis of Impacts on Model Establishments

In Section 4.3 EPA developed a series of model firms based on composite industry financial data collected by Dun & Bradstreet (D&B 2000). For single-family and multifamily housing EPA constructed one model for each starts size class while for commercial and industrial construction there is a single model firm. EPA examined the impact of the regulatory costs on model firm financial performance by analyzing changes in key financial ratios as the annual regulatory costs are absorbed into the model firm's financial statement. Complete details on the methodology can be found in Chapter Four, Section 4.3 of this economic analysis.

Under this baseline scenario some firms will be impacted to a greater extent than others because they operate on sites subject to the Phase II storm water requirements and in jurisdictions that have not yet fully implemented the Phase II requirements. As a result, the baseline financial conditions for these firms used in the economic analysis may not fully reflect adjustments necessary to meet the Phase II requirements. To address this, EPA has analyzed the impacts associated with meeting the combined requirements of Phase II and the C&D effluent guidelines.

As noted above, the Phase II rules apply to construction sites greater than one acre and less than five acres in size. EPA currently lacks information on how frequently firms operate on sites that fall within this size range. *As a result, EPA cannot present reliable data on the extent to which firms might* *be subject to both the Phase II requirements and the proposed effluent guidelines requirements.* At one extreme there may be firms that operate only on sites greater than five acres. Such firms are likely be already compliant with the existing Phase I requirements and thus would face only the incremental requirements associated with the proposed effluent guidelines. On the other extreme are firms that may operate exclusively on sites between one and five acres in size and in jurisdictions that have not fully implemented the Phase II requirements. These firms would incur the combined costs of the Phase II and proposed effluent guidelines Option 1 requirements on 100 percent of their projects. In between there will be firms who operate only part of the time on sites subject to the combined Phase II and proposed effluent guidelines requirements.

Insufficient data is available to allow EPA to develop a distribution of firms by the extent of exposure to both the Phase II requirements and the proposed effluent guidelines requirements. As a result, EPA has modeled this baseline scenario only for firms with 100 percent exposure to both sets of requirements. This represents an absolute worst-case scenario in terms of potential impacts. EPA expects that only a small proportion of the industry would actually be represented by this model firm scenario.

Table 5C-5 shows the impact of the combined Phase II and proposed effluent guidelines compliance costs on model firm financial ratios under the zero cost pass through assumption (i.e., the firm absorbs 100 percent of the compliance costs).

Table 5C-5. Impact of Combined Phase II and Proposed Effluent Guidelines Costs on Model Firm Financials – Zero Cost Pass Through

	Percent Change in Financial Ratios From Baseline							
	Gross Profit		**Return on Net Worth**		**Current Ratio**		**Debt to Assets**	
Option	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Single-family Residential								
1	0.00%	-2.40%	0.00%	-27.04%	0.00%	-0.21%	0.00%	0.96%
2	0.00%	-2.20%	0.00%	-24.83%	0.00%	-0.20%	0.00%	0.88%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Multifamily Residential								
1	0.00%	-1.73%	0.00%	-5.57%	0.00%	-0.30%	0.00%	1.15%
2	0.00%	-1.59%	0.00%	-5.11%	0.00%	-0.27%	0.00%	1.06%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: EPA estimates based on the methodologies presented in Chapter Four.

For Option 1, the largest impacts generally occur in the multifamily sector. Percent change in gross profit for the single-family sector ranges from -2.20 percent to -2.40 percent. Under the initial baseline, the range was from -0.23 percent to -0.52 percent. For the multifamily residential sector, the change in gross profit ranges from -1.59 percent to -1.73 percent. The change in gross profit for the multifamily sector is also higher under the alternate baseline than under the initial baseline assumption. Change in gross profit from the initial baseline was from -0.31 percent to -0.95 percent.

The current ratio shows the least change from baseline of all four financial ratios in both sectors. The maximum percent change in current ratio for the single-family sector ranges from -0.20 percent to -0.21 percent. Under the initial baseline, these impacts were lower, ranging from -0.02 percent to -0.05 percent. For the multifamily sector the change ranges from -0.27 percent to -0.30 percent. Again, impacts were less severe under the initial baseline assumption, where change in current ratio for the multifamily sector ranged from -0.05 percent to -0.16 percent.

As with the analysis in the EA, the largest impacts over all model firm financials under the alternate baseline is on the return on net worth. Here, the percent change from baseline ranges from -24.83 percent to -27.04 percent in the single-family sector and from -5.11 percent to -5.57 percent in the multifamily sector (both under zero cost pass through). Under the initial baseline, change in return on net worth ranges from -2.54 percent to -5.85 percent for single-family and from -0.99 percent to -3.07 percent for multifamily.

Incremental impacts on debt-to-assets ratios (also called the debt-to-equity ratio) for the single-family sector range from 0.88 percent to 0.96 percent. Under the initial baseline, change in the debt-to-assets ratio in this sector range from 0.21 percent to 0.90 percent. For the multifamily sector, the percent change in debt-to-assets ratio over baseline ranges from 1.06 percent to 1.15 percent. The impacts under the initial baseline for this sector range from 0.20 percent to 0.64 percent.

5C.2.2.3 Analysis of Impacts on Closures and Employment Losses

EPA examined the potential impact of the combined Phase II and proposed effluent guidelines requirements on closures and employment losses using the general approach developed in Section 4.3.2. The approach is based on the model firm analysis presented in the section above. EPA estimated the change in the number of firms considered financially "stressed" (and their employment) as a result of the regulatory action by examining key financial ratios with and without the compliance cost impacts. The financial stress indicators were used to identify firms that could potentially shut down and close as a result of the regulatory action.

As explained above, EPA lacks reliable data on the distribution of firms by extent of exposure to the Phase II requirements. Although key information on the exposure of firms to the combined effect of Phase II and the proposed effluent guidelines was not available, EPA developed closure estimates for the *single-family and multifamily homebuilding sector only* by making a number of assumptions.[2] First, EPA assumed that the firms most likely to operate on sites subject to the Phase II requirements (i.e., sites between one and five acres in size) are those in the 5-9 and 10-24 starts per year class.[3] At the national average lot size of 0.31 acres this translates to disturbance of between 1.55 and 7.44 acres. EPA further assumed that *all* of the activities of firms in these size classes takes place on sites between 1 and 5 acres in size.[4]

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[2] EPA has a distribution of establishments by starts size class for the single-family and multifamily sectors only and therefore could not conduct the same analysis for the commercial and industrial sector.

[3] These establishments represent 35 percent of all establishments and account for 21 percent of new single-family homes. See Table 2-20. Builders in the 1-4 starts class (accounting for 43 percent of establishments and 7 percent of starts) were already assumed to build predominantly on sites under 1 acre in size and thus will not be impacted by the proposed rule requirements. See Sections 2.34 and 2.35.

[4] The next largest starts class is between 25 and 99 units. This translates to between 7.5 and 33 acres disturbed. EPA judged that at this size class and above it was unlikely that firms would operate solely or predominantly on sites between 1 and 5 acres in size.

The closure analysis is thus based on the following:

- The combined Phase II and effluent guidelines costs are applied to establishments in the 5-9 and 10-24 starts class located in states without equivalent Phase II programs at the time of promulgation of the Phase II rules.
- The analysis assumes *all* activities of firms in these starts classes in affected states are subject to the combined compliance costs of Phase II and the effluent guideline.
- The costs per acre for the effluent guidelines only are applied to remaining establishments (i.e., those in the 25+ starts size classes) in these states and to all establishments in all other states.
- Closures and employment losses are calculated under the zero cost pass through assumption.

Tables 5C-6 and 5C-7 present the results of the closure analysis. Table 5C-6 shows the estimated closures for the single-family and multifamily sectors under the alternate baseline. Table 5C-7 shows the estimated employment losses for the single-family and multifamily sectors under the alternate baseline.

As shown in the tables below, EPA has estimated that approximately 16 single-family businesses (0.02 percent of all potentially affected single-family businesses), and 4 multifamily businesses (0.09 percent of potentially affected multifamily businesses), will be subject to possible closure due to the proposed rule. Under the initial baseline, EPA estimated that 13 single-family businesses and 3 multifamily businesses would be subject to closure.

EPA has estimated employment losses with the alternative baseline to be approximately 230 for the single-family and multifamily sectors (less than one-half of one percent of potentially affected employees in these two sectors). Under the initial baseline, EPA estimated employment losses of approximately 206 for both sectors.

Table 5C-6. Estimated Facility Closures
Alternate Baseline
Zero Cost Pass Through

Option	Single-Family		Multifamily		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	12	0.014%	2	0.043%	14	0.057%
2	16	0.019%	4	0.087%	20	0.106%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

Table 5C-7. Estimated Employment Losses
Alternate Baseline
Financial Ratio Method
Zero Cost Pass Through

Option	Single-Family		Multifamily		TOTAL	
	Number	Pct. of Total	Number	Pct. of Total	Number	Pct. of Total
1	64	0.019%	18	0.051%	82	0.070%
2	162	0.048%	65	0.185%	227	0.233%
3	0	0.000%	0	0.000%	0	0.000%

Source: EPA estimates based on the methodologies presented in Chapter Four.

5C.2.2.4 Analysis of Impacts on the National Construction Market

The Phase II baseline scenario adds the same costs per acre to each type of construction. The impact on each type of construction is a weighted average of the number of acres subject to the Phase II regulation. The incremental costs to bridge the gap between the Phase II baseline and the initial baseline are also the same across policy options. Thus, assessing this baseline scenario is unlikely to change the rank order of costs among policy options but merely demonstrate larger impacts by including all recent EPA C&D regulation rather than showing only the effects of the proposed effluent guidelines.

Table 5C-8 repeats the affordability assessment from the initial baseline analysis. It shows the worst case scenario in which the Phase II alternative baseline applies to all regulated construction sites. The impacts are considerably larger than under the standard baseline. The most costly option decreases the number of families that could have afforded the model home by 0.21 percent. This is slightly more than the 0.15 percent cut estimated under the standard baseline.

Table 5C-8. Impact of Erosion and Sediment Control Costs on Housing Affordability Alternative Baseline Scenario (No Phase II Compliance) ($1997 millions, pre-tax).

Option	Storm Water Control Costs Per Lot	Change in Costs per Unit	Income Needed to Qualify	Change in Income Needed	Number of Households Shifted (thousands)	Percent of Households Shifted That Could Afford Baseline
1	$62	$112	$82,503	$32	-16	-0.08%
2	$153	$277	$82,551	$79	-40	-0.21%
3	$0	$0	$82,472			

Source: EPA estimates based on the methodologies presented in Chapter Four.

The changes in output and employment are considerably greater under the alternative baseline. Table 5C-9 shows that under the more costly Option 2, construction-related impacts decrease employment by 7,800 jobs. The stimulus effect of the regulation increases employment by a more than offsetting 19,410 jobs. The change in consumer spending, however, causes a job loss of 12,900 jobs in all industries nationwide. This is half again as large as the job losses from consumer spending estimated under the original baseline for Option 2 (8,640 jobs). Table 5C-9 shows a net employment loss of 1,300 under Option 2. This is about the same as the net employment effect under the initial baseline (1,440 jobs) Clearly, the estimated impact of the proposed rule depends on which baseline is considered more appropriate.

Table 5C-9 Changes in Output and Total Employment from the Alternate Baseline ($1997)

Option Comb.	Loss of Output ($ Million)	Stimulus from Added Work ($ Million)	Change in Employment from Lost Output (Jobs)	Change in Employment from Stimulus (Jobs)	Net Change in Employment from Construction Impacts (Jobs)	Change in Employment from Consumer Spending (Jobs)	Net Change in Total Employment (Jobs)
Single-family							
1	(30)	67	(1,101)	2,477	1,376	(1,616)	(241)
2	(74)	165	(2,732)	6,147	3,414	(4,012)	(598)
3	0	0	0	0	0	0	0
Multifamily							
1	(4)	10	(136)	354	218	(260)	(41)
2	(8)	21	(293)	772	479	(567)	(88)
3	0	0	0	0	0	0	0
Commercial							
1	(50)	143	(1,840)	5,319	3,478	(3,569)	(90)
2	(102)	295	(3,789)	10,965	7,176	(7,361)	(185)
3	0	0	0	0	0	0	0
Industrial							
1	(14)	21	(520)	779	259	(478)	(219)
2	(27)	(41)	(1,019)	1,527	508	(940)	(432)
3	0	0	0	0	0	0	0
Total							
1	(97)	240	(3,597)	8,928	5,332	(5,923)	(591)
2	(211)	522	(7,833)	19,410	11,577	(12,880)	(1,303)
3	0	0	0	0	0	0	0

Source: EPA estimates based on the methodologies presented in Chapter Four.

5C.3 REFERENCES

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CHAPTER SIX
INITIAL REGULATORY FLEXIBILITY ANALYSIS

6.1 INTRODUCTION TO THE INITIAL REGULATORY FLEXIBILITY ANALYSIS

This section considers the effects that the proposed C&D regulations would have on small entities in accordance with the Regulatory Flexibility Act (RFA, 5 U.S.C et seq., Public Law 96-354) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). The purpose of the RFA is to establish as a principle of regulation that agencies should tailor regulatory and informational requirements to the size of entities, consistent with the objectives of a particular regulation and applicable statutes. The RFA generally requires an agency to prepare an initial regulatory flexibility analysis (IRFA) of any rule subject to notice-and-comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a "significant impact on a substantial number of small entities."[1] Small entities include small businesses, small organizations, and governmental jurisdictions.

For this proposed rulemaking, EPA conducted outreach to small businesses, convened a Small Business Advocacy Review (SBAR) panel, and prepared an IRFA.[2] The IRFA is detailed in this section and represents EPA's assessment of the impacts of the proposed regulations on small businesses in the C&D industries. The analysis is presented as follows:

- **Section 6.2** outlines EPA's initial assessment of small businesses in the industries affected by the proposed regulations.

- **Section 6.3** presents EPA's analysis (i.e., IRFA) and summarizes the steps taken by EPA to comply with the RFA.

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[1] The preparation of an IRFA for a proposed rule does not legally foreclose certifying no significant impact for the final rule (USEPA, 1999).

[2] This analysis or a summary of the analysis must be published in the *Federal Register* at the time of publication of a proposal.

- **Section 6.4** presents the data, methodology, and results of EPA's analysis of impacts to small businesses for this rulemaking.

6.2 INITIAL ASSESSMENT

EPA has determined that the proposed C&D regulations are subject to notice-and-comment rulemaking requirements. EPA has developed a profile of the C&D industry that includes all potentially affected operations as well as small businesses. This information is provided in Chapter Two and also in Chapters Four and Five of this EA. Much of the profile information covered in these sections applies to small businesses. Additional information on small businesses in the C&D industry is provided in Sections 6.2 and 6.3 of this chapter. EPA's assessment concludes that the proposed rule may affect small entities and the proposed rule would have an adverse economic impact on small entities.

Section 6.2.1 reviews the SBA definitions of small entities in the C&D industry. Section 6.2.2 then uses the definitions of small entities laid out in Section 6.2.1 to estimate the number of operations that meet this small business definition.

6.2.1 Definition of Affected Small Entities

The RFA defines a "small entity" as a small not-for-profit organization, small governmental jurisdiction, or small business. EPA expects that the principal impact of the C&D regulations on small entities will fall on (1) small businesses that undertake C&D activities and (2) small governmental units involved in permitting C&D activities. With respect to the first of these categories, the majority of C&D activity in the United States is undertaken by private businesses, hence the small entity analysis will focus on small businesses engaged in C&D activities.[3] With respect to the second category of impact, permitting activity is undertaken exclusively by governmental units (at various levels of government), hence this part of the analysis will focus on the impacts on small government units.

[3] While some governmental and nonprofit entities may engage directly in C&D activities (i.e., undertake C&D work of their own accord), complete information is not available to warrant inclusion of governmental or nonprofit entities in this analysis. For this reason, this analysis focuses only on small businesses.

The RFA requires (with some exception) that EPA define"small" businesses according to the size standards established by the Small Business Administration (SBA). SBA establishes criteria for identifying small businesses based on either the number of employees or annual revenues (13 CFR 121).[4] These size standards vary by NAICS (North American Industrial Classification System) code, and previously by Standard Industrial Classification (SIC) codes. Qualifying revenue levels differ among NAICS industries, and within the C&D industries there is a range of qualifying revenue levels, from $5.0 million for NAICS 23311 (Land subdivision and development) to $27.5 million for the majority of industries within NAICS 233 and 234. For businesses in the special trades industries, the small business size threshold is $11.5 million in revenues. Table 6-1 summarizes the SBA revenue thresholds for small businesses in each of the C&D industries.

[4] Employees counted in determining size includes all individuals employed on a full-time, part-time, temporary or other basis. Employment is measured as the average number of employees for each pay period over the previous 12 months. For standards based on revenues, SBA uses the average revenues over the last three completed fiscal years.

Table 6-1. SBA Small Business Definitions for the Construction and Development Industry

NAICS Code	Description	SBA Revenue Size Cutoff (Millions)
233110	Land subdivision and land development	$5.0
233210	Single-family housing construction	$27.5
233220	Multifamily housing construction	$27.5
233310	Manufacturing and industrial building construction	$27.5
233320	Commercial and institutional building construction	$27.5
234110	Highway and street construction	$27.5
234120	Bridge and tunnel construction	$27.5
234910	Water, sewer, and pipeline construction	$27.5
234920	Power and communication transmission line construction	$27.5
234930	Industrial nonbuilding structure construction	$27.5
234990	All other heavy construction	$27.5
235930	Excavation contractors	$11.5
235940	Wrecking and demolition contractors	$11.5

Source(s): 13 CFR 121 (Small Business Size Regulations; Size Standards and the North American Industry Classification System; Correction); Small Business Administration 1998: Firm Size Data (see http://www.sba.gov/advo/stats/data.html)

6.2.2 Number of Small Businesses Affected

The number of small businesses affected by the proposed rule was estimated through a series of steps. First, EPA estimated the number of establishments in the affected industries. From the number of establishments, EPA then estimated the number of businesses (or firms) affected. Finally, EPA estimated the number of small businesses affected.

6.2.2.1 Number of Establishments Affected

The first step in the small entity analysis is to determine the number of establishments affected. EPA developed estimates of the number of potentially affected establishments in Chapter Two (see Table 2-14.) The estimate of 148,553 potentially affected businesses was obtained after subtracting 62,400 establishments judged to be primarily engaged in remodeling activities, and 50,661 homebuilding establishments that construct fewer than four homes per year and who were judged unlikely to disturb more than one acre of land on a regular basis. Table 2-14 also reflects the fact that EPA distributed establishments in the land development industry (NAICS 2331) among the four building construction industries (NAICS 23321, 23322, 23331, and 23332) due to data limitations for the land development industry.

For the small entity analysis, EPA was unable to include all of the establishments potentially affected as shown in Table 2-14. In particular, EPA has not included special trades (NAICS 235) in its small entity analysis because the financial data upon which the small entity analysis is based is not available for these industries. EPA does not believe, however, that a substantial number of entities in these industries are NPDES storm water permittees or co-permittees and would therefore not be subject to the proposed rule requirements.

The final distribution of potentially affected establishments used in the small entity analysis is shown in Table 6-2. The total number of *establishments* potentially affected by the proposed rule is 128,782 under Option 1. This is the figure upon which the small business analysis is based.

Table 6-2. Number of Affected Establishments in the Construction and Development Industry

		Option 1		Option 2	
NAICS	**Industry**	**Number**	**Percent of Total**	**Number**	**Percent of Total**
23321	Single-family residential building construction	34,070	26.5%	21,362	18.7%
23322	Multi-family residential building construction	4,603	3.6%	2,699	2.4%
23331	Manufacturing and industrial building construction	7,742	6.0%	7,742	6.8%
23332	Commercial and institutional building construction	39,810	30.9%	39,810	34.9%
23411	Heavy construction	42,557	33.0%	42,557	37.3%
Potentially affected establishments		**128,782**	**67.0%**	**114,170**	**100.0%**

Totals may not add due to rounding.
Source: U.S. Census Bureau (2000a) and EPA estimates. See also Chapter Two, Table 2-14.

6.2.2.2 Number of Businesses Affected

In order to estimate the number of *businesses* affected by the proposed rule, EPA first examined the ratio of businesses to establishments from SBA (1998) data.[5] Table 6-3 shows these ratios.

[5] 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" (Census 2000). A business (or firm) refers to the aggregation of all establishments owned by one company; therefore one business may consist of several establishments.

Table 6-3. Ratio of Businesses to Establishments by Employment Size Class

Employment Class	23321 Single-Family Housing Construction	23322 Multifamily Housing Construction	23331 Manufacturing and Industrial Building Construction	23332 Commercial and Institutional Building Construction	23411 Heavy Construction
1 to 4	1.000	1.000	1.000	1.000	0.999
5 to 9	1.000	0.999	1.000	1.000	0.999
10 to 19	0.999	1.000	0.999	0.998	0.997
20 to 99	0.993	0.994	0.997	0.991	0.991
100 to 499	0.661	0.884	0.973	0.821	0.860
500+	0.203	0.540	0.558	0.327	0.215

Source: SBA (1998).

As seen, the ratio of businesses to establishments is almost one-to-one for all establishments with fewer than 100 employees. With the exception of NAICS 23331 (manufacturing and industrial construction), the ratio of businesses to establishments is significantly lower for establishments employing 100 or more workers. Table 6-4 applies these percentages to the total number of establishments in the four industries to estimate the number of businesses.[6] The overall ratio of businesses to establishments for each industry was then applied to the number of potentially affected establishments within each industry. To illustrate, for the single-family residential construction industry, the estimate of potentially affected businesses is based on the following calculation:

(adjusted no. of affected establishments) * (total businesses/total establishments) = affected businesses

(34,070) * (138,732/138,850) = 34,041 potentially affected businesses

The number of potentially affected businesses was calculated in the same manner for the remaining industries.

[6] The table also shows average revenues per establishment. These results are used in the next step to determine the number of small businesses affected.

Table 6-4. Estimated Number of Businesses by Employment Class, and Revenues per Establishment

Employment Class	Number of Establishments	Ratio of Businesses to Establishments	Estimated Number of Businesses	Estimated Number of Establishments Owned by Multifacility Businesses	Revenues per Establishment (x $1,000)
Single-Family Housing Construction (NAICS 23321)					
1 to 4	106,985	1.000	106,985	0	$412
5 to 9	21,377	1.000	21,372	5	$1,299
10 to 19	7,234	0.999	7,227	7	$2,991
20 to 99[1]	3,022	0.993	2,999	23	$12,073
100 to 499[2]	222	0.661	147	75	$75,923
500+[3]	10	0.203	2	8	$174,764
Subtotal	*138,850*	*0.999*	*138,732*	*118*	*$1,760*
Multifamily Housing Construction (NAICS 23322)					
1 to 4	4,725	1.000	4,725	0	$383
5 to 9	1,456	0.999	1,455	1	$1,474
10 to 19	782	1.000	782	0	$3,612
20 to 99[1]	532	0.994	529	3	$10,692
100 to 499[2]	46	0.884	41	5	$40,855
500+[3]	3	0.540	2	1	$122,949
Subtotal	*7,544*	*0.999*	*7,534*	*10*	*$1,070*
Manufacturing and Industrial Building Construction (NAICS 23331)					
1 to 4	3,136	1.000	3,136	0	$459
5 to 9	1,666	1.000	1,666	0	$1,529
10 to 19	1,261	0.999	1,260	1	$2,926
20 to 99[1]	991	0.997	988	3	$10,891
100 to 499[2]	195	0.973	190	5	$46,414
500+[3]	30	0.558	17	13	$217,247
Subtotal	*7,279*	*0.997*	*7,257*	*22*	*$4,682*
Commercial and Institutional Building Construction (NAICS 23332)					
1 to 4	17,722	1.000	17,718	4	$467
5 to 9	7,644	1.000	7,643	1	$1,490
10 to 19	5,861	0.998	5,850	11	$3,434
20 to 99[1]	5,518	0.991	5,470	48	$12,663
100 to 499[2]	637	0.821	523	114	$77,162
500+[3]	48	0.327	16	32	$342,102
Subtotal	*37,430*	*0.994*	*37,220*	*210*	*$437,317*
Heavy Construction (NAICS 23411)					
1 to 4	4,154	0.9997	4,153	1	$281
5 to 9	1,987	0..9995	1,986	1	$939
10 to 19	1,876	0.9966	1,870	6	$1,998
20 to 99[1]	2,683	0.9907	2,658	25	$7,124
100 to 499[2]	544	0.8601	468	76	$35,823
500+[3]	26	0.2153	6	20	$118,810
Subtotal	*11,270*	*0.9886*	*11,141*	*129*	*$4,301*

Source: Census (2000); SBA (1998).
[1] Combined data from Census 20 to 49 and 50 to 99 employment classes.
[2] Combined data from Census 100 to 249 and 250 to 499 employment classes.
[3] Combined data from all Census employment classes of more than 500 employees.

6.2.2.3 Number of Small Businesses Affected

To determine the number of potentially affected small businesses, the number of potentially affected businesses was multiplied by the ratio of small businesses to total businesses. To estimate the number of small businesses, EPA examined the distribution of revenues per establishment by size of establishment (see last column of Table 6-4). This review concluded that average revenues for establishments below 100 employees in size are consistently below the SBA small business size threshold ($27.5 million per year) while average revenues for establishments above 100 employees consistently exceed the SBA threshold.[7] EPA thus concluded that the number of businesses with 100 or fewer employees would be a good proxy for the number of businesses that fall below the SBA revenue size threshold. Table 6-5 shows the results of this review. EPA estimates there are 95,753 potentially affected businesses (representing 98.6 percent of all potentially affected businesses) that fall below the SBA-defined revenue threshold and that therefore may be considered "small" businesses.

[7] EPA notes that while the SBA threshold applies to businesses not establishments, there are very few multi-establishment businesses in the below 100-employee size classes, therefore the use of average establishment revenues is appropriate.

Table 6-5. Estimated Number of Small Businesses Potentially Affected by the Proposed Rule.

NAICS	Potentially Affected Establishments	Potentially Affected Businesses	Potentially Affected Small Businesses		Small Businesses as a Percent of Total for Individual Industry
			Number	Percent of total	
233210: Single-family housing construction	34,070	34,041	34,004	35.5%	99.9%
233220: Multifamily housing construction	4,603	4,597	4,571	4.8%	99.4%
233310: Manufacturing and industrial building construction	7,742	7,719	7,498	7.8%	97.1%
233320: Commercial and institutional building construction	39,810	39,587	39,013	40.7%	98.6%
23411 Heavy construction	11,270	11,141	10,667	11.1%	95.7%
Total	**97,495**	**97,085**	**95,753**	**100.0%**	**98.6%**

Source: EPA estimates based on methodologies presented in this chapter and in Chapter Four.

6.3 EPA COMPLIANCE WITH RFA REQUIREMENTS

6.3.1 Outreach and Small Business Advocacy Review

In accordance with section 609(b) of the RFA, as amended by SBREFA, EPA convened a Small Business Advocacy Review (SBAR) Panel for the proposed rule. The Panel was convened on July 16, 2001. Panel participants included representatives from EPA, the Office of Information and Regulatory Affairs within the Office of Management and Budget (OMB), and the Office of Advocacy of the Small Business Administration (SBA). "Small Entity Representatives" (SERs), who advised the Panel, included small homebuilders and commercial builders. Throughout the development of these regulations, EPA conducted outreach to small businesses in the C&D industries. EPA held several informational public meetings in 1999 and again in 2001 to provide the public and those in potentially affected C&D industries to learn more about the proposed rule and to voice their questions and concerns.

In addition, several half-day focus group sessions were conducted with members of the National Association of Home Builders (NAHB) in early 2001.

Consistent with the RFA/SBREFA, the Panel evaluated the assembled materials and small entity comments on issues related to the elements of the IRFA. The Panel's activities and recommendations are summarized in the *Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule on National Pollutant Discharge Elimination System (NPDES) and Effluent Limitations Guideline (ELG) Regulations for Construction and Development Activities* (USEPA, 2001), or "Panel Report." This document is included in the public record.

6.3.2 EPA's Initial Regulatory Flexibility Analysis

As required by Section 603 of the RFA, as amended by SBREFA, EPA has conducted an initial regulatory flexibility analysis. The IRFA includes a discussion of the problems the proposed rule will solve, as well as the objectives and legal basis for the proposal. The IRFA also includes a description and estimate of the following:

- Number of small businesses that will be affected;
- The reporting, recordkeeping, and other compliance requirements of the proposed rule;
- Any Federal rules that may duplicate, overlap, or conflict with the proposed rule;
- Any significant regulatory alternatives to the rule that would accomplish the stated objectives of the applicable statutes and minimize impacts to small businesses.

This section addresses each of these requirements of the IRFA that EPA has prepared to support the proposed C&D regulations.

Section 607 of the RFA further notes that the Agency is to "provide either a quantifiable or numerical description of the effects of a proposed rule or alternatives to the proposed rule, or more general descriptive statements if quantification is not practicable or reliable." For this rulemaking, EPA has prepared an economic analysis of the impacts to small C&D businesses. This analysis is provided in

Section 6.4. Additional information and the detailed results of this analysis are presented in Section 6.4.2.

6.3.2.1 Reasons EPA is Considering the Proposed Rule

EPA is proposing effluent limitation guidelines (ELG) for the C&D industry under a settlement agreement with the Natural Resources Defense Council (NRDC). The ELG is an effort to establish performance standards for construction and development projects during active and post-construction phases. This rulemaking is being proposed under Title III of the Clean Water Act (CWA), and was outlined in the Phase II NPDES storm water Final Rule (64 FR 68741) as the next step in the development of the framework of the storm water program. While construction activities disturbing five acres or more land are already subject to NPDES permits and the requirements set forth in EPA's construction general permit (CGP), these permits do not generally contain technology-based requirements for design, inspection, or maintenance of erosion and sediment control (ESC) best management practices (BMPs). The current regulations require permittees to develop a storm water pollution prevention plan (SWPPP) and in that plan to describe any ESCs they will use. The existing regulations do not require that permittees use particular ESCs; actual ESC selection and design is the responsibility of the permittee in conformance with any existing state and local requirements. State and local requirements for ESC design, inspection, and maintenance criteria, if present, vary widely. The purpose of this rule is "to establish nation-wide criteria to support builders and local jurisdictions in appropriate BMP selection" (64 FR 68741).

6.3.2.2 Objectives and Legal Basis for the Proposed Rule

Construction and development (C&D) activity affecting water quality typically involves site selection and planning, and land-disturbing tasks during construction such as clearing, excavating and grading. Disturbed soil, if not managed properly, can be easily washed off-site during storm events. Storm water discharges generated during construction activities can cause an array of physical, chemical and biological impacts. Water quality impairment may result, in part, because a number of pollutants are preferentially absorbed onto mineral or organic particles found in fine sediment. The interconnected process of erosion (detachment of the soil particles), sediment transport, and delivery is the primary pathway for introducing pollutants from construction sites into aquatic systems. A primary concern at most construction sites is the erosion and transport process related to fine sediment because rain splash, rills (small channels typically less than one foot deep) and sheetwash (thin sheets of water flowing across a surface) encourage the detachment and transport of this material to water bodies. Although streams and rivers naturally carry sediment loads, erosion from construction sites and runoff from developed areas can elevate these loads to levels above those in undisturbed watersheds.

Existing national storm water regulations require construction site operators to outline controls to manage construction site runoff, but do not require any specific level of control. One of the options being proposed (Option 2) would establish effluent limitation guidelines in the form of minimum standards for design and implementation of erosion and sediment controls used during the active phase of construction. This approach would cover sites with five or more acres of disturbed land, and would establish minimum requirements for conducting site inspections and providing certification as to the design and completion of various aspects of those controls.

EPA acknowledges that many State and local governments have existing standards for temporary controls. The proposed rule is intended to work in concert with existing requirements where equivalent, and would not supercede more stringent requirements. In addition, EPA is proposing two alternatives that would not set national standards for control of storm water discharges from construction sites subject to permit requirements under section 402 of the CWA. Both of these approaches would rely instead on a combination of existing State and local requirements and additional requirements based on the best professional judgement (BPJ) of the permitting authority. Under one of these alternatives (Option 1), the proposal would establish minimum requirements for conducting site inspections and providing certification as to design and completion of controls required by the permit authority in its NPDES permit. These requirements are similar to the inspection and certification requirements in Option 2. Existing compliance determination practices for construction site storm water controls rely principally on site inspections by local governments, however, enforcement efforts are reported to be uneven nationwide, largely due to limited enforcement resources at the Federal, State and local levels. The inspection and certification requirements in today's proposed rule could strengthen the current permit program.

Under another alternative (Option 3), no new requirements would be established under this option. Both the control requirements and the certification requirements would be left to the best professional judgement of the permitting authority in order to allow them to be better tailored to local conditions. These proposed options are discussed in more detail in sections IX and X of today's notice. At this time, EPA is co-proposing all three options because it sees advantages to each.

This rulemaking is being proposed under Title III of the Clean Water Act (CWA), specifically under the authorities of sections 301, 304, 306, 307, 308, 402 and 501 of the Clean Water Act. Further legal basis for this proposed rule may be found in 33 U.S.C. sections 1311, 1314, 1316, 1317, 1318, 1342 and 1361 and under authority of the Pollution Prevention Act of 1990, 42 U.S.C. 13101 et seq., Pub L. 101-508, November 5, 1990. Chapter One of this report and the preamble to the proposed rule contain more detailed information on the objectives and basis for this proposed rule.

6.3.2.3 Description and Estimate of Number of Small Entities Affected

As presented in Table 6-5, EPA estimates that there are about 97,085 potentially affected C&D businesses nationwide in the four industries discussed in this chapter, of which 95,753 (98.6 percent) are small businesses.[8] Approximately 40 percent of the small businesses are in the commercial and institutional building construction industry and 35 percent are in the single-family residential construction industry. Heavy construction accounts for 11 percent of small C&D businesses, manufacturing and industrial building construction accounts for 8 percent, and multifamily residential construction accounts for 5 percent.

[8] The businesses shown in Table 6-5 excludes those representing 19,771 establishments in Special Trades Contracting (NAICS 235) that are potentially affected by the proposed rule (see Table 2-14), but were not analyzed in this chapter because the financial data upon which the small entity analysis is based is not available for these industries. EPA does not believe, however, that a substantial number of entities in these industries are NPDES storm water permittees or co-permittees, and would therefore generally not be subject to the proposed rule requirements.

6.3.2.4 Description of Proposed Recordkeeping, Reporting, and Other Requirements

The proposed C&D regulations contain recordkeeping and reporting requirements for entities in the C&D industry. In Chapter Five, EPA estimated the costs associated with the additional requirements imposed on C&D establishments as a result of the proposed rule. This section focuses specifically on the costs and burden associated with recordkeeping, reporting and related requirements.

For the purpose of this analysis, "burden" means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust existing procedures to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information request; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

EPA estimated that states would incur some costs related to implementation of the proposed rule. Specifically, general permit development and implementation of the inspection and certification provisions are estimated to require approximately 200 labor hours per state during the first three years of program implementation. See Chapter Five, Section 5.8 for full details.

EPA analyzed costs to government units under the assumption that the majority of Phase I and Phase II storm water NPDES permit programs are fully implemented. Any new regulatory requirements will be incremental to the costs of these programs. The analysis in Chapter Five concluded that once Phase I and Phase II are fully implemented by communities, the proposed rule will not add any additional burden to government units.

The current NPDES storm water permitting authority defaults to the state level except where places are large enough to qualify as Phase I (medium and large MS4) or Phase II (small MS4) communities. Since permitting authority, and thus permitting costs, will affect only Phase II or larger communities, and since EPA's analysis indicates no incremental impacts to Phase II or larger communities, EPA does not expect smaller government units to be adversely impacted by the proposed rule. Therefore no additional analysis was conducted to assess the impacts of the proposed rule on small government entities.

A significant new requirement for construction firms contained in both Option 1 and Option 2 would be maintenance of a site log book. The site log will record the date of initial groundbreaking and any inspection or maintenance activities related to erosion and sediment control. The availability of the log must be posted on the site and the log must be made available to government inspectors and the public. This is a record-keeping requirement only and no information will be collected. EPA estimates that site log will require 8.7 hours per year for each construction firm respondent. EPA further assumes that all recordkeeping tasks will be performed by an engineering assistant. The fully loaded hourly wage for the engineering assistant labor category in the construction industry, based on data from the U.S. Department of Labor, Bureau of Labor Statistics, is $38.47 per hour. Thus, the 8.7 hours per year burden implies an average annual cost of $335 for each firm. Since there are an estimated 95,753 small firms subject to Option 1, the annual cost of the site log requirement is $32.07 million. This is the largest portion of the inspection costs discussed in Chapter Five. Since Option 2 excludes firms disturbing less than five acres each year from the site log requirement, the total costs of this requirement to small business will be reduced.

6.3.2.5 Identification of Relevant Federal Rules That May Duplicate, Overlap, or Conflict with the Proposed Regulations

EPA has analyzed the potential impacts of the proposed rule under the baseline assumption that all C&D activities are in compliance with existing federal and state regulations affecting C&D operations, including Phase I and future Phase II NPDES storm water regulations. Neither EPA nor the Small Business Advocacy Review Panel identified any federal rules that duplicate or interfere with the requirements of the proposed rule (USEPA, 2001).

6.3.2.6 Significant Regulatory Alternatives

The proposed rule retains the coverage of the Phase II NPDES storm water permitting program, which excludes construction activities that disturb less than one acre of land. EPA believes that this exclusion alleviates the potential compliance burden for small-scale builders who operate independently and who work on very few (and relatively small) projects in a given year.[9] EPA believes that larger plans of development and individual construction projects that disturb a total of more than one acre are more likely to contribute to increased storm water runoff and erosion problems than activities disturbing less than one acre. In addition, activities disturbing less than one acre are more likely to be dispersed, thus decreasing the concentration of adverse effects.

Additionally, under Option 2 of the proposed rule construction sites disturbing less than 5 acres would be excluded. EPA believes that a substantial share of activity on sites between one and five acres in size may also be undertaken by small-scale builders. This broader exclusion, therefore, would potentially reduce compliance burdens for more small-scale builders by exempting them from additional requirements.

EPA considered additional options that would, for example, exempt construction activities taking place on sites of ten acres or less. EPA was unable, however, to identify data to suggest that exempting sites under ten acres from the requirements of the proposed rule would produce substantial additional relief to small entities. In fact, EPA found evidence that even the largest home builders operate on sites in this size range (Otsuji, 2001).

Waivers for construction activities occurring in areas with low erosion potential remain in place from the Phase II NPDES storm water Final Rule. Under Phase II such waivers may be granted where little or no rainfall is expected during the period of construction. Qualification for this waiver may be determined using the tables of rainfall-runoff erosivity (R) factors published for each region of the U.S. by the Department of Agriculture (64 FR 68774). In addition, EPA has taken regional climate factors into account throughout the development of this proposed regulation and has built a sizeable amount of

[9] Note that as in the Phase II NPDES storm water rule, this exclusion does not apply to development activities disturbing less than one acre that are part of a larger development plan (64 FR 68772-68773).

flexibility into the rule to allow permittees to choose appropriate controls based on their particular site characteristics.

6.4 EPA'S ANALYSIS OF SMALL BUSINESS IMPACTS

The following sections describe the methodologies and results for the economic impact analysis of the proposed rule on small businesses in the C&D industry.

6.4.1 Classification of Model Facilities for Impact Analysis

For its economic impact analysis, EPA used model facilities based on Census data, however, these facilities are not identical to the *1997 Census of Construction* data. This section describes how EPA applied its analysis of small business-owned establishments to the model facilities used in the impact analysis.

In the single-family and multifamily housing construction industries, (NAICS 233210 and 233220, respectively), EPA used multiple model facilities based on the number of housing starts performed by the establishment per year for its economic impact estimates. EPA compared the model facility data by starts class with both the *1997 Census of Construction* data by employment class and the SBA size standard for small business status. Table 6-6 presents key model facility data by starts class.

Table 6-6. Key Model Facility Data by Housing Starts Classification Category

Number of Units Started	Average Number of Employees	Average Value of Construction Work ($1,000)
NAICS 233210 Single-Family Housing Construction		
1 to 4	2.5	$492
5 to 9	3.3	$1,089
10 to 24	4.3	$1,987
25 to 99	8.6	$4,923
100 to 499	32.1	$24,031
500+	160.0	$109,033
NAICS 233220 Multifamily Housing Construction		
2 to 9	3.2	$645
10 to 24	5.1	$1,382
25 to 99	8.0	$3,500
100 to 499	13.5	$7,410
500+	64.7	$43,844

Source: EPA estimates based on Rappaport and Cole (2000).

Single-family housing construction establishments with 100 to 499 starts per year employ, on average, 32 workers per establishment and earn $24 million in revenues. Establishments with fewer starts tend to employ fewer workers and have lower average revenues. Conversely, establishments with more than 500 starts per year employ on average 160 workers and earn revenues in excess of $109 million per establishment.

Multifamily housing construction establishments with 100 to 499 starts per year employ, on average, 13.5 workers per establishment and earn $7.4 million in revenues. Establishments with more than 500 starts per year employ on average 65 workers and earn revenues of $44 million per establishment. Although average employment per establishment in the 500+ start class does not exceed 100 workers, employment per establishment in that class is almost five times larger than the 100 to 499 starts class.

The natural break points in the employment and revenue per establishment data by housing start class match reasonably well with those from the *1997 Census of Construction* data described in Section 6.2.2. Therefore, for the purpose of this analysis, EPA assumes that model facilities with fewer than 500 housing starts per year in both the 233210 and 233220 NAICS codes are small business-owned establishments, and model facilities in the 500+ starts class represent large business-owned establishments. Note that based on *1997 Census of Construction* figures by employment class, EPA estimated 99.8 percent of establishments in NAICS 233210 and 99.4 percent of establishments in NAICS 233220 overall are small business-owned. Based on the Census *Housing Starts Statistics* special study, EPA estimated that 99.7 percent of establishments in NAICS 233210 and 98.4 percent of establishments in NAICS 233220 overall are small business-owned.[10]

To estimate the number of small business-owned facilities affected by the proposed C&D effluent guideline, EPA first projected impacts for each model facility and extrapolated those to the establishments represented by the model. If the model facility has fewer than 500 starts per year, then all impacts to establishments represented by that facility are incurred by small businesses; impacts to establishments represented by the model facility for the 500+ starts class are incurred by large business-owned establishments.

In the manufacturing and industrial, commercial and institutional, and heavy construction industries, (NAICS codes 233310, 233320, and 23411, respectively), a single model facility was used for the economic impact analysis. Selection of the model facility for each industry was based on median revenue by employment class. Because EPA used a single model facility in each of these industries, it is not appropriate to designate the model facility as owned by a small or large business. Therefore, EPA calculated the percent of establishments that are small business-owned, as estimated from the *1997 Census of Construction*, and applied that percentage to all impacts to estimate small business impacts. For example, approximately 97 percent of establishments in NAICS 233310 are small business-owned.

[10] Small differences arise in estimating the percentages of total establishments in the industry that are small business-owned because of differences in how the data is arranged. SBA sets its definition of "small" by firm revenues. However, the Census data available to EPA is arranged by employment class, not revenues, while data in the Census special study used to develop model establishments is arranged by starts class, not revenues or employment. Thus minor discrepancies in percentages that are insignificant to the analysis will occur.

If 100 establishments in that NAICS code are projected to incur compliance costs exceeding one percent of revenues, EPA assumes that 97 of those establishments are small businesses.

6.4.2 Revenue Test Methodology

EPA assessed the impacts to small businesses by examining the ratio of estimated compliance costs to business revenues. Impacts are determined by the number and percentage of businesses incurring costs that exceed one percent and three percent of revenues.

EPA's primary tool for projecting revenue test impacts is the model facility. For each model facility, it is straightforward to divide estimated business-level compliance costs by model facility revenues. However, that answers only part of the question concerning the impact of the proposed regulation on small business entities. To determine the number and percentage of businesses exceeding the revenue test thresholds, EPA must consider not only the model facility, but the businesses represented by that model as well. The model facility actually represents a set of approximately similar businesses (e.g., similar levels of employment within some bounded range) with revenues that form a statistical distribution around the model facility's revenue figure. Some businesses in this statistical distribution will have revenues below those of the model business while others will have revenues above those of the model business. Therefore, simply examining the ratio of compliance costs to revenues for the model business is insufficient. If, for example, the model facility incurs compliance costs that are less than one percent of revenues, a conclusion that no businesses are affected by the regulation is unwarranted. It is highly likely that other businesses represented by the model have lower revenues and therefore may well incur costs exceeding one percent of revenues.

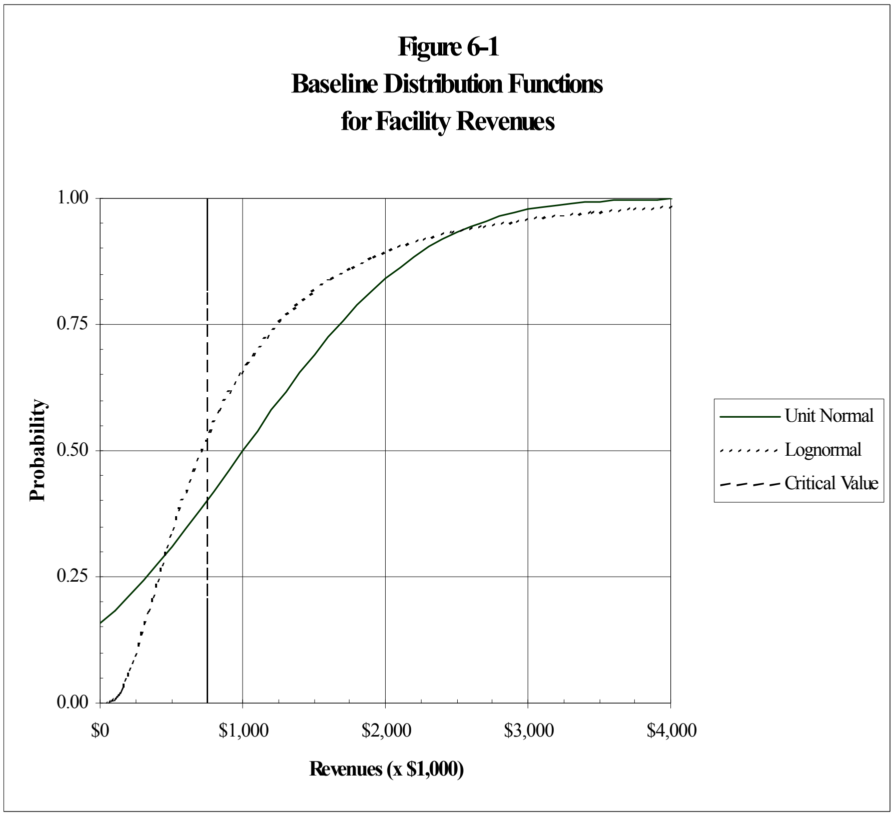
To address this issue, EPA developed estimates of the statistical revenue distribution of establishments represented by each model facility.[11] EPA then used those distributions to estimate the number and percentage of small business-owned establishments in each industry that incur compliance costs exceeding one and three percent of revenues. EPA used model facility revenues for the mean of

[11] As described in Section 6.2.2 above, EPA determined that in the construction industry, the small business is essentially identical to the small business-owned establishment.

each distribution, but had no direct information concerning the dispersion of establishment income around each model facility. EPA therefore developed the distributions by making reasonable assumptions about the variance and shape of the distribution. In order to deal with the uncertainty caused by the lack of direct evidence about the shape of the distribution, EPA used two different assumptions about the distribution of revenues to generate a range of impacts.

6.4.2.1 Development of Revenue Distributions

The two curves in Figure 6-1 represent the cumulative distribution functions for two different sets of assumptions concerning the distribution of establishment income around a hypothetical model facility mean of $1.0 million in annual revenues. The cumulative distribution function is used to determine the probability *y* that a random variable *x* is less than or equal to some specified value. It is appropriate to use the cumulative distribution function for this application because EPA is concerned with the probability that an establishment earns less than some specified level of revenues. For example, suppose estimated establishment compliance costs for this model facility class are equal to $15,000. Any establishment in this model facility class that earns revenues less than $1.5 million will incur compliance costs that exceed one percent of revenues. Thus, EPA would use the cumulative distribution function to estimate the probability that a facility earns revenues of $1.5 million or less.



As a starting point for its analysis, EPA examined the implications of assuming that income is normally distributed and has a standard deviation equal to the mean. That is, the coefficient of variation (standard deviation divided by mean) for this distribution is equal to one. In Figure 6-1, this is represented by the curve labeled "unit normal." An implication of the unit normal distribution for this analysis is that some establishments are projected to earn negative revenues. This can be observed by examining the y axis; the unit normal distribution assumption results in about a 15 percent probability of an establishment earning negative revenues. While negative income (e.g., net income, cash flow) is both possible and plausible for a business establishment, negative revenue is not.[12]

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[12] EPA examined an alternative assumption that income is normally distributed, but with standard deviation such that there was zero probability of an establishment earning negative revenues. This adjustment results in a coefficient of variation equal to about 0.29. EPA determined that this was probably not a reasonable distribution for use in this analysis because the probability of an establishment earning low revenues is quite small. For example, using the hypothetical mean revenues of $1 million, the probability of an establishment earning revenues less than $500,000 is only about 5 percent; the probability of an establishment earning revenues between $500,000 and $1.0 million is about 45 percent.

EPA then examined the implications of using a lognormal distribution. EPA estimated the mean and standard deviation for the lognormal distribution through a standard transformation of the mean and standard deviation of the unit normal distribution. Using this transformation, the lognormal distribution can be interpreted as having the same mean and standard deviation as the equivalent unit normal distribution, but a skewed distribution (unlike the normal distribution, which is symmetric). In Figure 6-1, for example, the probability of establishment revenues less than or equal to $1.0 million is 50 percent under the unit normal distribution assumption, as is the probability of revenues greater than $1.0 million. Under the lognormal distribution assumption, about 66 percent of establishments have income less than or equal to $1.0 million, and about 34 percent have income greater than $1.0 million.

The distribution of establishment revenues may be skewed because it is probable — but infrequent — that some establishments in any model class will perform extremely well and earn very high revenues relative to other establishments; there is no inherent limit to the revenues such an establishment might earn. Conversely, there is a limit to the minimum revenues even the poorest performing establishments will earn; poor performers cannot earn less than zero revenues. Such a distribution would tend to be skewed as is the lognormal distribution in Figure 6-1.

6.4.2.2 Application of Revenue Distributions to Estimating Small Business Impacts

Given the revenue distributions developed in the preceding section, EPA applied the distributions to the problem of estimating revenue test impacts as follows. First, EPA used revenues for each model facility from the four major construction industries (single-family, multifamily, manufacturing and industrial, commercial and institutional) as the mean of the distribution for each model class. EPA then set the standard deviation for each model class' distribution equal to its mean. With mean, standard deviation, and two alternative assumptions concerning the shape of the distribution (normal or lognormal), EPA calculated the probability that revenues are less than or equal to any given value for each model class.[13]

After estimating the compliance costs per establishment for each option, EPA calculated the level of revenues at which the estimated compliance costs would exactly equal one percent and three percent of revenues. EPA then used its two distributions to calculate the probability that establishments have revenues less than or equal to these specified levels. These probabilities provide the range for the percentage of establishments projected to incur compliance costs exceeding the one percent and three percent thresholds. Multiplying these probabilities by the number of establishments in the model class provides the range for the number of establishments projected to incur compliance costs exceeding the one percent and three percent thresholds. Note that EPA chose to truncate the unit normal distribution at zero revenues; EPA calculated the probability that establishments earn revenues equal to the specified one or three percent threshold for incurring impacts. This is because analytically the region of the distribution showing some probability of negative revenues cannot be appropriately evaluated.

This process is illustrated in Figure 6-1. The hypothetical model establishment earns $1 million, the mean for each distribution. If EPA estimates annual compliance costs of $7,500 will be incurred by this business, then any business in this model class earning less than $750,000 will incur compliance costs exceeding one percent of revenues, and any business earning less than $22,500 will incur compliance costs exceeding three percent of revenues. The "critical value" in Figure 6-1 represents the one percent threshold (i.e., revenues of $750,000). Based on the normal distribution, EPA would project that 22 percent of establishments incur costs exceeding the one percent threshold (i.e., the probability of revenues less than $750,000 is equal to 0.38, while the probability of revenues less than $0 is equal to 0.16, thus, the net probability equals 0.22). Based on the lognormal distribution, EPA would project that 54 percent of establishments incur costs exceeding the same threshold. These provide the lower and upper bounds for EPA's impacts estimates.

[13] For calculation purposes, EPA used the @NORMAL and @LOGNORMDIST functions in the Lotus spreadsheet program.

6.4.3 Small Business Impact Analysis Results

Tables 6-7a and 6-7b present the range of establishments projected to incur compliance costs exceeding one percent and three percent of revenues, respectively, for each proposed ESC option under a zero percent cost pass through assumption. Tables 6-7c and 6-7d present the same results under an estimated cost pass through assumption. In each table, the "A" denotes the results obtained assuming a normal distribution and the "B" indicates the results obtained using the lognormal distribution, as discussed in Section 6.4.2.

The number of small business-owned establishments incurring compliance costs exceeding the revenue threshold is less than one percent for all options and project types under the zero CPT assumption. Impacts under the estimated CPT assumption are even smaller. Under the zero CPT scenario, the number of small businesses with costs exceeding one percent of revenues ranges from a low of 0 to 126 under Option 1 and from a low of 104 to a high of 627 under Option 2 (Table 6-7a). The number of businesses with costs exceeding three percent of revenues ranges from a low of 0 to a high of 42 under Option 1 and from a low of 0 to a high of 205 under Option 2 (Table 6-7b).

Under the estimated CPT scenario, the number of small businesses with costs exceeding one percent of revenues ranges from a low of 0 to 15 under Option 1 and from a low of 0 to a high of 70 under Option 2 (Table 6-7c). The number of businesses with costs exceeding three percent of revenues ranges from a low of 0 to a high of 5 under Option 1 and from a low of 0 to a high of 24 under Option 2 (Table 6-7d).

Table 6-7a. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 1 Percent of Revenues Zero Percent Cost Pass Through

	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	47	0.000%	0.138%	0	5	0.000%	0.110%	0	62	0.000%	0.159%
2	40	140	0.118%	0.412%	8	18	0.175%	0.395%	18	234	0.046%	0.599%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	12	0.000%	0.160%	0	0	0.000%	0.000%	0	126	0.000%	0.000%
2	2	36	0.270%	0.480%	36	199	1.863%	0.337%	104	627	0.109%	0.109%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates based on methodologies presented in this chapter and in Chapter Four.

Table 6-7b. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 3 Percent of Revenues Zero Percent Cost Pass Through

	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	15	0.000%	0.044%	0	2	0.000%	0.044%	0	21	0.000%	0.054%
2	0	45	0.000%	0.133%	0	6	0.000%	0.132%	0	77	0.000%	0.197%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	4	0.000%	0.053%	0	0	0.000%	0.000%	0	42	0.000%	0.044%
2	0	12	0.000%	0.160%	0	65	0.000%	0.607%	0	205	0.000%	0.214%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates based on methodologies presented in this chapter and in Chapter Four.

Table 6-7c. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 1 Percent of Revenues Estimated Cost Pass Through

Option	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	7	0.000%	0.021%	0	0	0.000%	0.000%	0	6	0.000%	0.015%
2	0	20	0.000%	0.059%	0	1	0.000%	0.022%	0	24	0.000%	0.061%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Option	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	2	0.000%	0.027%	0	0	0.000%	0.000%	0	15	0.000%	0.016%
2	0	6	0.000%	0.080%	0	19	0.000%	0.178%	0	70	0.000%	0.073%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates based on methodologies presented in this chapter and in Chapter Four.

Table 6-7d. Estimated Number of Small Business-Owned Establishments With Compliance Costs Exceeding 3 Percent of Revenues Estimated Cost Pass Through

	Single-family				Multifamily				Commercial			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	2	0.000%	0.006%	0	0	0.000%	0.000%	0	2	0.000%	0.005%
2	0	7	0.000%	0.021%	0	0	0.000%	0.000%	0	8	0.000%	0.020%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%
	Industrial				Heavy				TOTAL			
	Number		Pct. of Small Businesses		Number		Pct. of Small Businesses		Number		Pct. of Small Businesses	
Option	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1	0	1	0.000%	0.013%	0	0	0.000%	0.000%	0	5	0.000%	0.005%
2	0	2	0.000%	0.027%	0	7	0.000%	0.065%	0	24	0.000%	0.025%
3	0	0	0.000%	0.000%	0	0	0.000%	0.000%	0	0	0.000%	0.000%

Source: EPA estimates .

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CHAPTER SEVEN
BENEFITS METHODOLOGY

Previous chapters have considered the costs of implementing the proposed regulations and their effect on the industry, markets, and economy. Those chapters discussed the negative impact of the regulation on the national economy but the purpose of the regulation is to benefit the nation by improving water quality and the environment. These benefits can be measured in economic terms and balanced against the costs of implementing the proposed rule. This chapter reviews previous benefits assessments for similar regulations to develop a methodology for measuring the benefits of the proposed construction and development regulation.

7.1 PREVIOUS APPROACHES TO BENEFITS ASSESSMENT

Two basic approaches are used to measure the economic benefits of a policy change. In the "top-down" approach, the analyst defines the total benefits of an improvement (or avoidance of degradation) brought about by some policy action or combination of actions, and posits a means of scaling the benefit to the size and scope of the action. The overall benefits of the proposed action can then be calculated. The alternative, "bottom-up" approach enumerates the pathways through which society derives value from the environmental consequences of the proposed action and estimates that value. Reducing sediment runoff, for example, reduces the potential need to dredge navigation channels. A bottom-up approach makes the connections from changes at the sediment source to deposition in the harbor to the savings to society from reduced dredging costs. The following sections establish a framework for development of bottom-up methods to estimate benefits of the proposed construction and development rule.

A prominent study of the benefits of reducing sediment in waterways is Ribaudo's *Water Quality Benefits from the Conservation Reserve Program* (Ribaudo, 1989). For benefit categories where there is sufficient information, Ribaudo carefully links soil loss to water quality measures and benefit values. For other categories, where he has estimates of total damage costs, he assumes that reductions in sediment discharge will lead linearly to similar reductions in damage costs. Fox, et al. (1995) suggest that the relationship between sediment loading and water quality is not linear but S-shaped. At high sediment loadings, incremental reductions in sediment discharge may have essentially no effect on water quality. At very low loadings, incremental reductions may actually be harmful for some purposes. Some fish, for example, prefer some sediment in the water column. The linearity assumption presumes that starting sediment loads are in the middle section of the S-curve. This may or may not be valid for a particular location and benefit category but is probably a reasonable working assumption.

In maintaining the connection from physical effects of the policy to changes in welfare, bottom-up approaches offer the opportunity to assess different policy options, if they can be well-described and have discernible effects. The connections, however, are only as good as the research upon which they are based. Poor connections may be bridged with reasonable assumptions. However, weakness at any level compromises the credibility of the results.

7.2 BENEFITS CATEGORIES CONSIDERED

The Environmental Assessment for the proposed rule (EPA 2002b) accomplishes the first two or three steps of Ribaudo's process. The assessment estimates the sediment loads avoided by implementation of the proposed regulation. Sediment load can be linked to services society values and therefore to benefit categories.

EPA used a model watershed approach to estimate the impacts of development on water quality. Several studies in Maryland and Pennsylvania provided the basic reference information for what occurs in a watershed as the landscape is developed. Attention focused on increased sediment loads from construction sites. These case studies were then generalized using appropriate adaptations to different weather, slope, and soil conditions in different regions of the country. Table 7-1 summarizes the categories of information developed in the baseline environmental assessment and the categories of benefits which they were used to estimate.

Table 7-1. Environmental Measures from the Baseline Environmental Assessment

Environmental Effect	Units	Benefit Category
Settleable Solids	Total tons per Year	Dredging
Turbidity Producing Solids	Total tons per Year	Treatment/Dredging

The theoretically correct benefit measure is the change in producer and consumer surplus ensuing from a change in environmental quality. As most environmental changes entail non-market goods, such as clean air and water, demand functions cannot be readily estimated. Economists instead use the fact that environmental externalities impose costs on the public to estimate benefits. Most benefit assessments in the soil conservation context use the costs of avoiding the consequences of the environmental harm as a proxy for the correct benefit measures. It can be shown that averting costs are a lower bound on the correct welfare measures (Laughland, et al., 1996). Whether averting costs are a near or distant lower bound depends on how closely the product of the averting process substitutes for the actual environmental good. Most of the studies cited below rely on avoided cost measures which should be considered a lower bound benefit estimate.

Although benefits are measured in terms of avoided costs, whether those costs are actually incurred or not is largely irrelevant. The measures indicate society's willingness to pay for the environmental change or the utility lost due to the change. If a reservoir fills with sediment, for example, the community has lost water storage capacity. Whether or not it chooses to replace the lost capacity depends on budget constraints and other priorities. Nevertheless, the community has lost some of the utility of the resource. If it is not replaced, the loss of utility may be exacted from the community in other ways such as increased flood damage or water shortages. Thus, the avoided costs should be viewed as the opportunity cost of failing to control sedimentation rather than as a budgetary saving for the responsible agency.

The following sections review benefit categories suggested for this analysis and used in other assessments. For each category we discuss the methods, units, and results of prior studies and EPA assessments. We also describe the methods used to assess the benefits of the proposed ESC controls for each category.

7.2.1 Decreased Erosion and Sediment Generation

Faster run off from construction sites and impervious surfaces has ill effects on stream sediment and structure both upstream and downstream in the watershed. Upstream, faster run off cuts into streambanks and adds to the sediment load. Downstream, additional sediment settles out when flows slow or reach larger water bodies. Some of the sediment is suspended degrading water quality. The benefits of reducing suspended sediment are discussed in Section 7.2.2. In this section we discuss the benefits of reducing larger sediment particles which contribute to sedimentation of water bodies.

7.2.1.1 Water Storage Capacity

People impound water for many reasons. Reservoirs supply municipal water systems and mitigate the rising waters of floods. Flow control structures on large rivers enhance navigation. When any of these impoundments fill with sediment, they are less capable of fulfilling their purpose. Ribaudo (1989) cited an estimate by Crowder (1987) that 820,000 acre-feet of water storage capacity are lost to anthropogenic sources annually. Thus, there is a benefit in reducing the amount of sediment that flows into these impoundments. Ribaudo estimated the benefits as the costs of constructing replacement reservoirs and assumed that a one percent reduction in sediment discharge would result in one percent lower replacement costs.

An alternative approach would estimate the connection from stream bank and overland erosion to sediment movement to reservoirs to the need to maintain water storage capacity. The Environmental Assessment estimates the total tons of sediment moved from stream bank and overland erosion. This total volume affects both water storage capacity in reservoirs and the need for dredging of navigational channels. The estimate of total sediment volume can be allocated to these two categories as well as to other fates, such as redeposition along watercourses. For example, the regional capacity of reservoirs compared to the total capacity of water bodies indicates the proportion of sediments settling in lakes that would be subject to dredging. Similarly, the number or area of navigational channels maintained in the region compared to natural outlets could indicate the proportion of sediment that would need to be removed from channels. Given the animus against new water projects in the current policy climate, construction of replacement water storage capacity is unlikely so all benefits from sediment reduction in this category are valued at the average cost of dredging.

Table 7-2 illustrates such an application using the stream bank erosion figures from the Environmental Assessment. The U. S. Army Corps of Engineers' (USACE) National Inventory of Dams indicates that the surface area of reservoirs behind dams represent 35.2 percent of the water area of the nation (USACE 2001). EPA adopted this percentage as an estimate of the proportion of sediment generated from construction sites that would reach constructed water bodies. The tonnage deposited is converted to cubic yards based on 1.82 cubic yards per ton (Sohngren and Rausch, 1998a). Sohngren and Rausch (1998a) estimate the variable costs of dredging as $2.10 per cubic yard which is in the same range as USACE estimates. As discussed in Section 7.2, the avoided costs should be viewed as the opportunity cost of failing to control sedimentation rather than as a cost saved by reducing the volume to be dredged. Whether the dam owner chooses to remove the sediment or not is irrelevant. Sedimentation reduces the social utility of the resource. Multiplying these factors together yields an estimate of the benefits of reduced sedimentation.

Table 7-2. Sample Calculation of Avoided Loss of Water Storage Capacity

			Row:Formula
Effect of regulation on sediment load (tons per year)		11,000,000	*1*
Allocation to Water Storage Facilities			
		Tons	
Amount of sediment reaching reservoirs	35.2%	3,872,000	*2: 1×0.352*
Tonnage expressed in cubic yards		7,047,000	*3: 2×1.82*
Cost of restoration dredging per cubic yard	$2.10		*4*
Total cost of re-dredging avoided annually		$14,799,000	*5: 3×4*

Sources: U.S. EPA, 2002a

7.2.1.2 Navigational Dredging

River channels and harbors are dredged periodically to maintain a mandated depth. Much of the sediment removed can be traced to human activities. According to the USACE, more than 400 ports and 25,000 miles of navigation channels (USACE 2002a) are maintained in the U. S. There are two kinds of dredging operations performed, construction, or new, dredging and maintenance dredging. Construction dredging involves the removal of sediments not previously disturbed in order to create a new channel, or to enlarge an existing channel. Maintenance dredging is the removal of extra sediment in an existing waterway (USACE 2002a).

Both the USACE and members of industry participate in dredging activities under the USACE Dredging Program. Under this program, industry and the Corps combined spent $494 million on maintenance dredging work and $127 million on new dredging work, for a total of $622 million in 1997. This activity removed 253 million cubic yards of material for maintenance and 32 million cubic yards for new work, combining for a total of 285 million cubic yards dredged (USACE 2002b). Based on this data, the average cost per cubic yard is $1.95 for maintenance dredging, $3.97 for new work, and $2.18 for both new and maintenance dredging work.

Relatively little of the sediment dredged from navigation channels comes from urban development. The totals above represent material deposited by all forms of sedimentation. EPA has estimated that the proposed rule would keep 0.6 to 2.6 million cubic yards from reaching navigational channels. This is less than one percent of the annual amount dredged under the USACE Dredging Program and an even smaller proportion of the total amount dredged in the U.S. annually.

Dredging costs have been used to estimate the benefits of sediment reduction in several other studies. Ribaudo (1989) assumed directly proportional reductions between erosion and dredging costs and used an estimate from Clark et al. (1985) for total dredging costs attributable to eroding soils. Sohngren and Rausch (1998b) looked specifically at the Maumee River watershed in Ohio. The marginal cost of dredging contaminated sediment there were quite high as an existing confined disposal facility for contaminated dredge spoil was near its capacity. This necessitated construction of a new facility. Sohngren and Rausch (1998a) make the connections from farm field to harbor and estimate that 12.7 percent of soil eroded off fields in the watershed ends up in the navigation channel.

As discussed in the water storage capacity section, the sediment load deposited in navigation channels can be estimated and average costs per ton dredged applied to estimate avoided costs from policy alternatives. The starting value is the change in sediment delivered to waterways. This value is taken from the Environmental Assessment. Table 7-3 shows an allocation of this sediment to navigation channels using Sohngren and Rausch's (1998a) estimate of the proportion of sediment reaching navigation channels, 12.7 percent. The Sohngren and Rausch estimate is probably relatively high, as the Maumee River which they studied flows into Toledo harbor. Many rivers do not flow to developed, commercial harbors. Variable cost avoided is the appropriate metric for this application as the regulation is unlikely to prevent dredging operations entirely since other sources of sediment will continue to flow. Sohngren and Rausch (1998a) estimate the variable costs as $2.10 per cubic yard. This agrees well with the $2.18 per cubic yard estimated from USACE data above.

Table 7-3. Sample Calculation of Avoided Navigational Dredging

		Row:Formula
Effect of regulation on total erosion (tons per yr)	11,000,000	*1*
Allocation to Navigational Channels		
Assume 12.7 percent reaches maintained channel (tons per yr)	1,397,000	*2: 1×0.127*
Amount of sediment to be dredged annually in cubic yards	2,543,000	*3: 2×1.82*
Variable cost per cubic yard	$2.10	*4*
Total avoided cost of navigational dredging	$5,339,000	*5: 3×4*

Sources: Sohngren and Rausch, 1998a, and U.S. EPA, 2002a.

7.2.2 Reduced In-Stream TSS and Sediment Concentration

Sediment and other components of storm water runoff contribute to low water quality in receiving waterways. If these waterways are used for public water supplies or industrial processes, the water may need treatment before it is used. Excessive sediment in the water causes turbidity which impedes the action of disinfectants and results in harmful disinfectant by-products. Conventional filtration and flocculation removes the turbidity before further treatment processes. The worse the intake water's quality the more intense and expensive the treatment required. Three studies in the late 1980's and one in 1998 estimated the elasticity of water treatment costs with respect to the turbidity of the intake water. The studies used a hedonic method. Dearmont, et al. (1998), for example, regressed the costs of chemicals for treatment on turbidity of intake water and other variables for a sample of Texas water treatment facilities. They found that a one percent reduction in nephelometric turbidity units (NTUs) in the intake water resulted in 0.27 percent reduction in treatment chemical costs. Similar elasticities from other studies ranged from 0.07 percent (Holmes, 1988) to 0.333 percent (Moore and McCarl, 1987). Ribaudo (1989) used Holmes' (1988) results to link total suspended solids (TSS) to turbidity to treatment costs per gallon for watersheds nationwide. Different studies express their results in various units corresponding to different points in the water use process. Sohngren and Rausch (1998b) do not describe their methods but estimate that water treatment costs are $0.05 for each ton of gross soil erosion. Fox and Dickson (1990) express their results in terms of sediment in waterways, i.e. tons of suspended sediment, and find a cost of $13.44 (Canadian) per ton. The two plus orders of magnitude difference between these estimates makes sense if only 1 out of 250 tons of soil eroded became suspended sediment. Fox and Dickson (1990) adjust their cost estimate based on the probability of the suspended sediment from their three sample watersheds reaching water treatment plants given the geography of the region.

The EPA assessment of the benefits and costs of President Clinton's Clean Water Initiative (U.S. EPA, 1994) estimated that improved water quality would reduce nationwide treatment costs by 1 to 5 percent; storm water was a source of 6.6 percent of the impairment. The nationwide avoided costs from improved storm water quality were estimated as $3.2 to $17.0 million per year.

The Environmental Assessment estimates the TSS loadings reductions from ESC management. EPA estimates water treatment benefits from reducing TSS loadings by taking a derivative from Holmes' (1988) equation which shows the change in NTU from changes in sediment loads, given stream flow, and water storage capacity. Values for assumptions about stream flow, storage capacity and costs of processing intake water are taken from Holmes (1988). The literature contains a range of NTU-to-cost elasticities from 0.07 to 0.333. Using this range of elasticities generates the range of benefit estimates from $22.49 to $106.97 per 1,000 tons of sediment introduced into waters. Holmes' costs were reported in 1984 values. Updating these values to 1997 price levels using the CPI for urban consumers (CPI-U in 1984=103.9, CPI-U in 1997=160.5) yields values of $34.74 and $165.24 per 1,000 tons in 1997 dollars.

Table 7-4. Sample Calculation of Avoided Water Treatment Costs

			Row:Formula
Change in annual TSS (1,000 tons/yr) after development from pre-development levels	2,000		*1*
	Low	High	
Calculated range of treatment costs per 1,000 tons/yr	$34.74	$165.24	*2*
Range of changes in costs[b/]	$69,480	$330,480	*3:1×2*

Sources: Holmes, 1988, and U.S. EPA, 2002a.

7.2.3 Non-Quantified Benefits

Several categories of benefits discussed in other studies were considered for this benefit assessment. For the most part, the benefits expected to be derived from these categories are relatively small and difficult to quantify. Rather than expend inordinate resources to quantify small benefits, EPA focused on the more promising, larger categories.

7.2.3.1 Water Contact Recreation

One of the salutary effects of improved water quality is wider opportunities for water contact recreation. Ribaudo and Young (1989) used a criteria-based approach to estimate the benefits of improved water quality on recreation. They established levels of suspended sediment, nitrogen, and phosphorous which would show whether or not the water body was safe for swimming. They then estimated the changes in runoff and ensuing change in water quality indicator levels to assess whether the program being considered would bring the water body within the criteria for swimmable waters. Ribaudo and Young found that the changes in erosion they assessed were too small to result in any water quality changes that would upgrade the receiving waters' status. So there were no water-based recreation benefits attributable to the program.

Feather and Hellerstein (1997) took a different approach. They used information from the National Resource Inventory and National Survey of Recreation and the Environment to estimate a direct relationship between soil loss and consumer welfare from water-based recreation. They were able to estimate improvements in recreation consumer surplus from erosion reductions from alternative agricultural practices.

While the ESC regulations would reduce TSS loadings, they are not expected to affect many of the other water quality indicators that preclude water contact recreation. Like the Ribaudo and Young study, estimation of recreation benefits could consume a great deal of analytical resources and not generate any measurable benefits.

7.2.3.2 Biodiversity Effects

Excess sediment can play havoc with natural stream ecosystems. Salmon and trout lay their eggs in scrapes on sand or gravel substrates. Flowing sediment can bury the eggs and prevent their hatching. Similarly, mussel beds can be buried by excessive sediment movement, smothering the mussels. Even relatively small sediment loads may become harmful during storm events when bed loads shift rapidly. More than half of the freshwater mussel species in the U.S. are imperiled or already extinct (Stein and Flack 1997). It is difficult to quantify either the value society places on preservation of endangered species or the contribution the proposed regulation may make to species preservation.

7.2.3.3 Other Sources of Benefits

Roads and irrigation ditches provide transportation services to people. When sediment and vegetation clog ditches these services are impeded. Ribaudo (1989) and Fox and Dickson (1990) both use government highway ditch maintenance costs as the starting point for valuing decreased roadside sedimentation. Ribaudo estimates state removal costs as a function of rural road mileage, gross erosion, and the reported costs to remove one cubic yard of material. This process yields an average cost of $79 per thousand tons of gross erosion. Fox and Dickson divide provincial expenses for ditch maintenance by the cropland area to arrive at a cost of $3.41 per hectare. Both studies then estimate the benefits of different practices by assuming directly proportional reductions in costs with reductions in gross erosion.

While maintenance of roadside swales is among the BMPs suggested under this regulation, major reductions in offsite road maintenance are not anticipated in the Environmental Assessment.

Ribaudo (1989) also estimates the benefits for irrigation ditch maintenance. He accepts Clark, et al.'s (1985) estimate of overall damage to irrigation systems from cropland erosion and assumes reductions in erosion would result in proportional reductions in damage. Sohngren and Rausch (1998b) estimate that drainage ditch maintenance costs are $0.15 per ton of gross soil erosion without explaining their methodology. Agricultural water management is probably not relevant to this proposed regulation.

7.3 CONCLUSION

These methods form a coherent assessment of the benefits of the proposed regulations. There are several opportunities for reality and sensitivity testing of benefit values to ensure that they are within the realm of possibility. Information on total navigational and reservoir dredging costs in the region can be compared to the final results to determine if the benefits estimates are in a reasonable range.

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CHAPTER EIGHT
BENEFITS ASSESSMENT RESULTS

The purpose of the proposed regulation is to benefit the nation by improving water quality and the environment. These benefits can be measured in economic terms and balanced against the costs of implementing the proposed rule. The preceding chapter described the methodology EPA developed to measure the benefits of the ESC regulation. This chapter summarizes the results of that analysis. The first section draws on the Environmental Assessment to show the changes in sediment loads and other factors that indicate the environmental effects of the regulation. The second section describes the results of applying these environmental changes to the benefit estimation model described in Chapter Seven.

8.1 ENVIRONMENTAL ASSESSMENT RESULTS

The Environmental Assessment used a model watershed approach to estimate several indicators of water quality in the baseline condition and under the alternative options. The primary environmental indicator selected was sediment entering waterways which was divided into turbidity producing solids and settleable solids, i.e. particle size 20 microns or less and greater than 20 microns. Sediment is a good indicator of the regulation's effectiveness as metals and organic compounds enter the environment attached to sediment particles. Table 8-1 shows the estimated difference between sediment tonnage released under the baseline and that released with each regulatory option.

8.2 BENEFITS ASSESSMENT RESULTS

As discussed in Chapter Seven, the sediment loadings drive benefit analyses for several categories of benefits. Table 8-2 shows the low and high values for the range of annual benefit estimates. The point estimate represents EPA's best judgment of the most probable benefit value after weighing the accuracy and distribution of the information used to develop the benefit range. Most of the benefits arise from the avoided costs of lost water storage capacity.

Table 8-1. Total Suspended Sediment (TSS) - Differences from Baseline

	Option 1 - Inspection and Certification		**Option 2 - Codify CGP, Inspection and Certification**	
Decrease from Baseline in:	**Turbidity Producing Load (Tons/Year)**	**Settleable Solids Load (Tons/Year)**	**Turbidity Producing Load (Tons/Year)**	**Settleable Solids Load (Tons/Year)**
High Estimate	1,582,541	7,912,707	2,225,328	11,126,639
Low Estimate	527,514	2,637,569	2,225,328	11,126,639

Source: U.S. EPA, 2002.

Table 8-2. Benefits Estimates

Benefit Category	**Type of Estimate**	**Option 1 Inspection and Certification**	**Option 2 Codify CGP + Inspectn & Certn**
Water Treatment	Point	0.1	0.2
	Low	0.0	0.1
	High	0.3	0.4
Water Storage	Point	7.1	15.0
	Low	3.5	15.0
	High	10.6	15.0
Navigational Dredging	Point	2.6	5.4
	Low	1.3	5.4
	High	3.8	5.4
Total	**Point**	**9.7**	**20.6**
	Low	**4.8**	**20.5**
	High	**14.4**	**20.8**

Source: EPA estimates based on the methodologies presented in Chapter Seven.

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CHAPTER NINE
COSTS AND BENEFITS OF THE PROPOSED RULE

9.1 INTRODUCTION

This chapter addresses the net social costs of the proposed rule. It brings together the results described in Chapters 5 and 8 to directly compare the estimated costs and benefits of the proposed regulation in accordance with Executive Order 12866 and other administrative regulations. The economic analysis describes a typical year's impacts subsequent to implementation of the proposed rule. When flows of costs and benefits vary through time, it is common practice to calculate the net present value of each series of flows and then compare the annual payments that would be necessary to amortize that value. For example, when new regulation requires investment in capital equipment there may be a large cost to retrofit plants and smaller maintenance costs in later years while benefits do not begin to accrue for several years. To compare the two, their net present values are placed on an annual basis, i.e. annualized. When flows are constant, and the same discount rate is used to calculate the net present value as well as the amortization, the annualized value is the same as the annual value. The impacts in this report represent typical annual values for costs and benefits and so are constant throughout the evaluation period. Thus, all years are considered the same and annualization is unnecessary. Section 9.2 describes the direct social costs of the proposed rule, while Section 9.3 describes the proposed rule's indirect effects. Section 9.4 compares these costs with the benefits estimated in Chapter 8.

9.2 SOCIAL COSTS OF THE PROPOSED RULE

9.2.1 Direct Social Costs

Direct social costs are the real resource opportunity costs to the private sector, and to the government, of implementing the regulation. The largest component of social cost is the cost to firms to comply with the CGP provisions. Installation of improved ESC management is a direct cost to construction firms. In addition, firms would also bear increased design, certification, and inspection costs. Operation and maintenance (O&M) of improved ESCs also adds to costs. Governments at the Federal, State, and Municipal level would have roles in implementing this regulation. These public resources spent by government entities might have been used for other purposes and so represent a direct social cost. Each of these direct cost categories was quantified in Chapter 5 and is briefly discussed below.

9.2.1.1 Compliance Costs

Implementation of the proposed rule requires the firm to devote real resources, which might have been used for other purposes, to compliance. EPA estimated design, installation, certification, and inspection costs per acre for the baseline and each regulatory option in Chapter 5. These figures are adjusted to constant 1997 dollars using the Engineering News-Record Construction Cost Index (ENR CCI) to represent the real private opportunity cost. These costs were shown in Table 5-4.

The ESCs in the proposed rule do not depart significantly from current practices. The basic operations of construction would change little from existing practices. Potential changes in the inputs or production processes are minimal. No radically new technology is proposed that would require a substantial learning period to operate or essentially change the production process. Nor would the proposed regulation generate new waste products which might raise issues for disposal, sale, or reuse.

9.2.1.2 Government Regulatory Costs

Codification of the CGP would require only a few hours of activity at the Federal, State, and local levels of government. Administration would, in most instances, be conducted at the State or local levels, though some oversight would remain with EPA. These activities impose opportunity costs as they draw resources from other government functions. EPA estimates that each state would require approximately 200 labor hours to codify the CGP. To a large extent the proposed regulation utilizes administrative and enforcement institutions established by prior zoning, building code, and storm water regulation. EPA estimates that this one-time activity would cost $260,000 per year for five years as states revise their permitting language and programs.

In addition, government entities conduct many projects that would be subject to the proposed regulations. Approximately 24.7 percent of the value of construction put in place would be incurred by government entities. The breakdown is 10.1 percent Federal, 8.5 percent State, and 6.1 percent local. Much of this expenditure is for maintenance of existing structures and so does not entail new ground disturbance.

9.2.2 Social Welfare Losses

Social welfare losses occur when compliance costs result in higher prices for the goods in question. Individuals gain utility from products when the market price is lower than the value they derive from the product. This difference between value and price is termed "consumer surplus." Producers also gain a surplus, or profit, when they can sell a product for more than the cost of production. The proposed regulations are likely to affect new construction prices and so shift the market supply function. Market models for each sector estimate the transfer of surplus from consumers to producers as buyers pay more to builders for the added storm water facilities. In addition, the higher price would discourage some buyers so the number of homes or buildings that will be sold would fall slightly. Such reductions in sales result in losses of both consumer and producer surplus without any offsetting gain, and so are termed "deadweight loss." The market models estimate these surplus changes based on linear supply and demand curves with elasticities taken from the literature.

Consumer and producer surplus losses were reported in Table 5-19 as the gross loss attributable to the proposed rule and include the deadweight loss. Although lost as profits, much of the producer surplus figure is spent in the industry to comply with the new regulations. Similarly, most of the consumer surplus loss is spent in the construction industry absorbing the "passed on" costs of compliance with the regulations. The loss in consumers' utility becomes spending for improved storm water management. Only the deadweight loss, estimated at $10,000 for Option 1 and $185,000 for Option 2, is completely lost to society.

9.2.3 Transitional Effects

Traditional environmental regulations may have resulted in some plant closings and unemployment. The local impact of such effects is generally not considered a social impact issue since, in general, the effects are transitory. The employees shift to other jobs and the capital invested in the plant shifts to other uses. There is a small social loss in job search costs and unemployment time. However, when workers are specialized or unable to adapt to new labor market conditions, they may be permanently unemployed which would result in a loss of social welfare.

Construction is a highly flexible industry. It is normal practice for employees and firms to move from job to job applying their individual skills to the task at hand. Job search costs and shifting investments are standard elements of the industry. EPA does not foresee any major disruptions in the industry as a result of the proposed rule.

9.3 INDIRECT EFFECTS

Beyond shifting the market supply for the regulated commodity, the regulation could affect the structure of the industry, change labor or capital productivity or discourage innovation. These effects would have wider impacts on society as they ripple through related markets and industries. EPA determined that the proposed rule has relatively little possibility of causing indirect social welfare effects.

No substantial changes in market structure are anticipated from this proposed rule. While some forms of regulation may result in advantages to large firms or encourage vertical integration, this regulation builds on existing practices of design and certification already common in the industry.

The proposed regulation is expected to have little effect on labor or capital productivity. It may require firms to employ more workers without increasing output, e.g., to maintain silt fencing, but this opportunity cost is captured in the installation, operating, and maintenance cost. No substantial changes in productivity are anticipated. Nor is the proposed regulation expected to have substantial affects on research, innovation, or investment toward future technological development of the industry. EPA expects that other costs to society not specifically addressed by the analyses presented in this report would be modest.

9.4 COMPARISON OF ESTIMATED COSTS AND BENEFITS

Chapter 8 described the results of the environmental assessment and benefit monetization. All of the benefits estimated represent incremental social benefits from the baseline case. Table 9-1 compares the sum of social costs discussed above with the benefits estimated in Table 8-5. Anticipated social costs are greater than the monetized benefits.

The social benefit estimate includes only those benefits that could be monetized. Section 7.2.6 discusses several other classes of benefits that could not be quantified yet provide real social benefits. These included increased utility from water-based recreation and biodiversity preservation.

Table 9-1. Social Costs and Benefits
(1997 $Million per year)

Option	Installation, Design and Permitting	Operation and Maintenance	Government Costs	Deadweight Loss	Total Social Costs	Total Benefits
1	$118.1	$0.0	$0.0	$0.1	$118.2	$9.7
2	$421.2	$48.0	$0.3	$0.2	$469.6	$20.6
3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

Source: EPA estimates based on the methodologies presented in Chapter Four and Chapter Seven.

CHAPTER TEN
UNFUNDED MANDATES REFORM ACT

10.1 INTRODUCTION

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of the 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 to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year.

Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally directs EPA to identify and 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 final rule an explanation of why that alternative was not adopted.

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it is to develop, under section 203 of the UMRA, a small government agency plan. 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 intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

10.2 ANALYSIS AND RESULTS

EPA has determined that the proposed C&D regulations may contain a federal mandate that may result in expenditures of $100 million or more by State, local or Tribal governments in the aggregate, or to the private sector in any one year. Accordingly, EPA has prepared the written statement in accordance with section 202 of the UMRA. This and previous sections of the EA constitute this statement: Chapter Five of the EA identifies costs and impacts (burdens) on construction firms that would be subject to the proposed regulations, as well as other market affects. Chapter Eight presents estimated monetary benefits that may accrue under the proposed regulations, in accordance with UMRA when costs of a federal mandate exceed $100 million in any one year.

EPA determined that the smallest unit of government potentially affected by the proposed rule would be on the sub-county (i.e., municipal or township) government level. Census data was used to determine financial and other information (e.g., population) for local government entities (Census 2000a, Census 1999). This information was combined with data from several other sources to assess the impacts of the proposed rule on small (serving populations of less than 50,000) government entities.

The estimated total cost of the proposed rule under ESC option 1 is approximately $118 million.[1] Based on the value of construction work done, approximately 24.7 percent of this cost, or $29 million, would be borne by public entities. Under ESC option 2, the estimated total cost of the proposed rule is $469 million, with public entities incurring approximately $116 million of this total.

Approximately 83 percent of the total U.S. population in 1996 (219 million out of 265 million) lived in areas governed by a municipality or town/township. Of those served by these sub-county governments, approximately 43 percent (114 million) lived in areas served by municipal or town/township governments with populations of less than 50,000. The remaining portion of the total U.S. population (i.e., those not served by municipal or town/township governments) may be served only by a county government, a

[1] Total compliance cost equals the installation, design, and permitting costs plus operation and maintenance costs.

special district government, or some other form of local government not covered by the Census report (Census 1999).

The value of construction work done by government agencies (federal, state, and local) is approximately 24.7 percent of the total value of construction work done, with the remainder performed by private entities. EPA applied the 24.7 percent factor to the total national compliance costs for each option to determine the portion of costs accruing to government entities.

EPA then used data on the funding of capital outlay for highway projects to determine the portion of compliance costs accruing to each level of government (i.e., to federal, state, and local entities). Based on this data, approximately 41 percent of government compliance costs would be borne by the Federal government, 34 percent would be borne by state governments, and the remaining 25 percent would be borne by local governments.

EPA compared the local government share of compliance costs against several financial indicators to determine the extent of the impacts on small governmental units. The indicators used were total revenues, capital outlay, and capital outlay for construction only. In all cases, compliance costs were less than 0.2 percent of the financial measure, indicating no significant impact on small governmental units. The calculations are shown in Table 10-1 below.

Table 10-1. Impacts of Proposed Rule Compliance Costs on Government Units

	Option 1		Option 2	
Government Component	**Costs**	**As Percent of Total Costs**	**Costs**	**As Percent of Total Costs**
Total Compliance Costs	$118,100,000	100.00%	$469,200,000	100.00%
Private Compliance Costs (75.3%) [a]	$88,929,300	75.30%	$353,307,600	75.30%
Public Compliance Costs (24.7%) [a]	$29,170,700	24.70%	$115,892,400	24.70%
Federal (41.07%) [b]	$11,980,406	10.14%	$47,597,009	10.14%
State (34.29%) [b]	$10,002,633	8.47%	$39,739,504	8.47%
Local (24.64%) [b]	$7,187,660	6.09%	$28,555,887	6.09%
Small Government Entities (< 50,000) [c]	$3,098,600	2.62%	$12,310,443	2.62%
Total Revenues: Small Government	**$103,640,793,000**		**$103,640,793,000**	
Compliance Costs as % of Total Revenues	0.00%		0.01%	
Capital Outlay: Small Government	**$11,262,360,000**		**$11,262,360,000**	
Compliance Costs as % of Total Capital Outlay	0.03%		0.11%	
Construction Outlay Only: Small Government	**$6,901,826,000**		**$6,901,826,000**	
Compliance Costs as % of Construction Outlay	0.04%		0.18%	

[a] Based on value of construction work done by government entity. 1997 Census of Construction.
[b] Based on the percent of capital outlay for highways funded by governmental unit. 1999 FHWA Conditions and Performance Report to Congress.
[c] Based on the percent of U.S. population living in municipalities or towns/townships serving < 50,000 (43.11% of the population in 1996).
Note: Approximately 83% of the U.S. population (or 219,004,000) lives in an area governed by a municipality or a town/township. The remaining population may be served only by a county government, a special district government, or other governmental organization not covered here. Of the 219 million served by these subcounty governments, approximately 114,347,000 (or 43 percent) are served by municipal or town/township governments with populations of < 50,000.
Sources: 1997 Census of Governments: Compendium of Government Finances; 1997 Census of Governments: Government Organization; 1999 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance, Report to Congress; 1997 Census of Construction.

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