4.0 POTENTIAL COSTS, POLLUTANT LOAD REDUCTIONS, AND COST EFFECTIVENESS

Based on internal review and comments received from the public on the EA that accompanied the proposed Phase II rule, EPA initiated several additional data collection activities and analyses to enable it to better estimate the incremental costs and pollutant loading reductions associated with the Phase II rule. This chapter describes these activities and analyses and presents revised estimates of costs and pollutant loading reductions. Specifically, Section 4.1 provides an overview of the methodology and discusses changes from the EA that accompanied the proposed rule. Section 4.2 discusses the revised analyses for estimating potential costs and presents the total costs for the Phase II rule, and Section 4.3 provides a summary of the results. Section 4.4 presents the potential pollutant loading reductions reflected in the revised analyses. Section 4.5 presents the results of an analysis of the cost effectiveness of the final rule. Section 4.6 presents the results of sensitivity analyses performed to evaluate the potential impact of several major assumptions used for the cost analysis. Finally, section 4.7 provides conclusions.

4.1 Overview of Methodology

This section provides an overview of the methodology used to estimate costs and pollutant loading reductions for both municipalities and construction sites subject to the final Phase II rulemaking. In general, the same approach that was used to estimate costs for the proposed rule was used for the final rule. However, additional data were collected, the methodology changed, and supplemental analyses were performed to strengthen and facilitate the analysis of the final rule. The specific components of the analysis are discussed below.

4.1.1 Municipalities

Municipalities that will be automatically designated by the Phase II rule are those that are located in an urbanized area and have a municipal separate storm sewer system (MS4) that serves a population of less than 100,000. The permitting authority may grant a waiver to automatically designated MS4s that serve a population of less than 1,000 (see sensitivity analysis number # 5, in Section 4.6 for the potential affect of the waiver on the cost analysis). In addition, other municipalities with MS4s may be designated by the permitting authority particularly if they have a population of at least 10,000 and a population density of at least 1,000 persons per square mile.

EPA estimated annual per household program costs for 5,040 automatically designated municipalities using data from a 1998 survey of municipalities conducted by the National Association of Flood and Stormwater Management Agencies (NAFSMA).[1] The survey obtained cost information from communities that currently conduct activities required by each of the Phase II minimum measures. Per household costs were developed by multiplying costs by minimum measure per MS4 by the number of persons/household (as indicated by US Census data), then dividing by population per MS4. Average costs were calculated for each minimum

[1]EPA did not include the 27 Federally-recognized Native American Indian Tribes and 39 municipios (Puerto Rico) in the municipal cost and benefit analysis. If EPA were to add these Tribal and Territorial governments to the analysis, costs and benefits would likely increase proportionately.

measure, then summed across all minimum measures to estimate costs for whole program implementation.

These findings were verified by comparing them to actual storm water program expenditures reported by 26 Phase I municipalities. The Phase I municipalities studied were selected because of their tenure in the Phase I program and their detailed cost information for Phase I program elements. In addition, many of the municipalities examined were smaller cities that more closely reflect the population of Phase II municipalities.

An average annual per household administrative cost was also estimated to address application, record keeping, and reporting requirements of the final rule. The average annual administrative per household cost was added to the program per household cost to derive a total average per household cost. To obtain the national estimate of compliance costs, EPA multiplied the total per household cost by the expected number of households in Phase II municipalities.

4.1.2 Construction Site Runoff Controls

The final Phase II rule regulates construction starts disturbing one to five acres of land. Specifically, small construction site owners or operators will be required to plan and implement appropriate erosion and sediment control BMPs.

In estimating incremental costs attributable to the final rule, EPA estimated a per-site cost for sites of one, three, and five acres and multiplied the cost by the total number of Phase II construction starts in these size categories to obtain a national cost estimate. Several steps were involved in obtaining the national estimates and are summarized below.

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 construction starts that would be affected by the Phase II rule. From this information, EPA estimated the number of construction starts disturbing between one and five acres of land.[2] EPA reduced the construction site universe by 15% to account for those starts that are anticipated to qualify for waivers (63 FR 1583).[3]

For analysis of per-site costs, EPA created 27 model sites of typical site conditions in the United States. The model sites considered three different site sizes (one, three, and five acres), three slope variations (3%, 7%, and 12%), and three soil erosivity conditions (low, medium, and high). EPA used the WEF database to develop and apply BMP combinations appropriate to the model site conditions. BMP costs for erosion and sediment control were estimated for each model site using standard cost estimates from RS Means (RS Means, 1997a and 1997b). Based on the assumption that any combination of these site factors is equally likely to occur on a given site,

[2]Based on public comments received on the proposed rule, EPA considered including oil and gas exploration sites but, upon further review, determined that few, if any, such sites actually disturb more than one acre of land.

[3] It should be noted that to obtain a waiver, construction site owners/operators must certify that they meet certain criteria, e.g., the construction activity occurs in an area of negligible rainfall or the permitting authority has completed wasteload allocations that are part of total maximum daily loads that address the pollutants of concern.

EPA averaged the matrix of estimated costs to develop an average cost for sites disturbing one, three, and five acres of land.

Administrative costs for the following elements required under the Phase II rule were estimated per construction site and added to each BMP cost: submittal of a notice of intent (application) for permit coverage; notification to municipalities; development of a storm water pollution prevention plan; record retention; and submittal of a notice of termination. The total per-site costs were then multiplied by the total number of Phase II construction starts disturbing one to two, two to four, and four to five acres of land to obtain the national cost estimate.

EPA also estimated per-site administrative costs for that portion of the construction universe expected to qualify for a waiver. These are costs associated with completing and submitting a waiver certification form. The per-site waiver costs were then multiplied by the total number of Phase II construction sites that are expected to be waived from the construction program.

4.1.3 Post-Construction Runoff Controls

The Phase II municipal program requires municipalities to develop, implement, and enforce a program that addresses storm water runoff from new development and redevelopment sites on which land disturbance is greater than one acre and that discharge into a regulated MS4. On new development and redevelopment sites, EPA recommends that post-development runoff conditions should not be different from predevelopment conditions in a way that adversely affects water quality.

While implementation of this rule will likely include a mix of planning, site design, and structural approaches, the cost analysis focused on structural controls (installation and maintenance of structural best management practices, or BMPs) because development of nationally-applicable planning and site design measures was infeasible.

EPA developed average annual BMP costs for sites of one, three, five, and seven acres. The analysis accounted for varying levels of imperviousness that characterize residential, commercial, and institutional land uses (i.e., per-site BMP costs are highest for intensely used commercial sites (85% impervious coverage), lowest for residential sites (35% impervious coverage), and moderate for a mixed category including institutional, commercial, and residential uses (65% impervious coverage).

Using information presented in an EPA Office of Science and Technology study (Preliminary Data Summary of Urban Storm Water Best Management Practices, US EPA, Office of Science and Technology, December 1998b), EPA developed a combination of BMPs for the model sites and calculated costs based on the amount of storm water runoff expected from sites of varying imperviousness. EPA then calculated a weighted average BMP cost for each of the model sites. Per-site costs were adjusted to reflect two factors: 1) a cost reduction associated with the anticipated use of a nonstructural practice, the redirection of rooftop runoff, and 2) anticipated cost savings because the new BMPs will reduce peak storm water flows, allowing developers to save on construction costs when they build sewer connections.

The adjusted per site BMP cost was then multiplied by the total number of construction sites that are located in Phase II urbanized areas to obtain a national cost estimate. EPA did not include

sites that disturb greater than 10 acres in the analysis because the construction general permit (CGP) already requires post-construction controls on those sites (63-FR 7858).

4.1.4 Phase I Industrial Activities

The proposed Phase II rule included a no exposure exemption for Phase I industrial sources which stated that if an industrial facility could show that no materials or material handling/processing activities were exposed to storm water, then the industry would be exempt from Phase I permit requirements (63 FR 1536). EPA assumed that no costs would be associated with this exemption provision. EPA included this exemption in the final Phase II rule and maintained the same assumption. Estimated cost savings resulting from the no exposure exemption are presented in Chapter 9.

4.2 Analyses of Potential Costs

This section provides a detailed description of the procedures used to estimate the potential incremental costs of the Phase II rule and presents per household municipal costs, per site construction costs, per site costs for post-construction controls, costs to state and federal agencies, and national cost estimates. Assumptions used and limitations of the analyses are also described.

4.2.1 Municipal Costs

National Phase II municipal cost estimates are a function of the number of entities to be regulated and unit costs. EPA estimated national municipal costs by determining the number of municipalities that would need to apply for a Phase II storm water permit, estimating the number of households in the Phase II municipalities, and developing unit costs for compliance. The following section discusses how EPA estimated national compliance costs for municipalities.

Phase II Municipal Universe

EPA verified the Phase II municipal universe by reviewing a current list of US Bureau of the Census municipalities meeting the definition of a Phase II MS4, i.e., a municipality located in an urbanized area that has an MS4 serving less than 100,000 people, and associated populations. All Phase I co-permittees that meet the definition of a Phase II MS4 were identified from EPA's Phase I MS4 database and removed from the Phase II municipal universe to ensure that no double counting of municipalities occurred. The final list is presented in the final rule (citation when available). It is important to note that the Phase II universe is dynamic since populations change and Phase II municipalities often become co-permittees with Phase I MS4s as individual Phase I permits are issued. Following review of the Census data, EPA estimated the Phase II municipal universe to be 5,040 MS4s with a total population of 85 million people and 32.5 million households (see Chapter 3, Section 3.2).

Establishing Per Household Costs

In order to obtain incremental cost estimates for Phase II municipalities, EPA reviewed a survey of the Phase II community provided by the National Association of Flood and Stormwater Management Agencies (NAFSMA0).[4] Using the list of potential Phase II designees published in the Federal Register (63 F.R. 1616 - 32), NAFSMA contacted more than 1,600 jurisdictions in a survey mailed on July 31, 1998 (see Appendix B–1, Exhibit B–1a). The goal of the survey was to solicit information from those communities about the proposed Phase II NPDES storm water program. The survey sought to identify current storm water spending levels in Phase II municipalities as well as to identify future needs for these communities. One hundred twenty-one surveys were returned to NAFSMA. Fifty-six of those surveys reported cost information that was used to develop a national snapshot of potential costs for Phase II municipalities.

Several of the survey questions correspond directly to the minimum measures required by the Phase II storm water rule. Communities were asked whether they currently conduct those activities required by the minimum measures, and, if so, annual costs were also obtained. These costs form the basis for the municipal cost estimate used in this analysis. The survey data covers the following five minimum measures: public education/outreach, illicit discharge detection and elimination, construction site storm water runoff control, post-construction storm water management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. (The NAFSMA survey did not specifically address municipal costs for public participation. It is EPA's belief that respondents considered public participation costs as part of public education and outreach efforts.)

The following steps were followed to conduct the analysis:

- Raw data was keyed in from the NAFSMA Phase II Raw Data Report, and re-ordered by municipal population sizes. Those respondents without population data were omitted from the analysis. Subsets of the respondents were able to provide cost data for each of the minimum measures, as shown in Appendix B–1, Exhibit B–1b.
- Per household costs were calculated by dividing costs per minimum measure per MS4 by the population of that MS4, then multiplying the result by 2.62 persons/household.
- Average and percentile costs (0, 25%, 50%, 75%, 95%, 100%) were calculated for each minimum measure, then summed across all minimum measures to determine hypothetical average and percentiles for whole program implementation (see Appendix B–1, Exhibit B–1c).
- One municipality's response to the survey question on municipal runoff control costs (question 6) was removed from the data set as a disproportionately huge "outlier" (almost 15 times the mean cost for all other municipalities and 4 times greater than the next highest per capita cost). This is documented in Appendix B–1, Exhibit B–1b.

The average annual household cost (before accounting for administrative costs) was found to be $8.93.

[4]The National Association of Flood and Stormwater Management Agencies is an organization of public agencies whose function is the protection of lives, property and economic activity from the adverse impacts of storm and flood waters. The mission of the Association is to advocate public policy, encourage technologies and conduct education programs which facilitate and enhance the achievement of the public service functions of its members.

In addition to expenditures associated with implementing Phase II program elements, Phase II municipalities will have to comply with administrative requirements. These include submittal of an application for coverage under the Phase II program, record keeping, and reporting. While some municipalities may have incorporated these costs into the figures reported in the NAFSMA survey, this was not assumed, and EPA therefore developed an additional estimate of administrative costs. EPA used estimates provided in the EA for the proposed rule, which were based on US Department of Labor (US DL) wage rates (US DL, 1995) and EPA's "Information Collection Request (ICR) for Revisions to the NPDES: Storm Water Discharges" (US EPA, 1990). EPA used labor hours reported in the ICR and matched the hours to US DL wage rates. The wage rates were adjusted to 1998 dollars using the Consumer Price Index. EPA estimated municipal application costs, over a five-year permit cycle, to be $805, record keeping costs to be $375, and reporting costs to be $6,445 per municipality. EPA estimated costs per household based on the Phase II municipal population of 85 million, 5,040 Phase II municipalities, and 2.62 persons per household. Costs were averaged over the five year NPDES permit term to obtain an annual administrative cost of $0.23 per household (Exhibit 4–1).

Exhibit 4–1. Annual Municipal Administrative Costs (1998 dollars)

Administrative Requirement	Estimated Hours Over Five Years	Estimated Annual Cost Per Municipality [1, 2]	Total Annual Cost [2, 3]	Annual Cost Per Household [4]
Municipal application	30	$161	$811,440	$0.02
Record keeping	14	$75	$378,000	$0.01
Reporting	240	$1,289	$6,496,560	$0.20
Total[5]	**284**	**$1,525**	**$7,686,000**	**$0.23**

[1]Based on a wage rate of $26.86 per hour.
[2]Costs were averaged over the permit term of five years.
[3]Based on a universe of 5,040 municipalities.
[4]Based on a population of 85 million people and 2.62 persons per household.
[5]Totals subject to rounding.

The annual administrative costs per household were added to the annual per household costs for the Phase II program elements to obtain a total annual per household cost ranging from $0.42 to $54.91 for the survey respondents. The mean and percentile range of total annual per household costs is presented in Exhibit 4–2.

Alternative Approach for Establishing Per Household Costs. As an alternative method and point of comparison with the NAFSMA-based approach described above, EPA reviewed annual reports from 35 Phase I MS4s to obtain incremental cost estimates for Phase II municipalities. Cost data was only available for 26 of those MS4s; EPA calculated annual per household cost estimates for each of these Phase I MS4s by using actual expenditures reported in their individual annual reports. The initial 35 Phase I MS4s were targeted because they had been in the Phase I program for nearly one NPDES permit term, were smaller cities that more closely reflected the population of Phase II municipalities, and had detailed data reflecting actual

program implementation costs.[5] EPA extracted costs from the Phase I annual reports for comparable Phase II program elements. EPA calculated a total annual cost for each municipality for the Phase II program elements. EPA then divided the annual costs by the relevant number of households in each Phase I municipality based on household data from the US Bureau of the Census to obtain a per household estimate. After adding annual per household administrative costs (see discussion above), annual per household program costs ranged from $0.62 to $60.43, with an average of $9.08, for the 26 Phase I MS4s. The range of costs obtained using this method is shown in Exhibit 4–2. The cost range and mean values obtained using this method are similar to those found using the NAFSMA survey data.

Exhibit 4–2. Mean and Percentage Findings:
Estimated Annual Per Household Cost of Compliance for Phase II Municipalities (1998 dollars)

Percentile	NAFSMA Annual Per Household Cost [1, 2, 4]	Phase I Adjusted Annual Per Household Cost [3, 4]
100th (Maximum)	$54.91	$60.43
95th	$36.57	$42.10
75th	$10.40	$10.51
Mean	**$9.16**	**$9.08**
50th (Median)	$4.19	$2.86
25th	$1.32	$1.46
0th (Minimum)	$0.42	$0.62

[1]Calculated from NAFSMA 1998 Phase II Survey responses that reported costs associated with implementing one or more of five Phase II minimum control measures. Percentiles were each determined per measure, then percentiles were added across all measures and sums multiplied by 2.62 people/household.

[2]These estimates removed the effect of one disproportionately huge "outlier" (almost 15 times the mean cost for all other municipalities and four times greater than the next highest per capita cost) in one municipality's estimate of its annual municipal runoff control costs.

[3]Costs extracted and adjusted from 26 Phase I MS4 annual reports, considering only those minimum measures for which comparable cost estimates could be derived. Thus, the annual per household costs reported for each MS4 is the sum of only those measures which the MS4 was implementing when the report was prepared.

[4]All costs incorporate administrative costs of $0.23/household, based on Exhibit 4–1.

National Municipal Costs

To determine potential national level costs for municipalities, EPA divided the Phase II population (85 million) by the number of persons per household to determine the number of households in the Phase II universe. The number of households was then multiplied by the per household compliance cost ($9.16). Exhibit 4–3 shows the annual estimated national Phase II municipal costs to be approximately $297 million.

Exhibit 4–3. Estimated National Phase II Municipal Annual Costs

[5]EPA evaluated the annual reports submitted by 35 Phase I MS4s. The 35 annual reports included one MS4, Orange County, California, with 31 co permittees. Twenty percent of the 35 MS4s have populations of less than 100,000 people and 74% of the Orange County permittees have populations of less than 100,000 people.

Per Household Costs (1998 Dollars)	Total Number of Households in Phase II Municipalities[1]	Estimated National Phase II Municipal Annual Cost (1998 Dollars)
$9.16	32,458,365	$297,318,623

[1] See Chapter 3, Section 3.2, for description of methodology used to determine the Phase II municipal universe.

4.2.2 Construction Costs

The Phase II rule includes two provisions that may result in additional costs to the construction community. The first provision requires the owners and operators of construction sites disturbing one to five acres of land to plan and implement erosion and sediment control BMPs. Similar to the national municipal cost estimates, EPA first estimated the universe of construction starts that would be required to submit an application for a storm water permit and then estimated unit costs (compliance costs) for each site to comply with the regulatory requirements. EPA also estimated the universe of construction starts that would qualify for a waiver and then estimated per site administrative costs (waiver costs) associated with obtaining a waiver. The following sections describe how EPA estimated national construction costs for sites disturbing between one and five acres of land and provide cost estimates for this measure.

The second provision requires the implementation of post-construction storm water runoff controls on construction sites located in Phase II municipalities. The Phase II municipal program requires municipalities to develop, implement, and enforce a program that addresses storm water runoff from new development and redevelopment sites on which land disturbance is greater than one acre and that discharge into a regulated MS4. EPA estimated incremental costs attributable to the post-construction runoff control measure. To develop a cost estimate associated with this measure, EPA estimated a per site BMP cost, including operation and maintenance, for 12 model sites of varying size and imperviousness. The per site BMP cost was then multiplied by the total number of multi-family, institutional, and commercial construction starts that are located in Phase II urbanized areas to obtain a national cost estimate.

Erosion and Sediment Control Costs

Phase II Construction Universe. For the final Phase II rule, EPA expanded the Prince George's County estimates of construction starts by collecting additional data. EPA conducted an extensive search to identify municipalities that record the area disturbed for each construction site and the number and types of structures (single family dwelling, townhouses, etc.) constructed in each development. The municipalities contacted include:

- Amarillo, TX
- Arvada, CO
- Atlanta, GA
- Austin, TX
- Baltimore County, MD
- Bellingham, WA
- Bismarck, ND
- Boise, ID
- Boulder, CO
- Bozeman, MT
- Canton, OH
- Cape Girardeau, MO
- Carbondale, IL
- Cary, NC
- Cedar Rapids, IA
- Cheyenne, WY
- Columbia, MO
- Dane County, WI
- Davenport, IA
- Denver, CO
- Douglas County, CO
- Duluth, MN
- Durham, NC
- Eureka, CA
- Eugene, OR
- Fairfax County, VA
- Flagstaff, AZ
- Fort Collins, CO
- Great Falls, MT
- Henrico County, VA

- Jefferson County, CO
- Kansas City, MO
- Kenosha City, WI
- Kenosha County, WI
- Lacey, WA
- LaCrosse City, WI
- LaCrosse County, WI
- Leon County, FL
- Lexington, KY
- Longmont, CO
- Loudoun County, VA
- Madison, WI
- Marion County, OR
- Milwaukee, WI
- Monroe County, NY
- New Britain, CT
- North Kansas City, MO
- Ogden, UT
- Oklahoma City, OK
- Olympia, WA
- Omaha, NE
- Overland Park, KS
- Owensboro, KY
- Peoria, IL
- Prince George's County, MD
- Racine City, WI
- Racine County, WI
- Raleigh, NC
- Reno, NV
- Rochester, NY
- Rochester, MN
- Rutland, VT
- St. Louis County, MO
- Salem, OR
- Sante Fe, NM
- Santa Rosa, CA
- Spokane, WA
- Springfield, MO
- Stark County, OH
- Tallahassee, FL
- Tulsa, OK
- Tuscon, AZ
- Waukesha, WI
- Waukesha County, WI
- Wichita, KS

Of the municipalities listed above, the following fourteen had sufficient data to support the analysis: Austin, TX; Baltimore County, MD; Cary, NC; Fort Collins, CO; Lacey, WA; Loudoun County, VA; New Britain, CT; Olympia, WA; Prince George's County, MD; Raleigh, NC; South Bend, IN; Tallahassee, FL; Tucson, AZ; and Waukesha, WI.

Data collected from these municipalities varied widely in the total number of construction starts and in the distribution of starts by size category (one- to two-acre, two- to three-acre, etc.). Municipalities with large land areas and population (Baltimore County, Maryland and Prince George's County, Maryland) generally recorded a greater number of construction starts than those with small land areas and population (Lacey, Washington and Waukesha, Wisconsin). Exhibit 4–4 provides data for some of the factors influencing this range, including population, percent population growth, median household income, and municipal land area for these communities.

The Phase II construction start universe was estimated using the number of construction starts and corresponding disturbed area data collected from the 14 municipalities. The number of construction starts indicating a disturbance of one to five acres for the 14 municipalities was totaled and divided by the total number of building permits for those areas (see Appendix B–2). The resulting ratio was then used to estimate the Phase II construction start universe as described in Appendix B–2. Exhibit 4–5 shows the results of the data collection effort.

Exhibit 4–4. Summary Characteristics of Municipalities Where Construction Start Data was Collected

Municipality	Population 1996 (Estimates)[1]	Population Growth 1990 to 1996	Median Household Income (1989)	Area (Sq. Mi.)
Austin, TX	541,278	+14.7%	$25,414	217.8
Baltimore County, MD	720,662	+4.1%	$38,837	599.0
Cary, NC	75,676	+70.5%	$46,259	31.2
Fort Collins, CO	104,196	+19.1%	$28,826	41.2
Lacey, WA	27,381	+42.0%	$29,726	10.1
Loudoun County, VA	133,493	+54.9%	$52,064	520.0
New Britain, CT	71,512	–5.3%	$30,121	13.3
Olympia, WA	39,006	+15.6%	$27,785	16.1
Prince George's County, MD	770,633	+5.6%	$43,127	486.0
Raleigh, NC	243,835	+15.0%	$32,451	88.1
South Bend, IN	102,100	–3.2%	$24,131	36.4
Tallahassee, FL	136,751	+9.6%	$34,764	63.3
Tucson, AZ	449,002	+9.1%	$21,748	156.3
Waukesha, WI	60,197	+5.8%	$36,192	17.3
United States	265 million	+6.6%	$35,225	

Source: US Department of Commerce, Bureau of the Census. [http://www.census.gov].
[1] US Census Bureau Data (1996).

EPA estimates that there were 123,145 Phase II construction starts which would incur incremental costs for Phase II in 1994.[6] The number of potential construction starts was increased 1.3% annually to estimate the potential number of starts in year 1998.[7] This yields a construction start universe of 129,675 ($123{,}145 \times 1.013^4$). As in the EA for the proposed rule, 15% or 19,452 of those starts are expected to take advantage of the waiver provision in the Phase II rule. The construction starts that take advantage of the waiver provision will incur administrative costs associated with the waiver. The other 110,223 starts would incur costs associated with obtaining a storm water permit.

[6]The methodology for estimating the number of construction starts is provided in Appendix B–2.

[7]Based on data collected from the US Bureau of the Census the annual growth rate for the number of building permits issued from 1980 to 1994 was 1.3%. This growth rate is used to estimate future construction starts from the 1994 baseline. However, EPA recognizes the growth rate for construction starts fluctuates yearly and does not necessarily increase each year.

Exhibit 4–5. Number of Construction Starts by Disturbed Area Size

Municipality	Number of Construction Starts by Disturbed Area Size							Total All Sizes	Total 1–5 Acres	% of Phase II Starts
	0–1 Acre	1–2 Acres	2–3 Acres	3–4 Acres	4–5 Acres	5 –10 Acres	> 10 Acres			
Austin, TX	113	61	29	19	17	44	128	411	239	58%
Baltimore County, MD	71	113	61	44	39	81	11	495	328	66%
Cary, NC	30	52	26	24	11	27	21	191	143	75%
Fort Collins, CO	29	17	16	17	17	34	49	179	96	54%
Lacey, WA	7	3	2	1	2	5	3	23	15	65%
Loudoun County, VA	15	14	4	6	10	32	31	112	49	44%
New Britain, CT	15	1	6	0	0	6	2	30	22	73%
Olympia, WA	31	4	5	2	2	8	10	62	44	71%
Prince George's County, MD	180	30	12	9	5	76	6	318	236	74%
Raleigh, NC	13	7	15	10	9	19	15	88	54	61%
South Bend, IN	26	21	19	16	12	35	43	172	94	55%
Tallahassee, FL	148	58	18	17	13	32	34	320	254	79%
Tucson, AZ	33	32	21	13	17	21	64	201	116	58%
Waukesha, WI[1]	5	8	6	5	1	5	0	30	25	83%
Total Number of Starts	752	453	259	194	164	972	68	2632	1822	69%

[1]Data for Waukesha does not include residential (single or multi-family) dwellings. Data includes all other categories.

Per-Site Compliance Costs: Installation and O&M.. To estimate Phase II construction site compliance costs, EPA developed 27 model construction sites in an effort to reflect site conditions and erosion and sediment control practices throughout the country. The model sites varied in size (one, three, and five acres), soil erosivity (low, medium, and high), and slope (3%, 7%, and 12%). Using guidance contained in US EPA (1992a), EPA developed combinations of BMPs for the model sites to mimic commonly accepted erosion and sediment control practices. 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 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. Exhibit 4–6 shows the mix of BMPs selected for the various model sites. In developing the mix for each model site, EPA assumed that entities, when faced with the need for installation of BMPs, would select the most cost effective mix of BMPs. Detailed drawings of the model sites (i.e., site plans), assumptions, and BMPs that could be used under the Phase II rule are found in Appendix B–3.

Following the development of the model sites, EPA estimated the BMP costs for each site using RS Means (RS Means 1997a and 1997b). A description of each BMP used for the model sites, average price, and efficiency are summarized in Exhibit 4–7. Based on the mix of BMPs assumed for each model site presented in Exhibit 4–6, combined with the costs provided for each BMP in Exhibit 4–7, EPA derived total estimated costs for each model site (Exhibit 4–8).

Exhibit 4–6. BMPs Used for the Model Sites

Site Size (acres)	Soil Erodibility	Slope		
		3%	7%	12%
1	low	a	a,b	a,c,e
	med	a,b	a,c,e	a,c,e
	high	a,c,e	a,c,e	c,e,f,g1
3	low	a,b	a,c,e	c,d,e,f,g2
	med	a,c,e	a,c,e	c,d,e,f,g2
	high	a,c,e	c,d,e,f,g2	c,d,e,f,g2
5	low	a,c,d,e	c,d,e,f,g3	c,d,e,f,g3
	med	a,c,d,e	c,d,e,f,g3	c,d,e,f,g3
	high	c,d,e,f,g3	c,d,e,f,g3	c,d,e,f,g3

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 (1=1,800 cf, 2=5,400 cf, 3=9,000 cf)

Exhibit 4–7. Description of BMPs Used for 27 Model Construction Sites

BMP	Description	Use on Model Site Plans	Price 1998 ($)	Removal Efficiency (%) for Total Suspended Solids[1]
Silt Fence	Sediment controlling device constructed from a geotextile fabric stapled to a wood stake. Polypropylene or wire mesh reinforcement is often incorporated for support. The lower six inches of the fence are installed in a trench and backfilled. Commonly used on small construction sites, usually installed around the perimeter of the disturbed area. Not appropriate where concentrated flows occur or for clay soils.	Placed along the lower perimeter of the site, curved slightly upland on the ends. A quantity of silt fence would be used to control runoff from soil stockpiles.	$1.13 per Linear Foot	Sandy loam: 80–99% Silt loam: 50–80% Silt clay loam: 0–20%
Mulch (Hay)	Erosion preventing practice which disperses the energy of raindrops, thereby decreasing splash erosion and increasing infiltration. Spread by hand or mechanically, usually up to an inch in depth (two to three tons/acre). An excellent choice for small sites as a low price erosion control with fairly easy maintenance and installation. Source: Brown, W. and Caraco, D. (1997).	On severe sites, mulch was specified for coverage on the entire site. On less severe sites, mulch was specified for coverage on half the site.	$0.21 per Square Yard	Sand, Silt loam: 90–100% Silt clay loam: 70–95%
Seed and Mulch	Used to establish a temporary stand of grass. Grass reduces the velocity of runoff and increases infiltration while its roots hold soil in place. Mulch is used to reduce rainfall impact and to hold seeds in place. Seed and mulch are used on a majority of the study sites.	On severe sites, seed and mulch was specified for coverage on the entire site. On less severe sites, seed and mulch was specified for coverage on half the site.	$0.43 per Square Yard	90–100%
Stabilized Construction Entrance	Areas where points of ingress/egress are stabilized with coarse stone over a bed of geotextile fabric. Soil tracking can lead to significant sediment pollution, as it tends to wash into the street drainage system. Stabilized construction entrances are used to dislodge soil from the treads of truck tires before exiting the site.	Not used on smaller sandy sites, since these soils do not tend to track from the site.	$15.72 per Square Yard	Na

Exhibit 4–7. Description of BMPs Used for 27 Model Construction Sites *(continued)*

BMP	Description	Use on Model Site Plans	Price ($) 1998	Removal Efficiency (%) for Total Suspended Solids
Stone Check Dam	Piles of 1.5" to 3" stone placed in swales and at outlets, usually on a bed of geotextile fabric. Cause water to pond behind the structure, thereby reducing the velocity and force acting on the soil. *Source:* US DOT. (1995). Capture sediment entering the swale from project grading activities and serve as a backup to the stabilized construction entrance, capturing any sediment washed into the swale from the street. Superior in removal efficiency and cost to hay bale check dams because hay bale dams need constant maintenance, are difficult to install properly, and frequently fail. *Source:* Brown, W. and Caraco, D (1997).	Used at various intervals in the swale on most of the study sites.	$61.53	na
Earth Dike	Ridges of soil constructed to direct the flow of sediment-laden storm water to a treatment device or area. Usually seeded and mulched if expected to remain in service for an extended period of time.	The dikes appearing on the study sites are used in place of silt fence where soil type (clay) or steepness preclude its use. The dikes direct flow from the entire site to either a sediment trap or detention pond.	$0.74 per Linear Foot	na
Sediment Trap (1,800, 5,400 and 9,000 CF)	Designed to intercept and retain runoff from disturbed areas for a long enough period of time to allow suspended sediment to settle out. Best suited for small construction sites with a maximum drainage area of five acres. Relatively inexpensive and easy to install in comparison to other frequently used practices such as silt fencing. *Source:* Brown, W. and Caraco, D. (1997).	Sediment traps appear on study sites with steep sites and clay soils. The traps are placed in the southeast corner of the site. Earth dikes convey runoff to the sediment trap from the upland areas of the site. The discharge from the sediment trap is stabilized with a stone apron.	$513.32 (1,800 CF) $1,669.47 (5,400 CF) $2,671.20 (9,000 CF)	60%

Source: RS Means (1997a) and RS Means 1997b.
Na = Not Available.

Exhibit 4–8. Estimated Cost of BMPs for the Model Sites (1998 dollars)

Site Size (acres)	Soil Erodibility	Cost by Slope			Average Cost
		3%	7%	12%	
1	low	$317	$814	$1,422	$1,206
	med	$814	$1,422	$1,422	
	high	$1,422	$1,422	$1,799	
3	low	$1,978	$3,804	$6,047	$4,598
	med	$3,804	$3,804	$6,047	
	high	$3,804	$6,047	$6,047	
5	low	$6,245	$9,334	$9,519	$8,709
	med	$6,245	$9,334	$9,519	
	high	$9,334	$9,334	$9,519	

EPA attempted to match construction start data collected from the fourteen municipalities to the model sites; however, data was unavailable on soil erodibility or slope. So, EPA calculated an average cost for each model site size by soil erodibility level across the slope categories. To obtain the average cost for a site size, all values were added across each soil erodibility category (low, medium, or high) for each site size and divided by the number of slope and soil erodibility cost categories. These values are presented in Exhibit 4–8.[8]

EPA developed an average BMP cost for one, three, and five acre starts for all soil erodibilities and 3%, 7%, and 12% slopes. The average BMP cost was estimated to be $1,206 for a one acre site, $4,598 for a three acre site, and $8,709 for a five-acre site.

Per-Site Compliance Costs: Administrative. Additional construction costs resulting from compliance with the final Phase II rule include the following: costs to submit a notice of intent (NOI) for coverage under the existing Construction General Permit (63 FR 7858); costs to notify municipalities about the project; costs for the development of a storm water pollution prevention plan (SWPPP); costs for record retention; and costs to submit a notice of termination (NOT) at the completion of the project. For purposes of estimating costs of the final Phase II rule, these other administrative costs were based on those presented in the EA for the proposed rule. Each of these other costs, estimated on a per-site basis, are discussed below. In analysis of the final rule, each other per-site cost was summed and added to the average site cost for a total compliance cost estimate per construction site.

EPA used labor categories and hourly rates to estimate labor costs for activities by construction sources. The fully loaded rates in 1998 dollars are $34.19 for engineering assistant, $33.27 for

[8]EPA considered estimating construction costs by weighted average, unfortunately the number of construction starts for each acre size, soil erodibility, and slope is unknown. In the fourteen municipalities in which data was collected few record slope, but none included soil erodibility.

drafter, and $22.57 for clerical support (US DL, 1993), (ENR, 1998), (RS Means, 1998). It is assumed that an engineering assistant and drafter would work on the development of SWPPP. An engineering assistant is assumed to work on the NOI, Notification of Municipalities, and NOT. Clerical support is assumed for record keeping.

- **NOI** Under the Construction General Permit (CGP), owners/operators of construction sites must complete an NOI to obtain coverage. EPA estimated the burden for completing the NOI form to be 3.7 hours with an associated labor cost of $126.50 (adjusted to 1998 dollars) (63 FR 7858).

- **Notification of Municipalities** Under the CGP, owners/operators of construction sites must notify the local municipality that they are operating an NPDES permitted construction site within their jurisdiction. EPA estimated the burden to be 0.5 hours and the cost of this notification to be $17.10 (adjusted to 1998 dollars).

- **SWPPP** Under the final Phase II rule, all construction site owners/operators will be required to develop and implement a SWPPP. The requirements for the SWPPP are identical to those included in the CGP, except for making the plans available for public review. The SWPPP requirements include the following: description of site conditions; identification of controls to be used to reduce the offsite transport of pollutants; regular maintenance of controls; and biweekly inspections of controls. Because Phase II construction sites are smaller than those regulated under the CGP, EPA assumed inspections will occur on a monthly, rather than a biweekly, basis.

Exhibit 4–9 presents the specific requirements for development and implementation of a SWPPP, associated low and high costs to complete each element, and an average cost for development and implementation of the SWPPP. In implementing the SWPPP, EPA assumed the life of a construction site to be six months (NAHB telecommunication, July 1998).

Exhibit 4–9. Storm Water Pollution Prevention Plan Requirements and Unit Cost Estimates (1998 Dollars)

Cost Elements	Estimated Quantity (Hours) (Low)	Estimated Quantity (Hours) (High)	Estimated Cost[1] (Low) (1998 dollars)	Estimated Cost[1] (High) (1998 dollars)
1. Contents of the Plan				
a. Site Description				
• Description of the Nature of Construction Activity	0.25	1	$8.55	$34.19
• Description of the Intended Sequence of Major Activities	0.25	1	$8.55	$34.19
• Estimate of Total Area Expected to be Disturbed	0.1	0.5	$3.42	$17.10
• Runoff Coefficient[1]	0.1	0.5	$3.42	$17.10
• Site Map	0.5	4	$16.64	$133.08
• Name of Receiving Waters	0.1	0.1	$3.33	$3.33
b. Controls to Reduce Pollutants				
i. Erosion and Sediment Controls	0.5	4	$17.10	$136.76
ii. Storm Water Management	0.5	2	$17.10	$68.38
iii. Other Controls	0.1	1	$3.42	$34.19
iv. State and Local Controls	0.1	0.5	$3.42	$17.10
c. Maintenance	2	6	$68.38	$205.14
d. Inspections[2]	3	6	$102.57	$205.14
• Inspection Report	1.5	6	$51.29	$205.14
e. Non-storm Water Discharges	0.5	1	$17.10	$34.19
2. Deadlines for Plan Preparation and Compliance	NCA[3]	NCA	NCA	NCA
3. Signature and Plan Review	1	1	$34.19	$34.19
4. Keeping Plans Current	NCA	NCA	NCA	NCA
5. Additional Requirements	NCA	NCA	NCA	NCA
6. Contractors	0.1	0.1	$3.42	$3.42
Total[4]	10.6	34.7	$361.87	$1,182.63
Average[5]	22.7		$772.25	

[1] Costs based on labor wage rate of $11.78 per hour for engineering assistant, except for site map and name of receiving waters which are based on drafter's wage of $11.58 an hour (US DL, 1993). These wage rates were escalated to 1998 dollars by using the Engineering News Record's Construction Cost Index, (www.enr.com/cost/costcci.asp). These labor were also inflated by 50% for fringe and 60% for overhead and profit. Source: RS Means, 1998a and RS Means 1998b.

[2]Construction is assumed to last six months at every site. The inspection at the smallest sites is assumed to take ½ hour per inspection event and at large sites (4–5 acres) one hour per inspection event.

[3]NCA = No Costs Associated.

[4]Totals may not add because of rounding.

[5]The average hours and costs was estimated by adding the low and high estimates and dividing by two.

- **Records Retention** Under the CGP, the owner/operator of a construction site must retain all records required under the permit for three years from the date of final stabilization. EPA estimated the cost for record retention to be $4.51 per site. This assumes that approximately 0.2 hours would be spent filing documents relevant to the site.

- **NOT** Under the CGP, upon final stabilization of the site, the owner/operator must submit an NOT to the permitting authority. EPA estimated the cost for submitting an NOT to be approximately $17.10 (adjusted to 1998 dollars) and the burden to be 0.5 hours to complete the form.

From this analysis, EPA estimated total average compliance costs (BMP plus other costs) for a Phase II construction site of $2,143 for sites disturbing between one and two acres of land, $5,535 for sites disturbing between two and four acres of land, and $9,646 for sites disturbing between four and five acres of land. A summary of the other administrative construction per-site costs is presented in Exhibit 4–10.

Exhibit 4–10. Estimated Other Administrative Phase II Construction Costs Per Site (1998 Dollars)

Administrative Requirement	Cost
NOI	$126.50
Municipal Notification	$17.10
SWPPP	$772.25
Record Retention	$4.51
NOT	$17.10
Estimated Total Cost (per site)	$937.46

Per-Site Waiver Costs. The permitting authority may waive permitting requirements for Phase II construction sites under two conditions. Construction sites can be waived if they are either located in areas with low rainfall potential or if water quality analyses show that there is no need for regulation. EPA estimated the cost for preparing and submitting a written waiver certification to be approximately $34.19. The corresponding hour burden is one.

National Construction Costs. EPA's estimate of national level incremental annual costs combines compliance costs for construction starts that disturb between one and five acres and administrative costs for construction starts that are expected to qualify for a waiver. To estimate national level incremental annual compliance costs, EPA multiplied the total cost of compliance, for one to two acre, two to four acre, and four to five acre sites by the total number of Phase II construction starts within each of those size categories. Exhibit 4–11 indicates the estimated construction compliance cost by climatic zone (climatic zones reflect regional variations in rainfall intensity and amount.) To estimate national level incremental annual waiver costs, EPA multiplied the total cost of preparing and submitting a waiver certification form by the construction universe that is expected to qualify for a waiver. Exhibit 4–12 summarizes the estimated national construction compliance and waiver costs.

Exhibit 4–11. Estimated National Phase II Construction Compliance Costs by Climatic Zones for Year 1998 (1998 Dollars)

Climatic Zone	Representative City	Number of Starts 1–2 Acres	Number of Starts 2–4 Acres	Number of Starts 4–5 Acres	Total Starts	Costs for Starts 1–2 Acres	Costs for Starts 2–4 Acres	Costs for Starts 4–5 Acres	Total Costs
A	Portland, OR	1,683	1,471	659	3,813	$3,608,528	$8,141,052	$6,360,054	$18,356,897
B	Boise, ID	1,508	1,345	576	3,429	$3,232,932	$7,443,548	$5,556,280	$16,455,088
C	Fresno, CA	2,388	2,018	974	5,380	$5,118,068	$11,171,812	$9,400,679	$26,039,422
D	Las Vegas, NV	7,154	6,256	3,035	16,445	$15,335,047	$34,628,344	$29,276,500	$80,306,157
E	Denver, CO	1,787	1,613	636	4,036	$3,829,714	$8,928,128	$6,135,764	$18,893,606
F	Bismarck, ND	560	469	156	1,185	$1,199,916	$2,595,370	$1,508,877	$5,304,163
G	Helena, MT	1,067	921	348	2,336	$2,287,796	$5,098,377	$3,354,650	$10,740,823
H	Amarillo, TX	3,295	2,838	1,152	7,285	$7,063,767	$15,708,383	$11,110,516	$33,882,666
I	San Antonio, TX	1,105	960	414	2,479	$2,368,045	$5,314,569	$3,997,033	$11,679,647
K	Duluth, MN	2,957	1,796	326	5,078	$6,339,106	$9,939,565	$3,141,089	$19,419,760
M	Des Moines, IA	9,335	7,599	2,695	19,629	$20,009,581	$42,063,182	$26,002,165	$88,074,928
N	Nashville, TN	5,801	4,707	1,705	12,212	$12,434,357	$26,052,990	$16,445,128	$54,932,475
P	Atlanta, GA	5,157	2,956	1,127	9,241	$11,054,430	$16,364,835	$10,875,252	$38,294,517
R	Hartford, CT	6,909	5,324	2,116	14,348	$14,808,848	$29,468,120	$20,412,901	$64,689,869
T	Charleston, SC	1,194	675	263	2,132	$2,560,342	$3,736,824	$2,535,496	$8,832,662
V	Hawaii	504	423	218	1,145	$1,080,648	$2,340,928	$2,099,447	$5,521,023
W,X,Y	Alaska	22	20	8	50	$47,885	$112,127	$72,563	$232,575
Total		52,426	41,389	16,408	110,223	$112,379,010	$229,108,154	$158,284,394	$499,771,558

Note: Number of sites include only those where storm water BMPs are not currently required by Federal or State programs. Totals may not add because of rounding.

Exhibit 4–12. Phase II Erosion and Sediment Control Annual Costs

Construction Costs	Universe	Estimated Total National Annual Costs (1998 dollars)
Compliance Costs	110,223	$499,771,558
Waiver Costs*	19,452	$665,064
Total	129,675	$500,436,622

*Based on an engineering assistant's wage of $34.19 per hour. U.S. Department of Labor, 1996.

Post-Construction Costs

EPA developed an analysis of potential costs to the construction and land development sector that may result from post-construction runoff control measures in municipal storm water management programs. The analysis and results are described in this section and Appendix B–4.

Cost Analysis Summary. The Phase II municipal program requires municipalities to develop, implement, and enforce a program that addresses storm water runoff from new development and redevelopment sites on which land disturbance is greater than one acre and that discharge into a regulated MS4. EPA did not include sites that disturb greater than 10 acres in the analysis because the construction general permit (CGP) already requires post-construction controls on those sites (63-FR 7858). On new development and redevelopment sites, EPA recommends that post-development runoff conditions should not be different from predevelopment conditions in a way that adversely affects water quality. Municipalities may select from an array of structural and non-structural options in implementing this measure.

While implementation of this rule will likely include a mix of planning, site design, and structural approaches, the cost analysis focused on structural controls (installation and maintenance of structural BMPs) because development of nationally-applicable planning and site design measures was infeasible. As detailed in Appendix B–4, EPA developed average annual BMP costs for sites of one, three, five, and seven acres. The analysis accounted for varying levels of imperviousness that characterize residential, commercial, and institutional land uses (i.e., per-site BMP costs are highest for intensely used commercial sites (85% impervious coverage), lowest for residential sites (35% impervious coverage), and moderate for a mixed category including institutional, commercial, and residential uses (65% impervious coverage). Exhibit 4–13 summarizes the weighted average total per-site costs for each of the modeled sites.

Exhibit 4–13. Summary of Per-Site Average Total Costs by Acreage and by Percent Imperviousness

Average BMP Costs (1998 dollars)			
Area (Acreage)	**35% Impervious (Multi-Family Residential)**	**65% Impervious (Multi-Family/Commercial)**	**85% Impervious (Commercial)**
1 Acre	$2,277	$4,867	$10,192
3 Acres	$5,172	$12,068	$15,260
5 Acres	$8,760	$14,389	$17,497
7 Acres	$15,865	$29,248	$68,996

Average per-site costs were multiplied by the number of construction starts for each category to determine national post-construction runoff control costs. Exhibit 4–14 summarizes the number of construction starts by acreage category that may be affected by the Phase II rule. In developing this estimate, EPA removed construction starts that were located in counties with roughly equivalent programs under CZARA in the following states: Rhode Island, Delaware, Maryland, Pennsylvania, Florida, South Carolina and Alaska. However, this is not a complete list of all the potentially equivalent programs that are in effect in Phase II municipalities and so the estimated number of construction starts should be considered a conservatively high estimate of the number of potentially affected by the post-construction runoff control provision.

Exhibit 4–14. Estimated Number of Construction Starts Potentially Affected by the Phase II Post-Construction Runoff Control Provision

Construction Starts (1998)[1]				
Area Acreage	**Multi-Family Residential (35%)**	**Multi-Family/ Commercial/ Institutional (65%)**	**Commercial (85%)**	**Totals**
1 Acre	221	2,942	2,505	5,668
3 Acres	287	2,451	1,939	4,677
5 Acres	228	822	523	1,573
7 Acres	244	818	384	1,445
Totals	981	7,033	5,351	13,364

[1] Totals may not add due to rounding.

Exhibit 4–15 summarizes the estimated costs that construction site operators could incur nationally when complying with requirements established by municipalities for the post-construction runoff control minimum measure. This approach to estimating costs on a per-site basis implicitly assumes that this measure is implemented by installing structural BMPs on a site-by-site basis. As noted above, however, the Phase II Storm Water rule allows flexibility in how MS4s design and implement their post-construction runoff control programs. Consequently, some programs may adopt alternative approaches that may be more cost effective than site-by-site BMPs.

To derive a national average for BMP costs, the cost estimates were based upon a weighted average of five commonly used structural BMPs. The weighting factors did take into account possible site size limitations for use of certain BMPs for the four site size categories, however, this is not a complete list of potential structural BMPs. Therefore, many developers have considerable flexibility to either implement structural or nonstructural BMPs. This flexibility cannot be readily incorporated into the weighted average. Given a construction operators incentives to minimize overall project costs, it is reasonable to assume that construction operators will use the most cost-effective approach to comply with any post-construction runoff program enacted by a municipality. The most cost-effective BMP is site dependent, and so cost-effectiveness could not be considered in the cost analysis either. Therefore, the weighted national average should be considered the high end of a potential range of costs. The following section explains how EPA accounted for cost savings and uncertainties related to these costs.

Exhibit 4–15. Estimated Post-Construction Runoff Control Costs

Area	35% Impervious (Multi-Family Residential)	65% Impervious (Multi-Family/ Commercial/ Institutional)	85% Impervious (Commercial)	Total Cost (1998 dollars)
1 Acre	$503,163	$14,318,035	$25,530,478	$40,351,676
3 Acres	$1,486,961	$29,571,535	$29,588,931	$60,647,426
5 Acres	$2,001,641	$11,835,630	$9,151,038	$22,988,309
7 Acres	$3,863,272	$23,910,571	$26,494,414	$54,268,258
Total Cost	$7,855,037	$79,635,771	$90,764,861	$178,255,669

Additional Options for Post-Construction Control. The post-construction control provision allows for an array of structural and non-structural options for municipal implementation. These options include:

- improved site/construction design that minimizes impervious areas or redirects runoff to grassy surfaces
- site-based local controls, such as buffer strips and riparian zone preservation
- other municipal regulatory approaches, such as reduced parking requirements for commercial facilities and changes to zoning and comprehensive plans, and
- requiring structural BMPs for new development and redevelopment sites.

Some of these options may result in cost savings to municipalities and land developers. In this section, several site-specific examples of cost savings associated with post-construction storm water management are presented. For example, reductions in levels of imperviousness through reducing roadway travel widths, minimizing setback requirements, using looped roads, and

providing compact car spaces are all strategies that may also lower site development costs (Ewing, 1998). With the exceptions noted in Appendix B–4, however, these types of savings are not incorporated into the national cost estimate because they depend on site-specific conditions and municipal ordinances.

Examples compiled by NRDC (1998) of how structural and nonstructural BMPs can reduce costs associated with traditional storm sewers include:

- Design changes for a new vehicle maintenance facility at Fort Bragg reduced parking lot paved surfaces from 19.1 acres to 14.3 acres with grassed islands and detention basins to reduce the size of storm water conveyance pipe. Cost savings included a $800,000 reduction in paving expenditures, $400,000 in storm drain costs, and $400,000 in excavation costs.

- A planned mall expansion in Farmington, Connecticut required an additional 4.7 acres in parking for peak shopping periods. The developer installed reinforced turf instead of asphalt, which allowed water infiltration, thereby avoiding any costs to expand the existing storm drain system and build a $1 million detention pond.

- Vegetated swales, percolation beds and ponds make up the surface drainage system of the Village Homes residential subdivision in Davis, California. The surface drainage system saved $800 per lot in infrastructure costs over a traditional subsurface drainage system. Furthermore, the system was able to handle the retention and infiltration needs of a 50-year storm, including overflow from nearby conventional drainage systems.

- Storm water redesign elements for the Oregon Museum of Science and Industry in Portland, Oregon, redirected storm water into parking lot medians, which were enlarged to create mini-wetlands. These changes generated construction cost savings of $78,000 by reducing the number of manholes and catch basins, and the amount of piping and trenching needed to handle storm water.

Other examples of potential cost savings of structural and nonstructural BMPs include:

- Cluster developments for housing subdivisions can reduce capital costs by 10% to 33% by reducing the length of the required infrastructure; reduce grading costs substantially by avoiding the need to clear and grade 35% to 60% of total site area; and lower the cost of storm water conveyance and treatment by reducing site impervious cover from 10% to 50% depending on size/layout (Schueler, 1997).

- A comparison between conventional development plans and alternatives that decreased impervious surface in three Delaware counties showed development cost savings ranging from 39% to 63%; conservation techniques included reducing street widths, reducing lot size, cluster developments, woodland preservation, and vegetated BMPs (DE DNRED, 1997 as cited in Center for Watershed Protection, 1998).

- Some types of well-designed structural or nonstructural BMPs can increase nearby property values because of the amenities associated with by a nearby open space, greenbelt, or year-round pond, or they can serve a dual purpose such as providing water for irrigation (Schueler, 1997).

Exhibit 4–16 presents results of a study conducted by the Delaware Department of Natural Resources and Environmental Control and the Brandywine Conservancy that examined comparative site development costs associated with storm water management (Delaware Department of Natural Resources and Environmental Control, 1997). Four case study sites were selected; these sites had actual development proposals with conventional storm water management designs. Conservation design alternatives were developed for these sites, and associated costs were compared to the conventional approaches. These alternatives used such approaches as concentrating development to reduce road lengths and impervious coverage, using natural site hydrology for conveying and treating storm water, careful selection of water infiltration areas based on soils, and revegetating key infiltration areas. Costs for such nonstandard items as revegetation were included in the cost comparison.

The average cost per lot for conventional development approaches was $16,464. The average cost per lot for conservation development approaches was $8,611, or just over half of the conventional development costs for storm water management systems. While these case study sites were larger than sites addressed by Phase II rule, the results nonetheless point to the possibility of significant cost savings resulting from creative planning and site design approaches.

Based on the flexibility offered by these potentially lower-cost BMP and development options, EPA considers the estimated annual cost for the post-construction runoff control provision, shown in Exhibit 4–15, to be the high end of a range of potential costs. This is due to the great deal of uncertainty in the number of potential starts, the flexibility in the types of post-construction runoff control measures adopted by each Phase II municipality, and the wide array of potential control options available to construction operators. As a result, EPA has chosen to present post-construction runoff control costs may range from 25% of the site-by-site costs represented in Exhibit 4–15, resulting in a range of costs from $44.5 to $178.2 million, as shown in Exhibit 4–17 below. Exhibit 4–18 shows the total estimated costs for the Phase II construction program, which consists of erosion and sediment control provision costs and post-construction runoff control provision costs.

Exhibit 4–16. Comparison of Site Development Costs Associated with Storm Water Management: Conventional Development vs. Conservation Development

	Chapel Run Sussex County, DE 96 Acres 142 Lots	New Castle County, DE 19 Acres 55 Lots	Tharpe Knoll Kent County, DE 33 Acres 23 Lots	Pleasant Hill Farm Kent Cty, DE 84 Acres 90 Lots
Project Costs for Storm Water Management				
Conventional Development	$2,460,200	$541,400	$561,650	$1,284,100
Conservation Development, Strategy 1	$888,735	$199,692	$339,715	$728,035
Conservation Development, Strategy 2	$1,174,716	Only one strategy evaluated.	$244,800	Only one strategy evaluated.
Costs Per Lot				
Conventional Development	$17,325	$9,844	$24,420	$14,268
Conservation Development, Strategy 1	$6,259	$3,631	$14,770	$8,089
Conservation Development, Strategy 2	$8,273		$10,643	

Source: Conservation Design for Stormwater Management, Delaware Department of Natural Resources and Environmental Control and the Brandywine Conservancy, September 1997.

Exhibit 4–17. Estimated Range of Post-Construction Runoff Control Costs (1998 Dollars)

	Low Cost Estimate	High Cost Estimate
Annual National Cost	$44,563,917	$178,255,669

Exhibit 4–18. Total Phase II Construction Program Costs (1998 Dollars)

	Cost Estimate
Erosion and Sediment Control Costs	$500,436,622
Post-Construction Runoff Control Costs	$44,563,917 – $178,255,669
Total Construction Costs	$545,000,539 – $678,692,291

4.2.3 Federal Costs

In administering the Phase II storm water program, the EPA will incur costs in its role as the permitting authority for the affected entities within non-NPDES authorized states and territories.[9] EPA must review and manage the application, certification, reporting, and notice requirements for these affected entities. The associated costs are based upon the amount of annual labor the agency will need to devote to these tasks.

There are approximately 10,711 construction starts which will have the EPA as the NPDES permitting authority; and of these starts 85% will need to come into compliance with Phase II while the other 15% will likely qualify for a waiver.[10] Using data from the 1990 Census, it was estimated that there are 357 MS4s, located in non-NPDES authorized states, that will come under the jurisdiction of the Phase II rule. This number includes incorporated places, counties, and minor civil divisions (i.e., unincorporated towns and townships), Federally-recognized Native American Indian Tribal lands, and municipios (Puerto Rico). Exhibit 4–19 reports the estimated costs to EPA as a result of Phase II permitting authority requirements.

Exhibit 4–19. Estimated Federal Annual Costs (1998 dollars)

Phase II Program Activity	Respondents Per Year[1]	Burden Hours per Respondent[2]	Hourly Labor Costs[3]	Estimated Cost[4]
Construction Program				
Waiver Cert. Processing & Review	1,607	1	$28.37	$45,590
NOI Processing & Review	9,104	1	$28.37	$258,280
NOT Processing	9,104	0.5	$28.37	$129,140
Small MS4 Program				
NOI Processing & Review	357	0.8	$28.37	$8,102
Report Processing & Review	357	1.6	$28.37	$16,205
Annual Total				$457,318

[1] The number of respondents per year was based on the 1990 Bureau of Census data for small MS4s and 8.26% of total starts that are in non-NPDES states and territories in exhibit B–2–3 and B–2–4 for construction.
[2]Burden hours per respondent was estimated by EPA.
[3]Hourly labor costs are based upon an average annual Federal employee salary of $39,338, divided by 2,080 labor hours per year and then increased 50% to represent overhead costs (US Office of Personnel Management, 1998).
[4]Estimated cost is the product of the respondents per year, hours per respondent, and hourly labor costs.

[9] These states and territories are expected to be Maine, New Hampshire, Massachusetts, Puerto Rico, District of Columbia, New Mexico, Arizona, Idaho, and Alaska.

[10] Using the information provided in Exhibits B–2–3 and B–2–4 from Appendix B, it was determined that 8.26% of the total starts are in the states and territories that EPA will be the NPDES permitting authority for the Phase II rule. 129,675* 0.0826= 10,711.

4.2.4 State Costs

Those states and territories that possess NPDES permitting authority, will incur costs related to the review and management of the application, certification, reporting, and notice requirements for the Phase II MS4s and construction starts under their jurisdiction. Based on 1990 Bureau of the Census data calculations, there are 4,749 Phase II regulated small MS4s located in NPDES-authorized States and Territories. This number includes incorporated places, counties, and minor civil divisions (i.e., unincorporated towns and townships). For the activity of developing designation criteria and using them to assess small MS4s located outside of an urbanized area, a respondent universe of 44 is used to represent each of the NPDES-authorized States and Territories for which this activity must be done. Exhibit 4–20 provides an estimate of the cost burden to the states and territories for administering the Phase II rule.

Exhibit 4–20. Estimated State Annual Costs (1998 dollars)

Phase II Program Element	Respondents Per Year[1,2]	Burden Hours per Respondent[3]	Hourly Labor Costs[4]	Estimated Cost
Construction Program				
Waiver Cert. Processing & Review	17,845	1	$26.87	$479,495
NOI Processing & Review	101,119	1	$26.87	$2,717,068
NOT Processing	101,119	0.5	$26.87	$1,358,534
Small MS4 Program				
NOI Processing & Review	4749	0.8	$26.87	$102,085
Report Processing & Review	4749	1.6	$26.87	$204,169
Annual Total				$4,861,350

[1] The number of respondents per year was based on the 1990 Bureau of Census data for small MS4s and 91.7% of total starts that are in NPDES states and territories in exhibit B–2–3 and B–2–4 for construction

[2]The number of respondents in each category represents the estimated respondents located within the 44 NPDES-Authorized States and Territories.

[3]Burden hours per respondent was estimated by EPA.

[4]The hourly labor rate for NPDES Authorized States and Territories was based on the average hourly rate for state and municipal employees as determined by the U.S. Department of Labor, Bureau of Labor Statistics (US DL, 1997).

4.3 Summary of Results

A summary of the potential costs from implementing the Phase II municipal measures and construction site erosion and sediment controls is presented in Exhibit 4–21. Once the Phase II storm water rule is fully implemented, the total annual cost for implementing the rule is expected to range from $847.6 to $981.3 million (assuming 129,675 construction starts, 13,364 construction starts relevant to the post-construction analysis, and 32.5 million households in 5,040 municipalities). The largest portion of the total cost is associated with erosion and sediment controls at construction sites.

Exhibit 4–21. Potential Annual Costs for Phase II Storm Water Regulation

Phase II Element	Universe	Estimated Total National Annual Costs (1998 dollars)
Municipal	32,458,000 Households	$297,318,623
Construction	129,675 Erosion & Sediment Control Starts and 13,364 Post-Construction Starts	$545,000,539 – $678,692,291
Federal and State	53 States and Territories	$5,318,668
Total		$847,637,830 – $981,329,582

4.4 Potential Pollutant Loading Reductions Resulting from the Phase II Rule

From the new data collected and the revised and new analyses conducted for the final Phase II rule, EPA developed two estimates of potential pollutant loading reductions from municipalities and construction starts.

4.4.1 Pollutant Loading Reductions from Municipalities

It is widely accepted that there are many different types of pollutants in storm water runoff depending on land use activities. The Nationwide Urban Runoff Program (NURP), a study conducted by EPA from 1978–1983, monitored the levels of pollutants in storm water runoff from 28 municipalities (US EPA, 1983). NURP found the following pollutants in the municipal storm water runoff: oil and grease, TSS, nitrogen, phosphorus, pathogens, lead, copper, zinc, other metals, biological oxygen demand (BOD), and chemical oxygen demand. However, there are no national studies to date that estimate pollutant loading reductions due to the implementation of municipal storm water controls.

To estimate municipal pollutant loading reductions for the final Phase II rulemaking, EPA used the results from a 1997 EPA draft report that calculated national municipal loading reductions for TSS based on results of the NURP study (Hagler Bailly Services, 1997). Each aspect of the municipal pollutant loading reduction methodology used in analysis of the final Phase II rule is explained in more detail below. While estimating the pollutant loading reduction for TSS does not capture the full extent of potential loading reductions that result from implementing municipal storm water controls, this provides a minimum estimate of the reductions that may result from the Phase II rule.

EPA conducted a draft study in 1997 to determine the benefits of all NPDES wet weather programs including storm water, combined sewer overflows, and sanitary sewer overflows (Hagler Bailly Services, 1997). The study uses NURP monitoring data as a baseline, and estimates loading reductions for TSS based on the assumed implementation of specific controls. Only TSS was analyzed because data was readily available for that pollutant. In the 1997 draft study, runoff volume was estimated from the land area for 405 urbanized areas defined by the 1990 Census and identified in EPA's 1995 Report to Congress entitled "Storm Water Discharges Addressed by Phase II of the National Pollutant Discharge Elimination System" (US EPA, 1995a). Municipalities located in the 405 urbanized areas (less 21 combined sewer overflow (CSO) exempt cities) are included in Phase I and Phase II of the storm water program. Runoff was estimated using population density and rainfall data.

The baseline TSS concentrations in storm water runoff in the 1997 EPA draft study were obtained from Table 6–4 of the EPA manual entitled, "Urban Runoff Pollution Prevention and Control Planning" (US EPA, 1993b). Baseline concentrations were found to range from 141 mg/L to 224 mg/L for TSS. The storm water data in the manual were taken from the NURP study (US EPA, 1983). The NURP data have been widely accepted and referenced as reasonable estimates of pollutant concentrations in urban storm water runoff.

Based on a review of literature on BMP effectiveness, EPA determined that BMPs are 20% to 80% effective. Therefore, EPA assumed that BMPs would reduce pollutants in storm water by between 20% to 80%. Exhibit 4–22 shows the resulting estimates of TSS reductions attributable to the implementation of BMPs required under the NPDES storm water program.

Exhibit 4–22. Estimated Ranges of Daily TSS Reductions from EPA's Phase I and Phase II Storm Water Programs

BMP Efficiency (%)	Volume (mgd)	Baseline Conc. (mg/L)		Baseline Loads (tons/day)		Reductions (tons/day)	
		Low	High	Low	High	Low	High
20	27,584	141	224	16,219	25,766	3,244	5,153
80	27,584	141	224	16,219	25,766	12,975	20,613

Source: US EPA, 1997a.

It should be noted that removal efficiencies depend on how much of the estimated runoff actually is affected by structural and nonstructural BMPs. At this time, no supporting data has been collected and analyzed to indicate how much of the total runoff in urban areas will be affected by storm water BMPs. Therefore, this analysis assumes that all runoff is controlled by BMPs which may not accurately reflect the actual reduction attributable to the storm water programs.

For analysis of the final Phase II rule, EPA developed a TSS reduction for Phase II by comparing total municipal populations between Phase I and Phase II and distributing the loading reductions proportionally. The total population for the 405 urbanized areas evaluated in the 1997 study was estimated at 160 million (US EPA, 1995a). Of the 160 million, the total Phase I MS4 population is 75 million while the total Phase II municipal population is 85 million (US EPA, 1995a). This results in 54% of the loading reduction attributable to implementation of the Phase II program.[11] Exhibit 4–23 shows the proportion of TSS loading reductions EPA attributed to Phase II municipalities on a daily and annual basis for both 20% and 80% BMP effectiveness. EPA anticipates that municipalities will strive to achieve 80% effectiveness when implementing their storm water programs.

Exhibit 4–23. Estimated TSS Loading Reductions for Phase II Municipalities

BMP Efficiency (%)	Tons/Day		Tons/Year	
	Low	High	Low	High
20	1,751	2,783	639,115	1,015,795

[11]EPA considered comparing Phase I and Phase II storm water loadings by miles of infrastructure but was unable to determine the miles of storm water sewers in the municipal universe.

80	7,006	11,131	2,557,190	4,062,815

Source: US EPA, 1997a.

4.4.2 Pollutant Loading Reductions from Phase II Construction Starts

To estimate pollutant loading reductions from Phase II construction starts, the US ACE developed a model based on EPA's 27 model sites to estimate sediment loads from construction starts with and without Phase II controls (US ACE, 1998). The US ACE model uses the construction site version of the Revised Universal Soil Loss Equation (RUSLE) to generate sediment delivery estimates for 15 climatic regions with each of the following variations: three site sizes (one, three, and five acres), three soil erodibility levels (low, medium, and high), three slopes (3%, 7%, and 12%), and the BMP combinations from EPA's 27 model sites. The 15 climatic regions were used in an effort to represent the various climatic conditions throughout the United States. Sediment delivery represents the quantity of sediment that bypasses the BMPs placed at the base of the hill slope.

Pollutant loading reductions for the Phase II construction universe were determined using an average for one, three, and five acre sites with medium erodibility and slopes ranging from 3% to 12%. This approach is consistent with that used in the construction cost analysis.

To determine the weighted average sediment load per Phase II construction site, the sediment loads developed by the US ACE for one, three, and five acre sites of medium soil erodibility were multiplied by the number of construction starts disturbing between one and two, two and four, and four and five acres of land in each climatic zone. The total loadings were summed and then multiplied by the ratio of construction starts in each size category by the total number of each construction sites for each climatic zone. This provided an average sediment load per climatic region for Phase II construction sites with moderately erodible soil. Then, the average loads per climatic region were multiplied by the ratio of total Phase II construction starts in each climatic zone to the total Phase II 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 II controls. The US ACE model was also used to derive an estimate of potential sediment load reductions attributable to soil erosion controls. These values, as presented in Exhibit 4–24, indicate that the weighted average soil loss per start was 96.1 tons and the potential reductions in soil loss could be 89.6 tons. 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.

Exhibit 4–24. Weighted Average Sediment Loadings and Loading Reductions (tons) from Phase II Construction Sites of Medium Soil Erodibility

Climatic Region	Representative Community	Average Loading—No Controls (tons)	Average Loading—With Controls (tons)	Average Loading Reduction (tons)
A	Portland, OR	52.3	1.8	50.5
B	Boise, ID	9.1	0.7	8.4
C	Fresno, CA	9.2	0.3	8.9
D	Las Vegas, NV	6.0	0.1	5.9

Exhibit 4–24. Weighted Average Sediment Loadings and Loading Reductions (tons) from Phase II Construction Sites of Medium Soil Erodibility

Climatic Region	Representative Community	Average Loading—No Controls (tons)	Average Loading—With Controls (tons)	Average Loading Reduction (tons)
E	Denver, CO	30.9	1.9	29.0
G	Bismarck, ND	37.0	2.2	34.8
G	Helena, MT	10.4	0.7	9.8
H	Amarillo, TX	78.3	5.8	72.5
I	San Antonio, TX	202.5	16.3	186.2
K	Duluth, MN	61.6	4.0	57.6
M	Des Moines, IA	124.3	9.8	114.5
N	Nashville, TN	176.5	12.4	164.0
P	Atlanta, GA	213.0	15.5	197.5
R	Hartford, CT	100.7	4.4	96.2
T	Charleston, SC	294.7	16.9	277.9
Weighted Average[1]		96.1	6.5	89.6

Source: Derived from US ACE (1998).
[1]EPA estimated the weighted average loads based on the slope, erosivitity of the soil, and the number of construction starts in each size category.

To determine the reduction in soil loss using the estimated 80% effectiveness rate, EPA multiplied the weighted average soil loss per start (89.6 tons) by 80%. This resulted in an estimated reduction in soil loss of 71.7 tons per-site. Multiplying this reduction by the 110,223 construction starts expected to implement erosion and sediment controls for the year 1998, results in an estimated 7.9 million ton reduction in soil loss annually.

4.4.3 Summary

A summary of the total annual national loading reduction estimates attributable to the Phase II rule, for both municipalities and construction starts, is presented in Exhibit 4–25.

Exhibit 4–25. National Reduction Estimates for Municipalities and Construction Starts (tons/year)

Phase II Element	20% Reduction	80% Reduction
Municipal TSS Loading	639,115	4,062,815
Soil loss from Construction Sites	1,975,196	7,900,785

4.5 Cost Effectiveness

For purposes of this regulatory analysis, cost effectiveness is defined as the incremental annualized cost of a pollution control option per incremental pound of pollutant removed annually by the control option. Cost-effectiveness analysis can thus be used to compare pollutant removal costs across regulatory alternatives. This type of analysis is limited for the Phase II rule because EPA was only able to quantify potential reductions in TSS loadings. EPA also anticipates that the rule will result in reductions in oil and grease, nitrogen, phosphorus, pathogens, lead, copper, zinc, and other metals.

EPA compared the potential costs per pound of TSS removed from Phase II municipalities to the costs estimated for publicly owned treatment works (POTW) to remove this same pollutant. This approach is parallel to the cost reasonableness test established by EPA in developing technology-based effluent limits for conventional pollutants (see 51 FR 24982). Under this approach, EPA compares industry costs with that of an "average" POTW with a flow of 2.26 million gallons per day (mgd) and costs of $0.70 (1998 dollars) per pound of pollutant removal (BOD and TSS).

Based on this cost effectiveness analysis, the rule may result in Phase II municipalities experiencing costs of between $0.04 (80% BMP efficiency; high end reduction) and $0.18 (20% BMP efficiency; low end reduction) per pound of TSS removed.[12] While EPA anticipates 80% effectiveness at reducing pollutant loading following program implementation, both low and high end reduction costs are low compared to the $0.70 (1998 dollars) established for POTWs to remove BOD and TSS.[13] Thus, the requirements of the final Phase II rule appear to be cost effective. This is particularly true since EPA's analysis of cost-effectiveness is based solely on removal of one of many pollutants believed present in storm water discharges.

4.6 Sensitivity Analyses

Due to the diversity of municipalities and various conditions of construction sites nationwide, the analysis of costs will likely reflect some uncertainty. A sensitivity analysis identifies the assumptions that may bias the final cost estimates. The purpose of this sensitivity analysis is to examine the importance and magnitude of the key assumptions used in the analysis. In its analysis, EPA may have overestimated municipal costs because municipalities that are currently implementing some components of the Phase II municipal program were not considered. EPA is uncertain of the activities municipalities will take to achieve compliance with the regulation, therefore estimating compliance costs is difficult. For example, EPA is uncertain about the number of municipalities that will be designated, by the permitting authority, to apply for a Phase II municipal permit. The potential also exists for construction activities to occur on areas with slopes greater than 12%; however, the number of starts, and for that matter the number of starts at any given slope is unknown. To determine the sensitivity of costs to the assumptions used in the analysis, EPA performed six sensitivity analyses as presented below. To be

[12]Cost effectiveness is based on the total cost of the rule because the municipal component includes construction activity within the watershed.

[13]The technologies used for secondary treatment at POTWs removes both BOD and TSS at the same time. Therefore, estimating the tons of TSS removed from secondary treatment is not possible.

conservative, EPA used the higher potential cost estimates for post-construction controls in the sensitivity analyses (see Exhibit 4–15).

Scenario One. As discussed in Section 4.2.1, the annual per household costs for the Phase II program elements ranged from $0.42 to $54.91. Estimated costs of the municipal program, presented in Section 4.2, are based on the mean of $9.16 per household. For this sensitivity analysis, EPA estimated national annual Phase II municipal costs using the median of $4.19 per household. The results are presented in Exhibit 4–26a.

Exhibit 4–26a. Results of Sensitivity Analysis for Scenario One

Assumption	Estimated Total National Annual Costs (1998 dollars)
Original Estimates as Presented in Section 4.3	$981,329,582
Scenario One — Estimate of Municipal Program Cost adjusted to Reflect Median[1]	$820,011,508
Percentage Change from the Original Estimate	–16.44%

[1]Based on per household costs of $4.19.

Scenario Two. As discussed in Section 4.2.1, the annual per household costs for the Phase II program elements ranged from $0.42 to $54.91. Estimated costs of the municipal program, presented in Section 4.2, are based on the mean of $9.16 per household. For this sensitivity analysis, EPA estimated national annual Phase II municipal costs using the 75th percentile of $10.40 per household. The results are presented in Exhibit 4–26b.

Exhibit 4–26b. Results of Sensitivity Analysis for Scenario Two

Assumption	Estimated Total National Annual Costs (1998 dollars)
Original Estimates as Presented in Section 4.3	$981,329,582
Scenario Two—Estimate of Municipal Program Cost adjusted to Reflect 75th Percentile[1]	$1,021,577,955
Percentage Change from the Original Estimate	4.10%

[1]Based on per household costs of $10.40 and 129,675 construction starts.

Scenario Three. To estimate municipal costs in Section 4.2.1, EPA used estimates of the number of households located in automatically designated Phase II communities. To develop this scenario, EPA estimated annual Phase II municipal costs by increasing the number of households to include 10% of the 4,539,440 potentially designated municipal households (see Exhibit 3–2). The results are presented in Exhibit 4–26c.

Exhibit 4–26c. Results of Sensitivity Analysis for Scenario Three

Assumption	Estimated Total National Annual Costs (1998 dollars)
Original Estimates as Presented in Section 4.3	$981,329,582
Scenario Three—Estimate of Municipal Program Cost Adjusted to Include 10% of the Households Located in Potentially Designated Communities[1]	$985,487,709
Percentage Change from the Original Estimate	0.42%

[1]Based on per household costs of $9.16, 129,675 construction starts, and an increase of 453,944 households.

Scenario Four. As presented in Section 4.2.2, to estimate Phase II construction site costs, EPA developed 27 model construction sites in an effort to reflect site conditions and erosion and sediment control practices throughout the country. The model sites varied in size (one, three, and five acres), soil erosivity (low, medium, and high), and slope (3%, 7%, and 12%). Many municipalities do not allow construction on very steep slopes, therefore slopes greater than 12% were not considered for the main analysis. However, for this sensitivity analysis, EPA included a slope value of 18%. The methodology used to develop the cost for this analysis is consistent with that used in Section 4.2.2. The results are presented in Exhibit 4–26d.

Exhibit 4–26d. Results of Sensitivity Analysis for Scenario Four

Assumption	Estimated Total National Annual Costs (1998 dollars)
Original Estimates as Presented in Section 4.3	$981,329,582
Scenario Four—Estimate of Construction Program Cost Adjusted to Include 18% Slope Variable[1]	$1,077,118,232
Percentage Change from the Original Estimate	9.76%

[1]Based on per household costs of $9.16 and 129,675 construction starts.

Scenario Five. To estimate municipal costs in Section 4.2.1, EPA used estimates of the number of households located in automatically designated Phase II communities. However, if all the municipalities that could potentially receive a waiver from the permitting, did receive a waiver, the number of households would be reduced. For this scenario, EPA estimated annual Phase II municipal costs by first subtracting those municipalities that serve less than 1,000 people from the list of Phase II municipalities. This subtraction represents the maximum number of municipalities (1,001) that could potentially qualify under the waiver provision. As a result, the total number of Phase II households are reduced by 107,539. The adjusted number of households was then multiplied by the average per house hold cost to determine total municipal costs. The results are presented in Exhibit 4–26e.

Exhibit 4–26e. Results of Sensitivity Analysis for Scenario Five

Assumptions	Estimated Total Annual National Costs (1998 dollars)
Original Estimate as Presented in Section 4.3	$981,329,582
Scenario Five—Estimate of Municipal Program Cost Adjusted to Reflect the waiver provision for municipalities serving less than 1,000	$980,343,435
Percentage Change from the Original Estimate	–0.10%

1. Based on a Phase II municipal population of 84,908,666 people (32,350,707 households) and 129,675 construction starts.

Scenario Six. To estimate state and federal administrative costs in Sections 4.2.3 and 4.2.4, EPA only considered those costs that are likely to be incurred on an annual basis. There, are start-up costs associated with the administration of Phase II by the permitting authorities. However, it is uncertain how often these costs will be incurred. As described in Appendix B–5, some of the start-up activities may occur only once while others may be done each permit cycle. For example, the incorporation of 401 certification language into the general permit language is likely to only need to be done once, while the designation of additional MS4s may occur occasionally at the beginning of each new permit cycle. Due to this uncertainty, and the relatively small magnitude of these costs when annualized (see Appendix B–5), EPA decided against including these costs within the cost analysis. However, to assess the potential impact of these costs a sensitivity analysis was conducted. Scenario six assumes that all start-up costs are incurred once every permit cycle of five years. The results are presented in Exhibit 4–26f.

Exhibit 4–26f. Results of Sensitivity Analysis for Scenario Six

Assumptions	Estimated Total Annual National Costs (1998 dollars)
Original Estimate as Presented in Section 4.3	$981,329,582
Scenario Five – Estimate of Federal and State administrative costs adjusted to include annualized start-up costs.[1]	$981,381,188
Percentage Change from the Original Estimate	0.005%

[1]A description of start-up costs can be found in Appendix B–5.

As demonstrated in Scenario One, selection of mean versus median makes a significant difference (16%) in national costs results. Scenario Two shows that use of the 75th percentile per household cost in estimating national municipal costs closely approximates the national municipal costs for the mean value, differing by just 4%. In Scenario Three, the change in assumptions regarding the municipal universe did not make a significant difference in cost outcome. The sensitivity analysis for construction costs (Scenario Four) shows that national costs may increase by $96 million annually when assumptions regarding construction activities on slopes are reconsidered. The sensitivity analysis for the municipal waiver provision showed that the waiver provision is unlikely to have a significant effect on the total costs. Finally, the sensitivity analysis for federal and state administrative start-up costs demonstrates that these costs will have no significant effect on total costs.

4.7 Conclusion

EPA estimates the total annual costs of the rule to be between $847 and $981 million. This estimate includes approximately $297 million attributable to the municipal component, approximately $545 to $678 attributable to construction controls, and $0.46 million and $4.9 million for federal and state administrative costs, respectively. The cost-effectiveness analysis shows the Phase II rule to be cost effective. For municipalities, costs are expected to range from $0.04 to $0.18 per pound of TSS removed compared to $0.70 per pound of TSS removed for POTWs. In addition, only TSS was considered in the municipal pollutant loading reduction analysis and it is well known that many other pollutants are found in storm water discharges, e.g., nitrogen, phosphorus, lead, copper, and zinc. The municipal minimum measures required by the final Phase II rule are expected to assist in removing these other pollutants as well. Other increases in cost effectiveness may result if certain assumptions used in this analysis were adjusted with respect to the results of the sensitivity analysis (mean municipal costs versus mean values, etc.).