

APPENDIX E

Phase I Construction Activity Load Reductions

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The Phase I rule regulates construction starts disturbing five or more acres of land, requiring construction site owners or operators to plan and implement appropriate erosion and sediment control BMPs. It is important to understand that the intent of construction requirements is to prevent a degradation of water quality due to run off and sediments escaping from the construction site. The prevention of water quality degradation as a result of implementing Phase I BMPs is comparable to seeing water quality improvement from the worst case scenario. That is to say the water quality is improved because the worst case scenario was averted.

The load reduction analysis projects that Phase I construction BMP compliance prevents 73.2 percent of the sediments generated during construction from reaching the nation's streams, rivers and lakes. An average of 63.4 tons of sediment may be eroded from each of the 62,755 construction sites regulated by Phase I in 1999. This reduction equates to 2,911,523 tons of sediment or (264,000 dump trucks of soil) being kept out of our nations waters.

To develop an estimate of sediment loadings from Phase I construction sites and the loads averted by complying with the Phase I requirements, EPA estimated the total number of Phase I construction starts for the year 1999. To approximate per-start sediment loads, EPA revised an earlier analysis performed by the US Army Corps of Engineers (USACE) for Phase II construction starts entitled "*Analysis of Best Management Practices for Small Construction Sites.*" The methodology followed is consistent with the *Economic Analysis for the Final Phase II Storm Water Rule* (US EPA, 1999b). A brief description of the steps taken to develop these estimates follows.

Determining the Phase I Universe of Construction Starts

EPA used building permit information from the US Bureau of the Census and construction start data from fourteen municipalities around the country to estimate the number of 1999 construction starts greater than five acres.¹ In determining the universe of construction starts, a correlation was made between the information obtained from the 14 municipalities on construction starts and data obtained

¹ The 14 localities providing construction start data were: Austin, Texas; Baltimore County, Maryland; Cary, North Carolina; Ft. Collins, Colorado; Lacey, Washington; Loudoun County, Virginia; New Britain, Connecticut; Olympia, Washington; Prince George County, Maryland; Raleigh, North Carolina; South Bend, Indiana; Tallahassee, Florida; Tucson, Arizona, and Waukesha, Wisconsin.

from the national building permits.

EPA obtained data files from the US Bureau of the Census indicating the number of building permits issued in the United States. The data files cover approximately 96% of the counties within the United States for the years 1980–1995. The Census Bureau stopped collecting nonresidential building permit information in 1995, which precluded the use of 1995 data in this analysis. EPA grouped building permits into similar types of buildings and activities. The following equivalents were developed based on commonly used zoning code descriptions and activities using common zoning code descriptions and the Census Bureau's definition of building categories.

The number of construction starts from 1994 to 1999 was escalated using an average annual growth rate of 1.013%, which reflects the average increase in permits during prior years.²

EPA developed ratios to estimate the number of building permits issued by construction type (residential, commercial, industrial, etc.) for two size categories (5–10 acres and >10 acres). The size category is equivalent to the land area disturbed by an individual development.

Census Bureau's definition of building categories:

1. code 101 represents single-family detached homes;
2. codes 103, 104, and 105 represent "attached" homes (e.g., apartments, townhouses, condominiums);
3. codes 213, 214, 318, 321, 322, 324, 327, and 328 represent commercial establishments;
4. code 320 represents industrial or manufacturing facilities;
5. codes 319, 323, 325, and 326 represent all institutional buildings (e.g., schools, hospitals, churches, government buildings);
6. code 329 represents parks and recreational facilities.

Based on a review of erosion and sediment control provisions as mandated under Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), EPA identified localities that have erosion and sediment control requirements for sites that disturb five or more acres. Those starts were eliminated from the analysis because they already have sediment and erosion control requirements similar to Phase I. There are other equivalent programs besides those mandated under the Coastal Nonpoint Pollution Control Program.

Determining the Sediment Load per Start

To estimate pollutant loading reductions from Phase I construction starts, the USACE developed a model of 18 construction sites to estimate sediment loads from construction starts with and without Phase I controls (USACE, 1998). The USACE model uses the Revised Universal Soil Loss Equation (RUSLE) to generate edge-of-construction site sediment delivery loads for 15 climatic regions with each of the following variations: two site sizes (5–10 and >10 acres), three soil erodibility levels (low, medium, and high), and three slopes (3%, 7%, and 12%) . The 15 climatic regions were used in an effort to represent the various climatic conditions throughout the United States. To adapt the USACE analysis to the Phase I universe, EPA modified the length-slope factor to reflect the larger

² Based on data collected from the US Bureau of the Census the average annual growth rate for the number of building permits issued from 1980 to 1994 was 1.013% per year. However, EPA recognizes the growth rate for construction starts fluctuates yearly and does not necessarily increase each year.

construction sites regulated under Phase I³ and used the same parameters as those for the remaining model assumptions.

The 1999 construction start data was then separated into the 15 climatic regions based upon the proportion of each State which falls into each climate zone. In this way an average per start load for each climate region could then be multiplied by the total number of starts in each climate zone. Consistent with the approach taken in the Phase II economic analysis, average loadings for each climate zone were determined using an average of the slope categories 3%, 7%, and 12%, assuming all were equally as likely, and assuming medium erodibility for the soil. Table E-1 provides the number of construction starts, sediment loads per construction start, and the load in tons per year.

Table E-1. Estimate of Sediment Loads from Construction Starts

Representative Climate		Number of Starts 5-10 Acres	Number of Starts >10 Acres	5-10 Acre Load per Start (Tons/Year)	>10 Acre Load per Start Tons/Year	5-10 Acre Loading (Tons/Year)	>10 Acre Loading (Tons/Year)
City	Zone						
Portland	A	278	377	21	25	5,952	9,431
Boise	B	511	700	4	4	1,802	2,878
Fresno	C	0	0	3	4	—	—
Las Vegas	D	2,478	3,556	2	2	5,229	8,759
Denver	E	1,239	1,724	13	15	15,787	25,650
Bismark	F	348	458	16	19	5,533	8,494
Helena	G	716	975	4	5	3,014	4,790
Amarillo	H	1,691	2,307	35	40	58,612	93,363
San Antonio	I	459	639	92	108	42,256	68,737
Duluth	K	1,739	2,308	31	37	54,755	84,848
Des Moines	M	5,506	7,436	57	67	313,919	494,814
Nashville	N	4,965	6,711	82	96	408,819	644,984
Atlanta	P	3,676	5,038	109	127	399,299	638,670
Hartford	R	1,671	2,206	45	53	75,514	116,352
Charleston, SC	T	974	1335	152	178	148,152	237,107
Hawaii	V	0	0	NA	NA		
Alaska	W,X,Y	65	90	NA	NA		
Atlantic Islands	Z	239	339	NA	NA		
	Total	26,554	36,201			1,538,642	2,438,875

Using EPA guidance on storm water management for construction activities (USEPA1992b), combinations of BMPs for the model sites were developed to mimic commonly accepted erosion and sediment control practices. Additionally, BMPs were selected based on guidance contained in Brown and Caraco (1997). The types of BMPs placed on each site varied based on the unique conditions of

³ The estimated amount of disturbed area for the 5-10 category was 7.5 acres, and 13.9 acres for the 10 and above category.

the site. For example, for sites with shallow slopes and low erosivity, few BMPs are required. In contrast, on larger, steeper, and more erosive sites, more BMPs are needed. Table E-2 shows the mix of BMPs selected for the various model sites. In developing the mix for each model site, EPA assumed that entities would select the most cost effective mix of BMPs.

Table E-2 BMPs Used for the Model Sites

Site Size (acres)	Soil Erodibility	Slope		
		3%	7%	12%
> 5	low	a,c,d,e	c,d,e,f,g	c,d,e,f,g
	med	a,c,d,e	c,d,e,f,g	c,d,e,f,g
	high	c,d,e,f,g	c,d,e,f,g	c,d,e,f,g

a = silt fence
 b = mulch
 c = seed and mulch
 d = stabilized construction entrance
 e = stone check dam
 f = earthen dike directing runoff to sediment trap
 g = sediment trap (9,000 ft³)

To determine the average sediment load from Phase I construction sites, the sediment loads were developed by:

- estimating the average climatic sediment load per site assuming moderate erodibility;
- developing a national weighted average sediment load per site; and
- developing the potential sediment load released from Phase I sites with and without erosion and soil control BMPs.

Average climatic sediment loads were developed using the RUSLE for sites between 5–10 acres, and sites larger than 10 acre sites assuming medium soil erodibility (USEPA 1999b).

To develop the national weighted average sediment load per site, the average climatic load per site was multiplied by the number of construction starts disturbing between 5-10 acres and more than 10 acres in each climatic zone. The total loadings were summed and then multiplied by the ratio of construction starts in each size category to the total number of each construction sites for each climatic zone.

The average loads per climatic region were multiplied by the ratio of total Phase I construction starts in each climatic zone to the total Phase I construction starts nationwide to obtain a national weighted average sediment load per site. This methodology was used to calculate sediment loads from construction starts with and without Phase I controls. The USACE model was also used to derive an estimate of potential sediment load reductions attributable to soil erosion controls. These values, as presented in Table E-3, indicate that the average soil loss per start without Phase I BMPs, was 63.4 tons and the average annual potential reduction in soil loss could be as high as 46.4 tons per start with Phase I BMPs. The sediment loss calculation used in the analysis is based on a version that was developed to model construction sites. Actual soil loss may vary from site to site due to the pattern and extent of soil disturbance as well as the placement of building materials and the buildings on the site. The analysis indicates that 73.2 percent of the sediment that would otherwise be delivered into

our nation's waters is retained on constructions sites due to the Phase I BMPs.

Table E-3. Estimate of Potential Sediment Load Reductions

Representative Climate		Number of Starts 5–10 Acres	Number of Starts >10 Acres	BMP Load per Start Tons/Year		BMP Total Load Tons/Year	
City	Zone			5–10 Acre	>10 Acre	5–10 Acre	>10 Acre
Portland	A	278	377	4	5	1,190	1,886
Boise	B	511	700	1	1	329	525
Fresno	C	0	0	0	1	—	—
Las Vegas	D	2,478	3,556	0	0	284	476
Denver	E	1,239	1,724	3	3	3,383	5,496
Bismark	F	348	458	3	4	1,141	1,751
Helena	G	716	975	1	1	554	881
Amarillo	H	1,691	2,307	9	11	15,603	24,855
San Antonio	I	459	639	27	32	12,606	20,505
Duluth	K	1,739	2,308	7	8	11,721	18,162
Des Moines	M	5,506	7,436	15	18	84,311	132,896
Nashville	N	4,965	6,711	23	27	113,618	179,252
Atlanta	P	3,676	5,038	30	35	109,500	175,143
Hartford	R	1,671	2,206	11	12	17,691	27,259
Charleston, SC	T	974	1,335	41	48	40,369	64,609
Hawaii	V	0	0	NA	NA		
Alaska	W,X,Y	65	90	NA	NA		
Atlantic Islands	Z	239	339	NA	NA		
	Total	26,554	36,201			412,300	653,695