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Analysis Of Implementing Permitting Activities For Storm Water Discharges Associated With Industrial Activity

Staff Analysis, July 1991

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ANALYSIS OF IMPLEMENTING PERMITTING ACTIVITIES FOR STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY

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1.0 INTRODUCTION

1.1 BACKGROUND

The 1972 amendments to the Federal Water Pollution Control Act (FWPCA, also referred to as the Clean Water Act or CWA), prohibited the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a NPDES permit. Efforts to improve water quality under the NPDES program have focused traditionally on reducing pollutants in discharges of industrial process waste water and from municipal sewage treatment plants. This program emphasis has developed for a number of reasons. At the onset of the program in 1972, many sources of industrial process waste water and municipal sewage were not controlled adequately, and represented pressing environmental problems. In addition, sewage outfalls and industrial process discharges were easily identified as responsible for poor, often drastically degraded water quality conditions. However, as pollution control measures were developed initially for these discharges, it became evident that more diffuse sources (occurring over a wide area) of water pollution, such as agricultural and urban runoff, were also major causes of water quality problems. Some diffuse sources of water pollution, such as agricultural storm water discharges and irrigation return flows, are exempted statutorily from the NPDES program. Controls for other diffuse sources have been slow to develop under the NPDES program.

Since enactment of the 1972 amendments to the CWA, considering the rise of economic activity and population, significant progress in cleaning up water pollution has been made, particularly with regard to industrial process waste water and municipal sewage. Expenditures by EPA, the States, and local governments to construct and upgrade sewage treatment facilities substantially have increased the population served by higher levels of treatment. Continued improvements are expected for these discharges as the NPDES program increases emphasis on control of toxics and water quality-based permit limits.

Several National assessments have been conducted to evaluate impacts on receiving water quality. For the purpose of these assessments, urban runoff was considered to be a diffuse source or nonpoint source pollution, although legally, most urban runoff is discharged through conveyances such as separate storm sewers or other conveyances which are point sources under the CWA and subject to the NPDES program. The "National Water Quality Inventory, 1988 Report to Congress" provides a general assessment of water quality based on biennial reports submitted by the States under Section 305(b) of the CWA. In preparing Section 305(b) Reports, the States were asked to indicate the fraction of the States' waters that were assessed, as well as the fraction of the States' waters that were fully supporting, partly supporting, or not supporting designated uses. The Report indicates that of the rivers, lakes, and estuaries that were assessed by States (approximately one-fifth of stream miles, one-third of lake acres and one-half of esturine waters), roughly 70 percent to 75 percent are supporting the uses for which they are designated. For waters with use impairments, States were asked to determine impacts due to diffuse sources (agricultural and urban runoff and other categories of diffuse sources), municipal sewage, industrial (process) wastewaters, combined sewer overflows, and natural sources, then combine impacts to arrive at estimates of the relative percentage of State waters affected by each source. In this manner, the relative importance of the various sources of pollution causing use impairments was assessed and weighted national averages were calculated. Based on 37 States that provided information on sources of pollution, industrial process wastewaters were cited as the cause of use impairment for 7 percent of rivers and streams, 10 percent of lakes, 6 percent of estuaries, 41 percent of the Great Lakes shoreline and 6 percent of coastal waters. Municipal sewage was the cause of use impairment for 13 percent of rivers and streams, 5 percent of lakes, 48 percent of estuaries, 41 percent of the Great Lakes shoreline and 11 percent of coastal waters.

The Assessment also concluded that pollution from diffuse sources such as runoff from agricultural, urban areas, construction sites, land disposal activities, and resource extraction activities is cited by the States as the leading cause of water quality impairment.[1] Diffuse sources appear to be increasingly important contributors of use impairment as discharges of industrial process wastewaters and municipal sewage plants come under control and intensified data collection efforts provide additional information. Some examples where use impairments are cited as being caused by diffuse sources include: rivers and streams, where 9 percent are caused by separate storm sewers, 4 percent are caused by construction and 11 percent are caused by resource extraction; lakes where 8 percent are caused by separate storm sewers and 7 percent are caused by land disposal; the Great Lakes shoreline, where 35 percent are caused by separate storm sewers, 46 percent are caused by resource extraction, and 19 percent are caused by land disposal; for estuaries where, 41 percent are caused by separate storm sewers; and for coastal areas, where 20 percent are caused by separate storm sewers and 29 percent are caused by land disposal.

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[1] Major classes of diffuse sources that include, in part, storm water point source discharges are: urban runoff conveyances, construction sites, agriculture (feedlots), resource extraction sites, and land disposal facilities.

The States conducted a more comprehensive study of diffuse pollution sources under the sponsorship of the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) and EPA. The study resulted in the report "America's Clean Water - The States' Nonpoint Source Assessment, 1985" which indicated that 38 States reported urban runoff as a major cause of beneficial use impairment. In addition, 21 States reported construction site runoff as a major cause of use impairment.

Studies conducted by the National Oceanic and Atmospheric Administration (NOAA)[2] indicate that urban runoff is a major pollutant source which adversely affects shellfish growing waters. The NOAA studies identified urban runoff as affecting over 578,000 acres of shellfish growing waters on the East Coast (39 percent of harvest-limited area); 2,000,000 acres of shellfish growing waters in the Gulf of Mexico (59% of the harvest-limited area); and 130,000 acres of shellfish growing waters on the West Coast (52% of harvest-limited areas).

II. FRAMEWORK OF NPDES SYSTEM

Congress established the NPDES program with the 1972 Amendments to the FWPCA. Section 402 of the Act requires EPA to administer a national permit program to regulate point source discharges of pollutants to waters of the United States and sets out the basic elements of the program.

A. STATE PROGRAMS

The Act allows States to request EPA authorization to administer the NPDES program instead of EPA. Under Section 402(b), EPA must approve a State's request to operate the permit program once it determines that the State has adequate legal authorities, procedures, and the ability to administer the program.

EPA is also directed by section 304(i) of the FWPCA to adopt procedural and programmatic requirements for State NPDES programs, including guidelines on monitoring, reporting, enforcement, personnel and funding, and to develop uniform national forms for use by both EPA and approved States. At all times following authorization, State NPDES programs must be consistent with minimum Federal requirements, although they may always be more stringent.

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[2] See "The Quality of Shellfish Growing Waters on the East Coast of the United States", NOAA, 1989; "The Quality of Shellfish Growing Waters in the Gulf of Mexico", NOAA, 1988; and "The Quality of Shellfish Growing Waters on the West Coast of the United States", NOAA, 1990.

Upon authorization of a State program, the State is primarily responsible for issuing permits and administrating the NPDES program in that State. At the same time, EPA suspends the issuance of Federal permits for those activities subject to the approved State program.

State NPDES authority is divided into four parts: the core program (POTW and industrial permitting), Federal facilities, pretreatment, and general permitting. At this point in time, 39 States or Territories are authorized to, at a minimum, issue NPDES permits for municipal and industrial sources. Of these 39 States, 23 are currently authorized by EPA to issue NPDES general permits. In the 12 States (MA, ME, NH, FL, LA, TX, OK, NM, SD, AZ, AK, and ID) and 6 territories (District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands) without NPDES authorized programs, EPA issues all NPDES permits. In 5 of the 39 States that are authorized to issue NPDES permits for municipal and industrial sources, EPA retains authority to issue permits for discharges from Federal facilities.

B. REQUIREMENTS IN NPDES PERMITS

The CWA establishes two types of standards for conditions in NPDES permits, technology-based standards and water quality-based standards. These standards are used to develop effluent limitations, special conditions, and monitoring requirements in NPDES permits. Numeric effluent limitations that establish pollutant concentration limits for effluents at the point of discharge (end-of-pipe conditions) are generally at the heart of permits for discharges from POTWs and industrial process discharges. More recent permitting efforts have also addressed limiting the toxicity of effluents through specific toxicity limitations included in permits. Section 402(a)(1) authorizes the inclusion of other types of conditions that are determined to be necessary, known as special conditions, in NPDES permits. Special conditions include requirements for best management practices (BMPs).

1. Technology-Based Standards

Technology-based requirements under section 301(b) of the Act represent the minimum level of control that must be imposed in a permit issued under section 402 of the Act. Two technology-based requirements are appropriate for existing storm water discharges associated with industrial activity: (1) best conventional pollutant control technology (BCT); and (2) best available technology economically achievable (BAT). The BCT standard applies to the control of conventional pollutants, while the BAT standard applies to the control of all toxic pollutants and for all pollutants which are neither toxic nor conventional pollutants. Section 306 of the CWA provides for EPA to establish new source performance standards for new sources.

Technology-based requirements may be established through one of two methods: (1) application of national BAT/BCT effluent e limitations guidelines promulgated by EPA under section 304 of the CWA and new source performance standards promulgated under section 306 of the CWA applicable to dischargers by category or subcategory; and (2) on a case-by-case basis under section 402(a)(1) of the Act, using best professional judgement (BPJ), for pollutants or classes of discharges for which EPA has not promulgated national effluent limitations guidelines. (Note: EPA only establishes new source performance standards under Section 306 of the CWA when developing national effluent limitations guidelines, and not when establishing permit conditions on a case-by-case basis).

In addition to these factors, section 40 CFR 125.3(c)(2) requires that, in setting permit case-by-case limitations, the permit writer shall consider the appropriate technology for the category or class of point sources of which the discharge is a member, based upon all available information, and any unique factors relating to the discharge.

2. Water Quality-Based Standards for Controls

In addition to technology-based controls, Section 301(b) of the CWA also requires that NPDES permits must include any conditions more stringent than technology-based controls necessary to meet State water quality standards. Water quality-based requirements are established under this provision on a case-by-case basis.

III. PRIOR STORM WATER PERMITTING EFFORTS

Between 1976 and 1984, EPA regulations required that permit applications be submitted for a wide range of storm water discharges. Many facilities that were required to submit applications for storm water discharges did not apply. In addition, many of the permit applications received by EPA and authorized NPDES States were never acted upon for a number of reasons, including: lack of resources for permitting, lack of technical understanding of the causes and controls for pollutants in storm water, reluctance of industrial dischargers to accept requirements for best management practices (BMPs) in NPDES permits, and a general perception that storm water discharges, when considered one at a time, were of low priority. In 1984, EPA again promulgated permit application requirements and deadlines for storm water discharges. However, these regulations were subject to extensive litigation which resulted in their being remanded to EPA in December 1987. In February of that year, Congress enacted the Water Quality Act (WQA) of 1987 which directly specified a new national strategy for storm water control.

Despite the lack of a comprehensive permitting program for all storm water discharges prior to the passage of the WQA of 1987, permitting efforts nonetheless proceeded in some areas. Between 1974 and 1982, EPA promulgated effluent limitations guidelines for storm water discharges from ten categories of industrial discharges:

- o Cement Manufacturing
- o Feedlots
- o Fertilizer Manufacturing
- o Petroleum Refining
- o Phosphate Manufacturing
- o Steam Electric
- o Coal Mining
- o Ore Mining and Dressing
- o Mineral Mining and Processing
- o Asphalt Emulsion

Permitting efforts for storm water discharges have focussed on industrial facilities subject to these effluent limitation guidelines. In addition, some EPA Regions and States with authorized State NPDES programs have, to varying degrees, written permits for storm water discharges from other industrial facilities. For example, in some States and Regions, storm water discharges from industrial facilities are often addressed when NPDES permits for process wastewaters of a facility are reissued.

IV. PERMIT APPLICATION REGULATIONS

On November 16, 1990, (55 FR 47990), EPA published NPDES permit application requirements for: storm water discharges associated with industrial activity; and discharges from municipal separate storm sewer systems serving a population of 100,000 or more. The rulemaking accomplished three major tasks: (1) the rule defined the initial scope of the NPDES storm water program; (2) the rule established a permitting scheme with respect to storm water discharges associated with industrial activity through municipal separate storm sewer systems; and (3) the rule established permit application requirements for those storm water discharges which are initially subject to the program.

A. SCOPE OF NPDES STORM WATER PROGRAM

The initial scope of the NPDES storm water program is defined by two key regulatory definitions, "storm water discharges associated with industrial activity" and "large and medium municipal separate storm sewer systems". The term "storm water discharge associated with industrial activity" is defined at 40 CFR 122.26(b)(14) and addresses point source discharges of storm water from eleven major categories of facilities.

The terms "large and medium municipal separate storm sewer systems" (systems serving a population of 100,000 or more) are defined at 40 CFR 122.26(b)(4) and (7) to include municipal separate storm sewers located in: 173 incorporated places (cities) with a population of 100,000 or more; unincorporated portions of 47 counties identified as having large populations in unincorporated, urbanized portions of the county; and other municipal storm sewers which are designated by the Director on a case-by-case basis.

The definitions of "storm water discharge associated with industrial activity" and "large and medium municipal separate storm sewer system" only address point source discharges. Section 502(14) of the CWA defines the term "point source" broadly to include "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, . . . from which pollutants are or may be discharged."

In most court cases, the term "point source" has been interpreted broadly. For example, the holding in Sierra Club v. Abston Construction Co., Inc., 620 F.2d 41 (5th Cir., 1980) indicates that changing the surface of land or establishing grading patterns on land will result in a point source where the runoff from the site ultimately is discharged to waters of the United States:

> "Simple erosion over the material surface, resulting in the discharge of water and other materials into navigable waters, does not constitute a point source discharge, absent some effort to change the surface, to direct the water flow or otherwise impede its progress . . . Gravity flow, resulting in a discharge into a navigable body of water, may be part of a point source discharge if the [discharge] at least initially collected or channeled the water and other materials. A point source of pollution may also be present where [dischargers] design spoil piles from discarded overburden such that, during periods of precipitation, erosion of spoil pile walls results in discharges into a navigable body of water by means of ditches, gullies and similar conveyances, even if the [dischargers] have done nothing beyond the mere collection of rock and other materials . . . Nothing in the Act relieves [discharges] from liability simply because the operators did not actually construct those conveyances, so long as they are reasonably likely to be the means by which pollutants are ultimately deposited into a navigable body of water. Conveyances of pollution formed either as a result of natural erosion or by material means, and which constitute a component of a . . .

drainage system, may fit the statutory definition and thereby subject the operators to liability under the Act." (emphasis added) 620 F.2d 41, 45 (1980).

Under this approach, point source discharges of storm water result from structures that increase the imperviousness of the ground that acts to collect runoff, with runoff being conveyed along the resulting drainage or grading patterns.

The Agency will embrace the broadest possible definition of point source consistent with the legislative intent of the CWA and court interpretations to include any identifiable conveyance from which pollutants might enter the waters of the United States.

B. INDUSTRIAL STORM WATER DISCHARGES THROUGH MUNICIPAL SEPARATE STORM SEWER SYSTEMS

The November 16, 1990 notice clarifies that storm water discharges associated with industrial activity to waters of the United States, including those through municipal separate storm sewers to waters of the United States, must obtain NPDES permit coverage. However, storm water discharges associated with industrial activity to municipal sanitary sewer systems (i.e. those systems which are part of a POTW collection system), including combined sewer systems, do not need to obtain NPDES permit coverage, although they may be subject to pretreatment requirements.

C. PERMIT APPLICATION REQUIREMENTS

The November 16, 1990 rule established individual (40 CFR 122.26(c)(1)) and group (40 CFR 122.26(c)(2)) application requirements for storm water discharges associated with industrial activity. The requirements associated with individual application requirements for storm water discharges associated with industrial activity are incorporated into Forms 1 and 2F, which are generally to be submitted to the Director by November 18, 1991. In addition, operators of storm water discharges associated with industrial activity through large and medium municipal separate storm sewer systems are required submit a notification of their discharge to the operator of the municipal separate storm sewer system receiving the discharge by no later than May 15, 1991 or 180 days prior to commencing such discharge (40 CFR 122.26(a)(4)).

The rule also established permit application requirements for discharges from large and medium municipal separate storm sewer systems at 40 CFR 122.26(d).

To provide a reasonable and rational approach to addressing this permitting task, the Agency is developing a Strategy for issuing permits for storm water discharges associated with industrial activity. In developing this Strategy, the Agency recognizes that the CWA provides flexibility in the manner in which NPDES permits are issued,[3] and will use this flexibility to design a workable permitting system. In accordance with these considerations, the draft permitting Strategy (described in more detail earlier in today's notice) describes a four-tier set of priorities for issuing permits for these discharges. The four-tier set of priorities for issuing permits under the policy are:

- o Tier I - Baseline Permitting: One or more general permits will be developed to initially cover the majority of storm water discharges associated with industrial activity;
- o Tier II - Watershed Permitting: Facilities within watersheds shown to be adversely impacted by storm water discharges associated with industrial activity will be targeted for individual or watershed-specific general permits.
- o Tier III - Industry-Specific Permitting: Specific industry categories will be targeted for individual or industry-specific general permits; and
- o Tier IV - Facility-Specific Permitting: A variety of factors will be used to target specific facilities for individual permits.

The draft general permits accompanying this fact sheet will initiate Tier I activities for storm water discharges associated with industrial activity in the 12 States and 6 territories which do not have authorized State NPDES programs[4]; Federal facilities

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[3] The court in NRDC v. Train, 396 F.Supp. 1393 (D.D.C. 1975) aff'd, NRDC v. Costle, 568 F.2d 1369 (D.C.Cir. 1977), has acknowledged the administrative burden placed on the Agency by requiring permits for a large number of storm water discharges. The courts have recognized EPA's discretion to use certain administrative devices, such as area permits or general permits, to help manage its workload. In addition, the court recognized flexibility in the type of permit conditions that can be established, including the use of requirements for best management practices.

[4] Currently, the 12 States without authorized State NPDES programs are: Alaska, Arizona, Florida, Idaho, Louisiana, Massachusetts, Maine, New Hampshire, New Mexico, Oklahoma, South Dakota, and Texas. The 6 territories without authorized NPDES programs are: District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands.

and Indian lands in Colorado and from Indian lands in North Dakota, Minnesota, Michigan, Montana, Utah, Wisconsin and Wyoming by proposing baseline general permits for the majority of storm water discharges in these States and Federal facilities in Delaware.[5] (Note that these permits are intended to initially cover the majority of storm water discharges associated with industrial activity in the States and on the Indian lands addressed by these permits. In addition to establishing baseline requirements for the majority of storm water discharges associated with industrial activity in these States, the draft general permits have some of the features of Tier III permitting activities in that they establish requirements for specific industries.

[5] In 6 of the 39 States that are authorized to issue NPDES permits for municipal and industrial sources, EPA issues permits for discharges from Federal facilities. State programs do not generally address permitting of discharges from Indian lands, as EPA retains this responsibility. However, this fact sheet only addresses general permits as indicated above. Where EPA is the permit issuing authority for other storm water discharges, either individual permits or a different general permit will be issued.

2.0 METHODS

2.1 Characterizing the Nature and Extent of Pollutants in Storm Sewer Discharges

Data describing the nature and extent of pollutants in storm water discharges from individual facilities came from a number of sources, including effluent limitations guidelines development documents, Reports to Congress, EPA studies and studies. In addition, a search was made of the EPA Permit Compliance System (PCS) data base. The PCS data base contains reported characteristics of certain discharges subject to NPDES permits. The data in the PCS system represents discharges which are subject to regulation and which may have undergone treatment prior to discharge.

Additional evaluation of pollutants in storm water discharges associated with industrial activity were based on a consideration of the pollution potential of storm water discharges by expert industry consultants involved consideration of several factors, including: 1) loading or unloading of dry bulk materials or liquids, 2) outdoor storage of raw materials or products, 3) outdoor process activities, 4) dust or particulate generating processes, 5) illicit connections or management practices, and 6) waste disposal practices.

2.2 IDENTIFYING SOURCES OF STORM WATER

In this study EPA has attempted to provide estimates of the number of storm water discharges associated with industrial activity.

The Standard Industrial Classification (SIC) system provided the initial framework for identifying individual facilities. Facilities which are addressed by the regulatory definition of "storm water discharges associated with industrial activity" were identified.

After an initial evaluation, it was determined that the SIC system did not provide an appropriate classification of several classes of activities such as, construction and waste management activities. Alternative methods were used to estimate the number of facilities in these groups. Estimates of the number of construction sites for residential development were projected from data describing a portion of the entire set of sites. Data from Housing and Urban Development (HUD) was used to provide estimates of the number and size of construction activities for residential subdivisions. The HUD data was based on the review of applications for Federal insurance. HUD officials also provided estimates for the number of subdivisions which were not covered by an application for insurance. Various EPA studies provided data on the number and size of landfills and other waste disposal facilities.

Drainage is provided by combined sewers in portions of many municipalities with areas of older development. These combined sewer systems are not the primary subject of this study, but need to be evaluated to determine the number of facilities which discharge to a combined sewer. Estimates of the area and population served by combined sewer systems were based on data from the 1984 "Needs Survey". The 1984 Needs Survey reported estimates for each urbanized area that was thought to have combined sewers.

2.3. Review of Options and Costs of Controls

In 1979, EPA completed a technical survey of industry best management practices (BMPs) which was based on a review of practices used by industry to control the non-routine discharge of pollutants from non-continuous sources including runoff, drainage from raw material storage area, spills, leaks, and sludge or waste disposal. This review included analysis and assessment of published articles and reports, technical bulletins, and discussions with industry representatives through telephone contacts, written questionnaires and site visits.

The review identified two classes of pollution control measures. The first class of controls are those management practices generally considered to be essential to a good BMP program, are low in cost, and applicable to broad categories of industry and types of substances. These practices are independent of the type of industry, ancillary sources, specific chemicals, group of chemicals, or plant-site locations. The survey concluded that these controls were broadly applicable to all industry types and activities, and should be viewed as minimum requirements in any effective BMP program. The second class of controls are those management practices controls which provide a second line of defense against the release of pollutants and included prevention measures, containment measures, mitigation and cleanup measures, and treatment methods[1].

Since that time, EPA has, on a case-by-case basis, imposed BMP requirements in NPDES permits. The Agency has also continued

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[1] For a complete description of the BMP survey, see "NPDES Best Management Practices Guidance Document", U.S. EPA, December 1979, EPA-600/9-79-045. See also the 1981 document of the same name, "NPDES Best Management Practices Guidance Document" which provides a more complete discussion of baseline BMPs.

to review and evaluate case studies involving the use of BMPs[2] and the use of pollution prevention measures associated with spill prevention and containment measures for oil[3] and hazardous substances. In addition, the Agency has evaluated the various control options for hazardous waste tank systems[4]. During the development of NPDES permit application requirements for storm water discharges associated with industrial activity, the Agency evaluated appropriate means for identifying and evaluating the potential risk of pollutants in storm water from industrial sites. Public comments received during the rulemaking provided additional insight regarding storm water risk assessment, as well as appropriate pollution prevention and control measures and strategies. During this time, the Agency again reviewed storm water control practices and measures[5]. These experiences have shown the Agency that pollution prevention measures such as BMPs can be appropriately used and that permits containing BMP requirements can effectively reduce pollutant discharges in a cost-effective manner.

Permit Compliance Costs

Cost data was obtained from a variety of sources, including background documents for effluent limitations guidelines, technical literature, the Means Construction Cost Index, public comments on previous storm water rulemakings, surveys of industrial representatives, and comparisons with contractor charges. The Information Collection Request (ICR) document for the storm water implementation package provides additional consideration of the costs of monitoring requirements and notice of intent requirements. In addition, the ICR for the revisions to the NPDES storm water permit application regulations was used to evaluate the costs of many of the source identification

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[2] For example, see: "Best Management Practices: Useful Tools for Cleaning Up", Thron, H., Rogoshewski, P., 1982, Proceedings of the 1982 Hazardous Material Spills Conference; "The Chemical Industries' Approach to Spill Prevention" Thompson, C., Goodier, J., 1980, Proceedings of the 1980 National Conference on Control of Hazardous Material Spills; and a series of EPA memorandum entitled "Best Management Practices in NPDES Permits - Information Memorandum", 1983, 1985, 1986, 1987, 1988.

[3] See Oil Pollution Prevention requirements, including Spill Prevention, Control, and Countermeasure Plan requirements, at 40 CFR 112.

[4] See July 14, 1986 (51 FR 25422).

[5] Draft "Analysis of Implementing Permitting Activities for Storm Water Discharges Associated with Industrial Activity" (EPA, 1991).

provisions of the storm water pollution prevention plans as well as requirements to certify outfalls have been tested for illicit connections.

The pollution potential for discharging storm water from industrial facilities is primarily related to specific plant site configurations, such as the presence of outdoor material storage or indoor process areas. To address this, the approach taken with several types of controls such as baseline pollution prevention measures and spill prevention and containment provisions provides flexibility in the manner in which they are implemented for a given facility. It is anticipated that various facilities will implement various provisions in different ways, and will emphasize different provisions of their comprehensive plans, resulting in varying costs between facilities. In this analysis, to address this variability, a number of control scenarios were used to establish the range of costs likely to be encountered by industries. Under this approach, the action taken to respond to requirements were assumed to correspond to the configurations of facilities with different ancillary industrial activities, such as loading and unloading, conducted on site.

Examples of different types of plant configurations include:

- facilities which process all or partially outdoors with existing controls,
- facilities which process all or partially outdoors without existing controls,
- facilities which process indoors and have no outdoor storage,
- facilities which process indoors and have outdoor tank storage, and
- facilities which process indoors and have outdoor material storage.

Outdoor storage of materials includes storage of final products or raw materials as drums, piles, bags, parts, or other stock piles.

Five ancillary industrial activities may also contribute pollutants to storm water. These activities include loading and unloading, transportation-related activities such as engine maintenance, outdoor electrical activities including substations, industrial waste management, and air deposition. The ancillary activities may occur at some or all of the industrial facilities distributed among the six model plant configurations. The percentages of industrial facilities estimated to conduct these activities (based again on Agency expertise and professional engineers' experience with the regulated populations) are as follows:

- loading and unloading: 90 percent,

- transportation: 50 percent,
- outdoor electrical: 50 percent,
- Subtitle D waste management: 5 percent, and
- air deposition of pollutants regulated: 12 percent.

Since one facility may perform more than one ancillary activity, the sum of the percentages of facilities performing each ancillary activity exceeds 100%.

Storm water controls are assumed to be complimentary. For example, smaller detention ponds may be needed if infiltration areas are used to collect a portion of storm runoff, and curbing around loading areas will minimize contact of storm water with pollutant sources, and screens will require less frequent cleaning if slope protection and swales are installed at construction sites to minimize sediment in storm water. Further, good housekeeping by industry may limit the need for treatment plants by ensuring that toxic or hazardous materials do not contaminate storm water.

Cost estimations were made assuming that some required control measures, such as material inventory, employee training,a nd preventive maintenance, have already been implemented to some degree by some of the affected facilities to reduce chemical losses, increase overall productivity, profitability, and safety, or as part of compliance with other regulations. Industry costs for control measures that the facility already provided were not included in the analysis.

In some scenarios, both capital and O&M costs, for certain types of controls are projected to be zero. This is because appropriate controls for many SARA Title III facilities, such as diked tank storage or indoor material storage, are likely to be in place already.

The methodology used in this analysis was based on the "model plant" approach often used by the Office of Water's Industrial Technology Division in its development documents for Industrial Effluent Limitation Guidelines and Pretreatment Standards. Under this approach, model plants are selected that characterize the range of production processes, materials, and scale of operations within that industry. For each model plant, varying levels of control technology are specified for each flow.

The model plant approach was adapted to the storm water problem as follows:

<u>Costs for Industrial Activities</u>

- For industrial activities, factors were developed to represent the initial and annual costs of preparing and implementing a Storm Water Management Plan. "Minimum" and "maximum" costs were estimated, representing different judgement regarding the scale and complexity of the operations.

- Six model plants were selected to represent industrial activities. Five of the model plants were differentiated by the degree to which manufacturing facilities and material storage are indoors or outdoors, and whether storm water controls currently exist on site. The sixth model represented oil and gas extraction facilities. Separate models were specified to represent ancillary activities such as transportation, materials handling, and waste management.

- Storm water controls and their respective cost factors were estimated by professional engineers having experience in industrial storm water management. For both groups of industries, "maximum" and "minimum" control scenarios were analyzed. Each scenario represents an engineering judgement regarding the size of the activity, the volume of storm water handled, the amount of contamination, and the nature of the contaminants.

- A unique set of storm water requirements and controls was chosen for each scenario and for each of the six model plant configurations. For the analysis the following storm water requirements and controls were used:

  - Storm water management plans,
  - Dye testing for illicit connections,
  - Certification that outfalls have been tested for non-storm water discharges,
  - Employee training,
  - Preventive maintenance/housekeeping,
  - Discharge monitoring,
  - Runoff diversion trenches, ditches, and curbing, and
  - Treatment.

- All costs were converted to 1990 dollars.

3.0 FACILITIES COVERED

Facilities addressed by the regulatory definition of storm water associated with industrial activity can be broken into the following categories:

- o Resource extraction
- o Manufacturing
- o Construction
- o Land disposal
- o Transportation
- o Power generation

3.1 Resource extraction

3.1.1 Mines - Total number of facilities

The number of active mines varies from year to year, depending on economic factors. In 1980, the U.S. Bureau of Mines estimated that there were 600 metal mines. Over 90 percent of the metal mines are west of the Mississippi River, and over 60 are concentrated in 10 States with 20 or more mines each. There are about 6,045 non-metal mines (except fuels). Most of the nonmetal mines are clay, sand and gravel, and stone mines.

The Energy Information Administration of the Department of Energy (DOE) estimated that about 3,900 coal mines were active in 1987. The trend over the last ten years has been towards fewer small mines as more efficient mining methods for large mines (e.g. longwall and continuous mining) allow for greater production and productivity for the larger mines. DOE estimates that under 900 active mines produce less than 10,000 short tons of coal during the year, compared to over 3,000 active mines which produce more than this amount. The greatest number of mines are situated in the Appalachian region, which has about 90 percent of the national total. The number of underground versus surface operations in the Appalachian region are fairly close, but in both the Interior and Western regions there are many more surface than underground operations (about three times as many surface mines in the Interior region, and about twice as many surface mines as underground in the Western region).

Estimates of the number of inactive or abandoned mines vary considerably, with most estimates in the range of 400,000 to 1,000,000 sites. The present condition of these sites varies considerably with some site having been totally reclaimed, while other sites closely resemble the condition of active sites.

3.1.2 Oil and gas operations - Total number of Facilities

The oil and gas industry is extremely large and varied. The American Petroleum Institute estimates that in 1986, there were approximately 880,000 producing oil and gas wells in the United States, distributed throughout 38 States. About 30,000 wells are drilled each year. Texas has about 250,000 producing wells. Production from a single well can vary from a high of about 11,500 barrels per day (the 1985 average for wells on Alaska North Slope) to less than 10 barrels per day in many thousands of "stripper" wells. Overall, 70 percent of U.S. oil wells are strippers, accounting for roughly 14 percent of total U.S. production). On average, 3 to 4 wells are located at one site, with an estimated 240,000 sites nationwide. About 130,000 of these facilities have been required to develop spill prevention plans, generally after having reported releases of oil under the reporting requirements of the CWA. There are an estimated 1,200,000 abandoned oil or gas wells in the United States.

The "Census of State and Territorial Subtitle D Non-hazardous Waste Programs" estimates that there are more than 145,000 oil and gas waste or mining waste units.

3.1.3 Facilities with Contaminated Runoff

Section 402(l)(2) of the CWA provides that EPA shall not require an NPDES permit for discharges of storm water runoff from mining operation or oil and gas exploration, production, processing, or treatment operations or transmission facilities if the storm water discharge is not contaminated by contact with, or does not come into contact with, any overburden raw material, intermediate product, finished product, byproduct, or waste product located on the site of such operation.

The operator of a storm water discharge from an oil or gas operation is not required to submit a permit application unless the facility:

- o has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 117.21 or 40 CFR 302.6 at any time sine November 16, 1987;

- o has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 110.6 at any time sine November 16, 1987; or

- o contributes to a violation of a water quality standard.

NPDES permit applications are required when discharges of storm water runoff come into contact with any overburden, raw material, intermediate product, finished product, byproduct, or waste product located at the site. However, only mining operations with 'contaminated' storm water discharges are required to obtain NPDES permit coverage. The determination of whether a mining operations' runoff is contaminated will be made in the context of permit issuance proceedings.

3.2 Manufacturing

3.2.1 Total number of manufacturing facilities

Manufacturing industries include the industries covered by SIC codes 20 to 39. Table 3-1 provides estimates of the number of manufacturing facilities from the 1987 Census of Manufacturers.

3.2.2 Manufacturing facilities with Storm Water Discharges Associated with Industrial Activity

The regulatory definition of storm water discharge associated with industrial activity divides manufacturing facilities into two groups. Under the definition, facilities addressed by (SIC codes 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221-25 are only addressed by the regulatory definition if certain materials are exposed to storm water (see 40 CFR 122.26(b)(14)). Estimates of these facilities are provided in Table 3.2.

TABLE 3.1
1987 CENSUS OF MANUFACTURERS
TOTAL NUMBER OF MANUFACTURING FACILITIES

SIC	GROUP	NUMBER OF ESTABLISHMENTS
20	food	20,624
21	tobacco	138
22	textile	6,421
23	apparel	22,872
24	lumber and wood	33,962
25	furniture	11,613
26	paper	6,342
27	painting	61,774
28	chemicals	12,109
29	petroleum	2,254
30	rubber and plastic	14,515
31	leather	2,193
32	stone,clay and glass	16,166
33	primary metal	6,771
34	fabricated metal	36,105
35	industrial machinery	52,135
36	electronic	15,962
37	transportation equip.	10,500
38	instruments	10,326
39	misc, manu.	16,544

TABLE 3.2

NUMBER OF MANUFACTURING FACILITIES WITH
STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY

SIC	GROUP	NUMBER OF ESTABLISHMENTS
24 (except 2434)	lumber and wood	30,268
26 (except 265, 267)	paper	519
28 (except 283)	chemicals	10,753
29	petroleum	2,254
311	leather tanners	344
32 (except 323)	stone,clay and glass	14,734
33	primary metal	6,771
3441	fabrated. struct. metal	2,452
373	ship and boat build.	2,766
subtotal		70,861
category (xi) facilities		14,000

3.3 Construction

About 1.6 million acres of land are disturbed annually throughout the nation, much of it in building highways and other heavy development. About 80,000 acres a year are disturbed for urban housing and another 80,000 acres for urban non-residential development. The regulatory definition of storm water discharge associated with industrial activity addresses storm water discharges from construction activities that disturb over 5 acres of land.

3.3.1 Residential Construction

The majority of detached single family residential homes, as well as duplexes, or townhouses are built as part of a larger subdivision project. The number of subdivisions reviewed by Housing and Urban Development (HUD) for approval of federal insurance are provided in Table 3-3. The average number of lots or housing units within a subdivision reviewed by HUD was 64. These data were used to estimate that the total number of subdivision projects occurring annually equalled 13,000 (see Table 3-4).

3.3.2 Other Construction Activity

The amount of land disturbed by construction activities for non-residential projects is about equivalent to the amount of land disturbed for residential projects. EPA estimates that the number of non-residential projects annually is about 13,000.

TABLE 3-3. HUD REVIEWS - AVERAGE ANNUAL CHARACTERISTICS FOR SUBDIVISIONS APPLYING FOR FEDERAL INSURANCE DURING 1983-1985

	Number of Subdivisions	Number of Lots	Lots per Subdivision
Northeast	52	6,501	138
South	1,751	116,298	77
Midwest	332	18,385	55
West	1,435	81,766	58
Total	3,570	222,950	64

SOURCE: Housing and Urban Development (HUD)

Table 3-4. National Projection of the Number and Size Distribution of Single Family Detached and Townhouse Construction Operations.

Number of Units per Site	Number of Sites	Average Area of Subdivision or lot (acres)
more than 400	60	over 100
300 - 399	120	87
250 - 299	260	69
200 - 249	325	56
150 - 199	650	44
100 - 149	780	31
75 - 99	1,500	21
50 - 74	3,250	16
35 - 49	2,470	10
25 - 34	3,540	8
10 - 24	2,500	4
5 - 9	750	2
4 or less	8,000	1

3.4 Land disposal

The regulatory definition of storm water discharge associated with industrial activity addresses storm water discharges from the following four groups of facilities in the regulatory definition of "storm water discharge associated with industrial activity":

- o Hazardous waste treatment, storage, and disposal facilities (TSDFs) subject to RCRA Subtitle C permitting or interim status;
- o Landfills, land application sites, and open dumps that receive industrial wastes and are subject to regulation under RCRA Subtitle D;
- o Recycling facilities, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards; and
- o On-site POTW lands used for land application treatment technologies, sludge disposal, handling or processing areas, and chemical handling and storage areas.

3.4.1 RCRA Subtitle C

RCRA Subtitle C regulates facilities that treat, store, or dispose of RCRA-defined hazardous wastes. The National Screening Survey of Hazardous Waste Treatment, Storage Disposal, and Recycling Facilities (1986) estimated that there are 2,959 active treatment, storage, and disposal facilities (TSDFs). The majority of these facilities receive waste from on-site a manufacturing plant, and are counted as a manufacturing facility in this report. Commercial facilities (facilities receiving waste from off site) included 205 treatment facilities, 58 land disposal facilities and 220 recycling facilities.

3.4.2 Subtitle D Facilities (Excluding Mining and Oil and Gas Wastes)

Disposal of "nonhazardous" wastes is regulated under Subtitle D of the Resource Conservation and Recovery Act (RCRA). These wastes include many different types of waste streams, such as municipal solid waste, industrial waste, and construction and demolition debris.

EPA estimates that there are 35,163 active landfills, land application units and waste piles that receive Subtitle D wastes including municipal solid wastes, industrial wastes, municipal sewage sludge, construction and demolition debris and other miscellaneous wastes. These totals do not include units which receive mining waste, and oil and gas wastes. In addition, these totals do not include surface impoundments. Discharges from surface impoundments which receive Subtitle D wastes to waters of the United States are required to receive NPDES permits independently of the storm water regulations.

The State Census indicated that there are about 16,500 landfills and 19,000 land application units. Of the estimated 16,500 landfills, the States estimated that 6,034 are municipal solid waste landfills. The State Census indicates that an additional 32,000 closed solid waste disposal facilities are located across the United States. However, EPA is unable to determine how many of these facilities are municipal landfills, or industrial landfills.

Landfills or other waste disposal units are only addressed by the regulatory definition of storm water discharges associated with industrial activity if they receive industrial wastes.

Municipal Solid Waste Landfills

Table 3.5 provides estimates of the ownership of landfills. According to the State Census, landfills receiving municipal waste are distributed throughout the country, occurring in virtually every hydrogeologic setting, and generally concentrated near or in populated areas. Landfills receiving municipal wastes are owned predominantly by local governments (80 percent), with the remainder owned by private entities (15 percent), the Federal Government (4 percent) and State governments (1 percent). Approximately 42 percent are small (less than 10 acres) and 52 percent dispose of small amounts of waste (less than 17.5 tons per day).

The majority of Subtitle D facilities are both owned and operated by the same entity. However, some facility owners contract out the operation of their facility. Approximately 5 percent of publicly owned municipal solid waste landfills are operated by private entities. In addition, certain Federal agencies lease land to local governments for the operation of municipal solid waste landfills.

insert Table 3-5

Industrial Landfills

In 1985, about 14,000 industrial solid waste land disposal facilities (other than surface impoundments) handled approximately 7.6 billion tons of waste. Results of the "Census of State and Territorial Subtitle D Non-Hazardous Waste Programs" indicate only sporadic use of design and operation controls at industrial solid waste landfills. Study findings also revealed that few of these facilities have monitoring systems.

Recycling Facilities

Resource Recycling Magazine estimates that there are about 6,000 scrap metal and automobile salvage yards nationwide. Many other facilities involved in recycling activities are also involved in the manufacture of goods. For example, the estimated 1,800 facilities which recycle waste paper are addressed as paper manufacturers above. 200 of these paper mills use only waste paper as a raw material. An estimated 95 glass manufactures recycle glass. In addition, about 1,000 communities have recycling programs which involve curbside pickup. Over 60 percent of the recycling facilities are located in the following ten states: PA, NY, CA, OH, IL, TX, MI, NJ, IN, and FL.

POTWs

The 1988 Needs Survey indicates that 2,107 POTWs are required to have pretreatment programs. In addition, another 1,466 POTWs which are not required to have pretreatment programs under the NPDES program have flows of over 1.0 million gallons per day.

3.5 Transportation

The regulatory definition of storm water discharges associated with industrial activity addresses certain transportation facilities in SIC codes 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171. Based on data from the 1987 Census of Manufacturers, EPA estimates that there are 102,000 facilities in these SIC categories. However, facilities in these SIC codes are only addressed by the regulatory definition of storm water discharge associated with industrial activity if they have vehicle maintenance shops, equipment cleaning operations or airport deicing.

3.6 Power generation

Coal, petroleum, and natural gas are the most common fossil fuels used in electrical power generation. Hydroelectric and nuclear are the other major types of electrical generation plants. (Hydroelectric plants are not considered steam electric facilities, and hence are generally not addressed by the regulatory definition of storm water discharge associated with industrial activity). Electrical power plants typically have 1 to 10 units. Table 3-6 provides estimates of the number of electrical units by the type of fuel used for power generation, as well as the number of generating units.

TABLE 3-6. Operable Capacity by Energy Source in the United States, as of December 1987

Primary Energy Source	Estimated Number of Plants	Generator Capacity (nameplate)
Coal	163	718,056
Petroleum	432	315,697
Gas	257	84,215
*Hydroelectric	1,234	125,911
Nuclear	71	101,604
*Other	113	4,718
TOTALS	2,270	718,056

* Generally not addressed by EPA's regulatory definition of storm water discharge associated with industrial activity

SOURCE: Energy Information Administration, Department of Energy, Inventory of Power Plants in the United States 1987

NOTE: Many fossil-fuel burning units can use alternative sources of energy which are not accounted for here. (e.g. a unit using petroleum as the primary fuel, may use coal as an alternative unit)

3.7 Discharges to Combined Sewers

Storm water discharges associated with industrial activity that discharge to combined sewer systems or separate sanitary sewer systems are not addressed in the regulatory framework established under section 402(p) of the CWA. These discharges are generally not required to obtain an NPDES permit, but may be subject to local pretreatment limits established by the POTW.

Based on Need Survey data, about 25% of the population of the United States is served by combined sewers. The percentage of facilities discharging storm water to municipal storm sewers or combined sewers will vary depending on the type of activity. For example, many chemical industries and most metal products industries are located in or close to urbanized centers, and have a high probability of discharging storm water to municipal separate storm sewers or combined sewers. Other activities such as mining facilities, wood preservers, pulp and paper mills, and fertilizer manufacturers, and resource extraction are more rural in nature and are less likely to discharge storm water to municipal separate storm sewers or combined sewers.

The Agency estimates that about 40,000 facilities discharge storm water associated with industrial activity to combined sewer systems. These facilities are not included in EPA estimates of facilities that have storm water discharges associated with industrial activity which require NPDES permit coverage.

3.8 Summary - Facilities with Storm Water Discharges Associated with Industrial Activity

Table 3-7 provides estimates of the number of facilities with storm water discharges associated with industrial activity that are expected to have to obtain NPDES permit coverage. These estimates exclude facilities which discharge storm water to combined sewers. Based on an assessment of the various estimates used to reach these numbers, an error of plus or minus 50,000 can be expected.

For the following categories, estimates of the total number of facilities were reduced to only address facilities with storm water discharges associated with industrial activity:

Resource Extraction - The estimates provided in Table 3-7 only address facilities with contaminated storm water discharges which are required to submit permit applications under 40 CFR 122.26(c).

Waste Disposal - Estimates of facilities in the waste disposal category only addresses facilities which are not otherwise addressed under the manufacturing category. The majority of waste disposal facilities receive waste from on-site a manufacturing plant, and are counted as a manufacturing facility in this report.

Subtitle D landfills or other waste disposal units are only addressed by the regulatory definition of storm water discharges associated with industrial activity if they receive industrial wastes.

POTWs which route storm water from the facility through the treatment works are not included in these estimates.

Transportation Only transportation facilities in the identified SIC codes are only addressed by the regulatory definition of storm water discharge associated with industrial activity if they have vehicle maintenance shops, equipment cleaning operations or airport deicing.

Power Plants Coal pile runoff from steam electric facilities is subject to an effluent limitations guidelines. These facilities should have permits for these discharges. Only facilities with storm water discharges associated with industrial activity that is not covered by an existing NPDES permit are addressed.

TABLE 3-7
TOTAL NUMBER OF FACILITIES ADDRESSED BY REGULATORY DEFINITION OF STORM WATER DISCHARGE ASSOCIATED WITH INDUSTRIAL ACTIVITY (Excluding facilities which discharge to combined sewers)

Category	Number of facilities
Resource Extraction	
Mining with contaminated runoff	10,500
Oil and gas operations with contaminated runoff	23,000
Manufacturing (SIC codes 24(except 2434), (26 (except 265 and 267), 28 (except 283), 29, 311, 32 (except 323), 33, 3441, 373)	53,100
Manufacturing (SIC codes 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, 4221-25)	10,000
Construction	
Residential	13,000
Non-residential	13,000
Waste Disposal facilities	
Subtitle C RCRA facilities which receive wastes generated offsite	450
Subtitle D RCRA facilities	6,500
Recycling facilities	2,300
POTWs	1,500
Transportation facilities	19,000
Power generation	650
TOTAL	153,000

3.9 Special Classes of Facilities

3.9.1 Small Businesses

There is no standard size definition of a small business[1]. For the purposes of developing permit application requirements, EPA defines small businesses at 40 CFR 122.21(g)(8) as coal mines with a probable total annual production of less than 100,000 tons per year, and for all other applicants, businesses with gross total annual sales averaging less than $100,000 per year (in second quarter 1980 dollars or approximately $150,000 in 1990 dollars). This provision exempts small businesses from permit application monitoring requirements for certain organic chemicals.

Alternatively, small business can be defined in a number of ways, including in terms of gross total annual sales and number of employees. Around 32 percent of business have gross total annual sales of $220,000 or less, and 55 percent have gross total annual sales of $575,000 or less (see "The Annual Report on Small Business and Competition" (1989), The U.S. Small Business Administration).

Some statistics on distribution of manufacturing facilities within different SIC codes and the number of employees are presented in Table 3-8. Note that all facilities identified in Table 3-8 are not addressed by the regulatory definition of storm water discharge associated with industrial activity.

SARA Title III, Section 313 only applies to facilities with 10 or more full time employees. Therefore no small businesses with less than 10 or more full time employees are subject to the special requirements of these permits for these facilities. In addition, SARA Title III, Section 313 establishes thresholds for the amount of chemical that the facility manufactured (including imported), processed, or otherwise used a toxic chemical. After 1989, the threshold quantity of listed chemicals that the facility must manufacture, import or process in order to be required to submit a release report is 25,000 pounds per year. The threshold for a use other than manufacturing, importing or processing of listed toxic chemicals is 10,000 pounds per year. EPA believes that the amount of toxic chemical a facility manufactures, processes or otherwise uses generally correlates well with the size of the facility. For this reason, the Agency believes that the number of facilities with toxic chemicals subject to SARA Title III, Section 313 is disproportionately distributed towards larger facilities.

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[1] "The Annual Report on Small Business and Competition", 1989, U.S. Small Business Administration.

TABLE 3.8
1987 CENSUS OF MANUFACTURERS
TOTAL NUMBER OF MANUFACTURING FACILITIES
AND FACILITIES WITH LESS THAN 20 EMPLOYEES

SIC	GROUP	NUMBER OF ESTABLISHMENTS	ESTABLISHMENTS WITH LESS THAN 20 EMPLOYEES	ESTABLISHMENTS WITH LESS THAN 10 EMPLOYEES	ESTABLISHS. WITH LESS THAN 5 EMPLOYEES
20	food	20,624	10,930	8,045	4,167
21	tobacco	138	55	34	22
22	textile	6,421	2,975	2,514	1,993
23	apparel	22,872	13,335	10,127	6,358
24	lumber and wood	33,982	26,594	16,055	9,686
25	furniture	11,613	7,559	7,260	4,259
26	paper	6,342	2,179	1,429	675
27	painting	61,774	49,179	41,446	24,417
28	chemicals	12,109	7,192	6,154	3,240
29	petroleum	2,254	1,500	750	358
30	rubber and plastic	14,515	7,247	5,084	2,730
31	leather	2,193	1,283	1,615	1,111
32	stone,clay and glass	16,166	11,047	7,726	4,366
33	primary metals	6,771	3,083	2,272	1,112
34	fabricated metal	36,105	22,198	16,358	8,725
3[illegible]	industrial machinery	52,135	38,243	35,272	20,281
36	electronic	15,962	8,398	8,714	4,906
37	transportation equip.	10,500	6,248	5,572	3,268
38	instruments	10,326	6,242	6,357	3,660
39	misc, manu.	16,544	12,890	14,954	9,574
40	railroad trans.	255	151	108	43
41	local & iu transp.	9,889	6,694	4,865	2,872
42	trucking & warehou	69,106	58,868	49,013	34,200
44	water transportat	6,638	5,605	4,765	3,278
45	air transport.	5,505	4,684	3,995	2,547

3.9.2 Facilities subject to RCRA

All 4,484 facilities classified as hazardous waste treatment, storage, or disposal facilities (TSDFs) under RCRA Subtitle C are addressed by the regulatory definition of storm water discharge associated with industrial activity. An estimated additional 9,500 to 12,500 facilities which have notified EPA as generators of hazardous waste are addressed by the regulatory definition of storm water discharge associated with industrial activity.

3.9.3 Facilities subject to SARA Title III, Section 313

The Superfund Amendments and Reauthorization Act (SARA) of 1986 resulted in the enactment of Title III of SARA, the Emergency Planning and Community-Right-to-Know Act. Section 313 of Title III of SARA requires operators of certain facilities that manufacture, import, process, or otherwise use listed toxic chemicals to report annually their releases of those chemicals to any environmental media. Listed toxic chemicals include 329 chemicals listed at 40 CFR 372.

Facilities that meet all of the following criteria for a calendar year are subject to Title III reporting requirements for that calendar year and must report under 40 CFR 372.30:

o The facility has 10 or more full-time employees;

o The facility is a multi-establishment complex where all establishments have a primary SIC code of 20 through 39;

o The facility is a multi-establishment complex in which one of the following is true:

  - The sum of the value of products shipped and/or produced from those establishments that have a primary SIC code of 20 through 39 is greater than 50 percent of the total value of all products shipped and/or produced from all establishments at the facility;
  - One establishment has a primary SIC code of 20 through 39 and contributes more in terms of value of products shipped and/or produced than any other establishment within the facility;

o The facility manufactured (including imported), processed, or otherwise used a toxic chemical in excess of an applicable threshold quantity of that chemical set forth in 40 CFR 372.25.

After 1989, the threshold quantity of listed chemicals that the facility must manufacture, import or process in order to be required to submit a release report is 25,000 pounds per year. The threshold for a use other than manufacturing, importing or processing of listed toxic chemicals is 10,000 pounds per year. EPA estimates that 35,000 facilities nationwide will be subject to SARA Title III reporting requirements after 1990. EPA promulgated a final regulation clarifying these reporting requirements on February 16, 1988 (53 FR 4500).

SARA Title III, Section 313 facilities are subject to special requirements in the NPDES storm water general permits if they meet the following two criteria:

- o The facility has a "storm water discharge associated with industrial activity".
  - Many SARA Title III, Section 313 facilities will not have a storm water discharge associated with industrial activity because areas where industrial activity occur are not exposed to storm water.
- o The facility has a "Section 313 water priority chemical" in amounts above threshold levels established by SARA Title III, Section 313.
  - Section 313 water priority chemicals include 175 of the 329 chemicals or chemical categories which are both: listed under Section 313 of Title III of SARA; and are on one of three lists of chemicals developed under the NPDES program (e.g. priority pollutants and certain other toxic and hazardous pollutants).

Information from the 1989 TRIS data base indicates that about 22,000 facilities are subject to SARA Title III, Section 313. The Agency estimates that 12,000 of these facilities are subject to SARA Title III, Section 313 for water priority chemicals. EPA estimates that, nationwide, 5,700 of the 22,000 facilities subject to SARA Title III, Section 313 for water priority chemicals will also have storm water discharges associated with industrial activity. Of these 5,700 facilities, about 4,275 facilities will have to obtain NPDES permit coverage for their storm water discharges associated with industrial activity, as about 25% of the facilities will discharge to combined sewers and do not need NPDES permits.

3.9.4 Facilities with coal piles

Coal is used as a boiler fuel in a number of industries which require large amounts of steam such as electric power generation, metal manufacturing, and certain chemical processes. Coal is also used as a source of carbon in certain metallurgical and chemical processes. Nationwide, electric utilities use about

77% of the coal produced, coke plants about 4%, other industries about 7.5% (see "Coal Distribution, January-December 1988", Energy Information Administration, DOE/EIA-0125(88/4Q). Over 50% of domestic distribution of coal in the United States is by rail, 12% by truck, 13% by tramway or slurry pipeline and 15% by water (IBID).

Coal mines and other production facilities are discussed in detail in the "Development Document for Effluent Limitations Guidelines and Standards for the Coal Mining Point Source Category". Over 940 coal distribution companies are identified in that reference.

3.9.5 Facilities with salt piles

Salt is used by industrial facilities for a number of purposes including as a raw material (e.g. food industry), as a catalyst, and for deicing purposes. Brine solutions can also be used for restoring resins.

3.9.6 Facilities with effluent limitations guidelines for storm water

EPA has developed effluent limitations guidelines for storm water discharges from a number of industrial subcategories. These subcategories, and a description of the effluent limitations guidelines are provided in Table 3-9.

SUMMARY OF POINT SOURCE CATEGORIES SUBJECT TO STORM WATER EFFLUENT LIMITATIONS GUIDELINES

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Cement Manufacturing	40 CFR 411	Runoff from material storage piles	All Subparts	BPT	10 yr. 24 hr.	TSS	Not to exceed 50 mg/l	
						pH	6.0 - 9.0	
Feedlots	40 CFR 412	Any precipitation which comes into contact with manure, bedding, or any other raw material or intermediate or final material or product used in or resulting from the production of animals or poultry or direct products (e.g., milk, eggs)	Subpart A - All subcategories except ducks	BPT	10 yr. 24 hr.		No discharge of process wastewater pollutants	
				BAT	25 yr. 24 hr.		No discharge	
			Subpart B - Ducks	BPT	Not Specified		Maximum for any 1 day	30-day average
						BOD5	1.66	0.91
						Fecal coliform	Not to exceed mpn of 400/100 ml at any time	
							(units - kg/1,000 ducks)	
Fertilizer Manufacturing	40 CFR 418	Precipitation runoff which has come into contact with any raw material, intermediate product, by-product, or waste product	Subpart A - Phosphate	BPT	Not Specified		Maximum for any 1 day	30-day average
						Total phosphorus	105 mg/l	35 mg/l
						Fluoride	75 mg/l	25 mg/l
		*For Subparts B and F, it is unclear whether or not storm water is intended to be included in the definition of process wastewater	Subpart B - Ammonia	BPT	Not Specified	Ammonia	0.1875	0.0625
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/kkg of product)	
			Subpart F - Ammonium sulfate production	BPT	Not Specified		No discharge	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration: Maximum for any 1 day	Concentration: 30-day average
Fertilizer Manufacturing (Continued)		Precipitation runoff from outside the battery limits of the manufacturing operations excluded	Subpart C - Urea	BPT	Not Specified	Urea produced as a solution:	Maximum for any 1 day	30-day average
						Ammonia	0.95	0.48
						Organic Nitrogen	0.61	[illegible]
							(units - kg/1,000 kg of product)	
						Urea prilled or granulated:	Maximum for any 1 day	30-day average
						Ammonia	1.18	0.59
						Organic Nitrogen	1.48	0.80
							(units - kg/1,000 kg of product)	
				BAT	Not Specified	Urea produced as a solution:	Maximum for any 1 day	30-day average
						Ammonia	0.53	0.27
						Organic Nitrogen	0.45	0.24
							(units - kg/1,000 kg of product)	
						Urea prilled or granulated:	Maximum for any 1 day	30-day average
						Ammonia	0.53	0.27
						Organic Nitrogen	0.86	0.46
							(units - kg/1,000 kg of product)	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Fertilizer Manufacturing (Continued)			Subpart D - Ammonium Nitrate	BPT	Not Specified		Maximum for any 1 day	30-day average
						Ammonia	0.73	0.39
						Nitrate	0.67	[illegible]
							(units - kg/1,000 kg of product)	
				BAT	Not Specified		Maximum for any 1 day	30-day average
						Ammonia	0.08	0.04
						Nitrate	0.12	0.07
							(units - kg/1,000 kg of product)	
Petroleum Refining	40 CFR 419	Runoff contaminated by contact with any raw material, intermediate product, finished product, by-product, or waste product located on petroleum refinery property	All Subparts	BPT	Not Specified	For discharges composed entirely of contaminated runoff (not commingled or treated with process wastewater)		
						Oil and grease	15 mg/l	
						TOC	110 mg/l	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration
Petroleum Refining (Continued)	40 CFR 419			BPT	Not Specified	If contaminated runoff is commingled or treated with process wastewater or if wastewater consisting solely of contaminated runoff which exceeds 15 mg/l oil and grease or 110 mg/l TOC is not commingled or treated with any other type of wastewater, the quantity of pollutants discharged shall not exceed the quantity determined by multiplying the flow of contaminated runoff as determined by the permit writer times the concentrations listed below:	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Petroleum Refining (Continued)		Runoff contaminated by contact with any raw material, intermediate product, finished product, by-product, or waste product located on petroleum refinery property (Continued)	All Subparts (Continued)	BPT (Continued)	Not Specified		Maximum for any 1 day	30-day average
						BOD5	48	26
						TSS	33	[illegible]
						COD	360	[illegible]
						Oil and grease	15	8
						Phenolic compounds (4AAP)	0.35	0.17
						Total chromium	0.73	0.43
						Hexavalent chromium	0.062	0.028
						pH	6.0 - 9.0	6.0 - 9.0
							(metric units - kg per 1,000 m^3 of flow)	
				BAT	Not Specified		Maximum for any 1 day	30-day average
						Phenolic compounds (4AAP)	0.35	0.17
						Total chromium	0.60	0.21
						Hexavalent chromium	0.062	0.028
						COD	360	180
							(metric units - kg per 1,000 m^3 of flow)	
Phosphate Manufacturing	40 CFR 422	Runoff contaminated by contact with any raw material, intermediate product, finished product, by-product, or waste product	Subpart D - Defluorinated phosphate rock Subpart E - Defluorinated phosphoric acid	BPT	Not Specified		Maximum for any 1 day	30-day average
						Total phosphorus	105 mg/l	35 mg/l
						Fluoride	75 mg/l	25 mg/l
						pH	6.0 - 9.5	6.0 - 9.5

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Phosphate Manufacturing (Continued)		(Continued) *For Subpart F it is unclear whether or not storm water is intended to be included in the definition of process wastewater	Subpart F - Sodium phosphates	BPT	Not Specified		Maximum for any 1 day	30-day average
						TSS	0.50	0.25
						Total phosphorus	0.80	0.40
						Fluoride	0.30	0.15
						pH	6.0 - 9.5	6.0 - 9.5
							(units - kg/kkg of product)	
Steam Electric Power Generating	40 CFR 423	Runoff from coal piles		BPT	10 yr. 24 hr.	TSS	50 mg/l maximum at any time	
						pH	6.0 - 9.0 at all times	
						PCBs	No discharge	
Coal Mining	40 CFR 434	Discharges from coal refuse disposal piles	Subpart B - Coal preparation plants and coal preparation plant associated areas	BPT	Less than 1 yr. 24 hr.	Normal pH of less than 6.0 prior to treatment:	Maximum for any 1 day	30-day average
						Iron, total	7.0 mg/l	3.5 mg/l
						Manganese, total	4.0 mg/l	2.0 mg/l
						TSS	70 mg/l	35 mg/l
						pH	6.0 - 9.0 at all times	
						Normal pH ≥ 6.0 prior to treatment:	Maximum for any 1 day	30-day average
						Iron, total	7.0 mg/l	3.5 mg/l
						TSS	70 mg/l	35 mg/l
						pH	6.0 - 9.0 at all times	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration
Coal Mining (Continued)					Greater than 1 yr. 24 hr. but less than or equal to 10 yr. 24 hr.	Settleable solids pH	0.5 ml/l maximum not to be exceeded 6.0 - 9.0 at all times
					Greater than 10 yr. 24 hr.	pH	6.0 - 9.0 at all times
		Discharges from reclamation areas	Subpart E - Post-mining areas	BPT	Less than 10 yr. 24 hr.	Settleable solids pH	0.5 ml/l maximum not to be exceeded 6.0 - 9.0 at all times
					Greater than 10 yr. 24 hr.	pH	6.0 - 9.0 at all times
		Discharges from coal preparation plants and associated areas, excluding coal refuse piles; discharges from steep slope areas and mountain top removal areas; discharges of alkaline mine drainage except discharges from underground workings of underground mines that are not commingled with other discharges eligible for alternate limitations	Subpart B Subpart D - Alkaline mine drainage	BPT	Less than or equal to 10 yr. 24 hr.	Settleable solids pH	0.5 ml/l maximum not to be exceeded 6.0 - 9.0 at all times
					Greater than 10 yr. 24 hr.	pH	6.0 - 9.0 at all times

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
							Maximum for any 1 day	30-day average
Coal Mining (Continued)		Controlled discharges of acid or ferruginous surface mine drainage and acid or ferruginous drainage from underground workings of underground mines which are commingled with other discharges eligible for these alternate limitations	Subpart C - Acid or ferruginous mine drainage	BPT	Less than 10 yr. 24 hr.	Iron, total	7.0 mg/l	3.5 mg/l
						Manganese, Total	4.0 mg/l	[illegible]
						TSS	70.0 mg/l	35 mg/l
						pH	6.0 - 9.0 at all times	
					Greater than 10 yr. 24 hr.	pH	6.0 - 9.0 at all times	
		Non-controlled acid or ferruginous surface mine drainage (except steep slope and mountain top removal areas)	Subpart C	BPT	Less than or equal to 2 yr. 24 hr.	Iron, total	7.0 mg/l maximum for any 1 day	
						Settleable solids	0.5 mg/l maximum not to be exceeded	
						pH	6.0 - 9.0 at all times	
					Greater than 2 yr. 24 hr. but less than 10 yr. 24 hr.	Settleable solids	0.5 mg/l maximum not to be exceeded	
						pH	6.0 - 9.0 at all times	
					Greater than 10 yr. 24 hr.	pH	6.0 - 9.0 at all times	
		Discharges from underground workings of underground mines - not commingled	Subpart C Subpart D Subpart E				No alternate limitations	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Mineral Mining	40 CFR 436	Runoff which becomes commingled with any wastewater used in the slurry transport of mined material, air emissions control, or processing exclusive of mining. Also included are mine dewatering discharges, defined as any water that is impounded or that collects in the mine and is pumped, drained, or otherwise removed from the mine.	Subpart B - Crushed stone Subpart C - Construction sand and gravel	BPT	10 yr. 24 hr.	pH	6.0 - 9.0 (pH limitation may be adjusted downward to no less than 5.0 if water quality criteria in water quality standards approved under the Act authorize such lower pH and if the discharge unaltered by man's activity would have a pH of less than 6.0)	
			Subpart R - Phosphate rock	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	60 mg/l	30 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
			Subpart AL - Graphite	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	20 mg/l	10 mg/l
						Total Iron	2 mg/l	1 mg/l
						pH	6.0 - 9.0	6.0 - 9.0

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Mineral Mining (Continued)			Subpart D - Industrial sand	BPT	10 yr. 24 hr.	pH (applicable to all discharges in Subpart D)	6.0 - 9.0 (see note under Subparts B and C above)	
			(i) Discharges of process-generated wastewater from facilities that recycle wastewater except	BPT	10 yr. 24 hr.	TSS	Maximum for any 1 day	30-day average
							45 mg/l	25 mg/l
			(ii) Discharges from facilities employing HF flotation		10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	0.046	0.023
						Total fluoride	0.006	0.003
							(units - kg/kkg final product)	
			(iii) All other discharges of process-generated wastewater		10 yr. 24 hr.		No discharge	
			(iv) Mine dewatering discharges		10 yr. 24 hr.	TSS	Maximum for any 1 day	30-day average
							45 mg/l	25 mg/l

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration
Mineral Mining (Continued)			Subpart E - Gypsum	BPT	10 yr. 24 hr.		No discharge
			Subpart F - Asphaltic mineral				
			Subpart G - Asbestos and Wollastonite				
			Subpart M - Borax				
			Subpart N - Potash				
			Subpart O - Sodium sulfate				
			Subpart S - Frasch sulfur				
			Subpart W - Magnesite				
			Subpart X - Diatomite				
			Subpart Y - Jade				
			Subpart Z - Novaculite				

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Mineral Mining (Continued)			Subpart J - Barite Subpart K - Fluorspar Subpart L - Salines from brine lakes Subpart V - Bentonite Subpart AF - Tripoli	BPT	Not Specified		No discharge	
			All remaining Subparts reserved					
Ore Mining and Dressing	40 CFR 440	Runoff from the drainage area of the facility	Subpart A - Iron ore	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Iron (dissolved)	2.0 mg/l	1.0 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
			Subpart D - Mercury ore	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Mercury	0.002 mg/l	0.001 mg/l
						Nickel	0.2 mg/l	0.1 mg/l
						pH	6.0 - 9.0	6.0 - 9.0

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Ore Mining and Dressing (Continued)		Runoff from the drainage area of the facility (Continued)	Subpart J - Copper, lead, zinc, gold, silver, and molybdenum ores	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Copper	0.30 mg/l	[illegible] mg/l
						Zinc	1.5 mg/l	0.75 mg/l
						Lead	0.6 mg/l	0.3 mg/l
						Mercury	0.002 mg/l	0.001 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
				BAT	10 yr. 24 hr.	Copper	0.30 mg/	0.15 mg/l
						Zinc	1.5 mg/l	0.75 mg/l
						Lead	0.6 mg/l	0.3 mg/l
						Mercury	0.002 mg/l	0.001 mg/l
						Cadmium	0.10 mg/l	0.05 mg/l
		Surface runoff which has commingled with mine drainage or waters resulting from the beneficiation process	Subpart M - Gold placer mine	BPT	10 yr. 24 hr.	Settleable solids	0.2 ml/l instantaneous maximum	
		Surface runoff incorporated into mine drainage *Storm water only indirectly included in the phrase "mine drainage"	Subpart B - Aluminum ore	BPT	10 yr. 24 hr.		Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Iron	1.0 mg/l	0.5 mg/l
						Aluminum	2.0 mg/l	1.0 mg/l
						pH	6.0 - 9.0	6.0 - 9.0

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Ore Mining and Dressing (Continued)		Surface runoff incorporated into mine drainage (Continued)	Subpart C - Uranium, radium, and vanadium ores	BPT	10 yr. 24 hr.	Excluding mines using in-situ leach methods:	Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						COD	200 mg/l	[illegible]
						ZINC	1.0 mg/l	0.5 mg/l
						Ra 226 (dissolved)	10 pCi/l	3 pCi/l
						Ra 226 (total)	30 pCi/l	10 pCi/l
						Uranium	4 mg/l	2 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
				BPT	10 yr. 24 hr.	Mines using in-situ leach methods and mills: same as above except:	Maximum for any 1 day	30-day average
						COD	–	500 mg/l
			Subpart E - Titanium ore	BPT	10 yr. 24 hr.	All mine drainages:	Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Iron	2.0 mg/l	1.0 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
						Discharges from mills:	Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Zinc	1.0 mg/l	0.5 mg/l
						Nickel	0.2 mg/l	0.1 mg/l
						pH	6.0 - 9.0	6.0 - 9.0

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Ore Mining and Dressing (Continued)		Surface runoff incorporated into mine drainage (Continued)	Subpart F - Tungsten ore Subpart G - Nickel ore Subpart H - Vanadium ore	BPT	10 yr. 24 hr.	Drainages from mines producing 5,000 metric tons or more:	Maximum for any 1 day	30-day average
						TSS	30 mg/l	[illegible] mg/l
						Cadmium	0.10 mg/l	[illegible] mg/l
						Copper	0.3 mg/l	0.15 mg/l
						Zinc	1.0 mg/l	0.5 mg/l
						Lead	0.6 mg/l	0.3 mg/l
						Drainage from mine producing 5,000 metric tons or more (Continued):	Maximum for any 1 day	30-day average
						Arsenic	1.0 mg/l	0.5 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
						Mills processing 5,000 metric tons or more:	Maximum for any 1 day	30-day average
						TSS	30 mg/l	20 mg/l
						Cadmium	0.10 mg/l	0.05 mg/l
						Copper	0.30 mg/l	0.15 mg/l
						Zinc	1.0 mg/l	0.5 mg/l
						Arsenic	1.0 mg/l	0.5 mg/l
						pH	6.0 - 9.0	6.0 - 9.0
						Mines and mills producing less than 5,000 metric tons:	Maximum for any 1 day	30-day average
						TSS	50 mg/l	30 mg/l
						pH	6.0 - 9.0	6.0 - 9.0

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Ore Mining and Dressing (Continued)			Subpart K - Platinum ores	BPT	10 yr. 24 hr.	Mines other than placer:	Maximum for any 1 day	30-day average
						Copper	0.30 mg/l	0.15 mg/l
						Zinc	1.5 mg/l	0.75 mg/l
						Lead	0.6 mg/l	[illegible] mg/l
						Mercury	0.002 mg/l	0.001 mg/l
						Cadmium	0.10 mg/l	0.05 mg/l
						Mills, same as mines except:	Maximum for any 1 day	30-day average
						Zinc	1.0 mg/l	0.5 mg/l
			Subpart I - Antimony ore (reserved)					
Paving and Roofing Materials	40 CFR 443	All rainwater runoff containing pollutants	Subpart A - Asphalt emulsion	BPT	Not Specified		Maximum for any 1 day	30-day average
						Oil and grease	0.020	0.015
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/m³ of runoff)	
				BAT	Not specified		Maximum for any 1 day	30-day average
						TSS	0.023	0.015
						Oil and grease	0.015	0.010
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/m³ of runoff)	

Category	Regulatory Citation	Covered Discharges	Applicable Subparts	Legal Standard	Design Storm	Parameter	Concentration	
Paving and Roofing Materials (Continued)	40 CFR 443	Any water which comes into direct contact with any raw material, intermediate product, by-product, or product used in or resulting from production *This definition of process wastewater only indirectly includes storm water in the phrase "any water"	Subpart B - Asphalt concrete	BPT	Not Specified		No discharge	
			Subpart C - Asphalt roofing	BPT	Not Specified		Maximum for any 1 day	[illegible] average
						TSS	0.056	0.038
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/kkg of product)	
				BAT	Not Specified	TSS	Maximum for any 1 day	30-day average
							0.028	0.019
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/kkg of product)	
			Subpart D - Linoleum and printed asphalt felt	BPT	Not Specified		Maximum for any 1 day	30-day average
						TSS	0.038	0.025
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/kkg of product)	
				BAT	Not Specified	TSS	Maximum for any 1 day	30-day average
							0.019	0.013
						pH	6.0 - 9.0	6.0 - 9.0
							(units - kg/kkg of product)	

CHAPTER 4 - NATURE AND EXTENT OF POLLUTANTS IN STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY

This chapter describes the nature and extent of pollutants in discharges from storm sewer from industrial facilities. This Chapter begins with a discussion of general factors which affect pollutants in storm water discharges from industrial facilities in section 4.1. Section 4.2 provides a summary description of the nature and extent of discharges from separate storm sewers from major classes of industrial facilities. The discussion in section 4.2 addresses both a non-storm water component (illicit connections, improper dumping, or spills) as well as a storm water component to these discharges.

For the purposes of discussing the storm water component of these discharges, the following major groups of facilities were addressed:

- o Mining and Oil and Gas Production Facilities
- o Manufacturing Industries
- o Construction Industries
- o Waste Management and Recycling Facilities
- o Transportation Facilities
- o Electric Power Generation

4.1 FACTORS AFFECTING POLLUTANTS IN DISCHARGES FROM SEPARATE STORM SEWERS FROM INDUSTRIAL FACILITIES

For many non-industrial, non-municipal facilities and for some industrial activities, the types and concentrations of pollutants in storm water discharges will be similar to the types and concentrations of pollutants generally found in storm water discharges from residential areas. However, for other facilities the potential for pollutants in storm water discharges from the facility may be significantly higher than pollutant levels from broader urban or developed areas. In addition, pollutant loadings per unit area from some facilities may be high because of a high degree of imperviousness.

Seven activities were identified for estimating the potential for affecting pollutants in storm water discharges: 1) loading or unloading of dry bulk materials or liquids, 2) outdoor storage of raw materials or products, 3) outdoor process activities, 4) dust or particulate generating processes, 5) illicit connections or management practices, 6) waste disposal practices, and 7) site specific or industry specific pollution control requirements.

The potential for pollution from many of these activities may be influenced by the use and presence of toxic chemicals.

Table 4.1 provides estimates of the number of facilities which have hazardous substances in amounts in excess of limits established under SARA Title III Community Right-to-Know requirements.

Table 4.1 - Facilities with 10,000 or more pounds of Hazardous Chemicals or the lower of 500 or more pounds or threshold planning quantities of Extremely Hazardous Substances (Proposed Reporting limits under Sections 311 and 312 of Title III of the Superfund Amendments and Reauthorization Act)

SIC CODE		NUMBER OF FACILITIES
7	Agricultural Services	5,554
Manufacturers		
20	Food Products	4,414
22	Tobacco Products	767
23	Textile Mill Products	520
24	Apparel Products	3,048
25	Lumber and Wood Products	1,746
26	Furniture and Fixtures	2,012
27	Printing and Publishing	4,111
28	Chemical and Allied Products	11,286
29	Petroleum and Coal Products	1,798
30	Rubber and Misc. Plastics Products	4,651
31	Leather Products	503
32	Stone, Clay and Glass Products	5,928
33	Primary Metal Industry	4,372
34	Fabricated Metal Products	13,660
35	Machinery, Except Electrical	5,951
36	Electric and Electronic Equipment	3,229
37	Transportation Equipment	1,676
38	Instrument and Related Products	1,658
39	Misc. Manufacturing	1,778
42	Trucking and Warehousing	119
45	Transporation by Air	3,043
46	Pipe Lines, Except Natural Gas	997
48	Communiciation	118
49	Electric, Gas and Sanitary Services	4,938
50	Wholesale Trade - Durable Goods	8,615
51	Wholesale Trade - Nondurable Goods	12,910
54	Food Stores	293
55	Auto Dealers and Service Stations	134,979
59	Miscellaneous Retail	72
72	Personal Services	2,875
73	Business Service	985
75	Auto Repair, Services and Garage	31,249
76	Miscellaneous Repair Services	3,337
80	Health Services	4,095
81	Legal Services	3,317
Total		290,604

Extremely hazardous substances and their respective threshold planning quantities are listed in 40 CFR 355. Extremely hazardous substances have been identified pursuant to Section 302 of Title II as being particularly significant for emergency planning.

Hazardous chemicals are defined under the Hazard Communication Standard promulgated by the Occupational Safety and Health Administration.

1) Loading and unloading operations are typically performed along facility access roads, railways, and at loading/unloading docks and terminals. These operations include pumping of liquids or gases from truck or rail car to a storage facility or vice versa; pneumatic transfer of dry chemicals to or from the loading or unloading vehicle; transfer by mechanical conveyor systems; and transfer of bags, boxes, drums, or other containers from vehicle by fork-lift trucks or other materials handling equipment. Material spills or losses in areas can discharge directly to the storm drainage systems, or may accumulate in soils or on surfaces, and be washed away during a storm event or facility washdowns.

2) Outdoor storage activities include the storage of fuels, raw materials, byproducts, intermediates, final products, and process residuals. Storage can be accomplished in various ways, for example, using storage containers (e.g., drums or tanks), platforms or pads, bins, silos, boxes, or piles. Materials, containers, and material storage areas that are exposed to rainfall and/or runoff can contribute pollutants to storm water when solid materials wash off or materials dissolve into solution.

3) Other outdoor activities include certain types of manufacturing and commercial operations, waste treatment, and land-disturbing operations. Although many manufacturing activities are performed indoors, some activities, such as timber processing, rock crushing, and cement making, typically occur outdoors. Processing operations can result in liquid spillage and losses of material solids to the drainage system or surrounding surfaces, or creation of dusts or aerosols, which can be locally deposited.

Some outdoor industrial activities cause substantial physical disturbance of land surfaces that result in soil erosion and transport by storm water. Examples where disturbed land occurs include construction, mining, and feedlots. Disturbed land can result in soil losses and other pollutant loadings associated with increased runoff rates.

Facilities whose major process activities are conducted indoors may still apply chemicals such as herbicides, pesticides and fertilizer outdoors for a variety of purposes.

4) Dust or particulate generating processes include industrial activities with stack emissions or process dusts that settle on plant surfaces. Localized atmospheric deposition is a particular concern with heavy manufacturing industries. For

example, monitoring of areas surrounding smelting industries has shown much higher levels of metals at sites nearest the smelter (Bearington 1977). Other industrial sites, such as mines, cement manufacturing and refractories, will generate significant levels of dusts.

5) Illicit connections or inappropriate management practices result in improper non-storm water discharges to storm sewer systems. In some cases, non-storm water connections to sewer systems predate their legal prohibition, and facility operators may be unaware of the actual configuration of their systems. The likelihood of illicit discharges to storm water collection systems is expected to increase for older facilities as well as for those facilities that use high volumes of process water or that dispose of significant amounts of liquid wastes, including process waste waters, cooling waters and rinse waters.

Pollutants from non-storm water discharges to the storm sewer system of industrial facilities are typically caused by a combination of improper connections, spills, improper dumping and a belief that the absence of solids in a discharge is equivalent to the absence of pollution.

Illicit connections are often associated with floor drains that are connected to separate storm sewers. Rinse waters used to clean or cool objects discharge to floor drains which may be connected to separate storm sewers. Large amounts of rinse waters may originate from industries that utilize regular washdown procedures, for example, bottling plants use rinse waters for removing waste product, debris and labels. Rinse waters can be used to cool materials by dipping, washing or spraying objects with cool water, for example, rinse water is sometimes sprayed over the final products of a metal plating facility for cooling purposes. Condensate return lines of heat exchangers often discharge to floor drains. Heat exchanges, particularly those used under stressed conditions such as within the metal finishing and electroplating industry, typically develop pin-hole leaks, which may result in contamination of condensate by process wastes. These and other non-storm water discharges to a storm sewer may be intentional, based on the belief that the discharge (in this case condensate), does not contain pollutants, or it may be inadvertent, for example, the operator may be unaware that a floor drain is connected to the storm sewer.

Spills often accompany material management activities. The Emergency Response Notification System (ERNS) indicated that about 62% of spills of hazardous substances exceeding a reportable quantity that were reported in 1989 were to land or water (3,153 spills to water, 858 spills to land). The

ERNS data base for 1988 that over half of the releases of hazardous substances and oil reported were from fixed facilities (18,824 releases from fixed facilities)

6) Waste management practices include the operation of landfills, waste piles and land application sites which involve land disposal. Outdoor waste treatment operations also include waste water and solid waste treatment and disposal processes, such as waste pumping, additions of treatment chemicals, mixing, aeration, clarification, and solids dewatering. Table 4-2 provides estimates of the volume of wastes generated by various types of industrial facilities. These types of facilities often conduct some waste management on site. Other off-site waste management units will be addressed as a distinct category of facilities.

TABLE 4-2. NUMBER OF LANDFILLS, LAND APPLICATION UNITS AND WASTE PILES RECEIVING INDUSTRIAL WASTES

Industry Type	Landfills		Land Application Units		Waste Piles		TOTALS	
	number of units	amount of waste	number of units	amount of waste	number of units	amount of waste	number of units	amount of waste
Organic Chemicals	17	263	27	1,827	79	48	123	2,138
Primary Iron and Steel	201	3,687	76	76	464	6,129	741	9,892
Fertilizer and Agriclultural Chemicals	31	5,789	160	756	50	4,820	241	11,365
Electric Power Generation	155	53,449	43	331	110	1,528	308	55,308
Plastics and Resins Manufacturing	32	86	17	1,166	32	373	81	1,625
Inorganic Chemicals	120	3,220	24	108	98	41,323	242	44,651
Stone, Clay, Glass, and Concrete	1,257	7,571	309	51	2,528	9,184	4,094	16,806
Pulp and Paper	259	5,873	139	8,942	232	1,469	630	16,284
Primary Nonferrous Metals	111	1,375	9	373	312	8,764	432	10,512
Food and Kindred Products	194	3,595	3,128	75,938	540	460	3,862	79,993
Water Treatment	121	157	147	8,955	48	9	316	9,121
Petroleum Refining	61	272	144	396	158	79	363	747
Rubber and Miscellanous Products	77	520	16	52	123	58	216	630
Transportation Equipment	63	172	11	0.3	362	708	436	880
Selected Chemicals and Allied Products	21	112	17	428	41	8	79	548
Textile Manufacturing	28	69	72	763	103	18	203	850
Leather and Leather Products	9	9	0	0	54	11	63	20
Totals	2,757	86,219	4,308	99,160	5,335	76,936	12,400	262,315

7) Technology based national effluent guideline limitations for storm water discharges have played a significant role in reducing pollutants from a limited number of industries. EPA has promulgated effluent limitation guidelines which address storm water from the following industries shown in Figure 4-1: cement manufacturing; feedlots; fertilizer manufacturing; petroleum refining; phosphate manufacturing; steam electric; coal mining; ore mining and dressing; mineral mining and processing; and asphalt emulsion. In addition to these control standards, many States or local governments have developed controls for runoff from construction activities.

Figure [illegible]-1. NPDES Effluent Guideline Limitations which Address Storm Water Discharges

CEMENT MANUFACTURING CATEGORY

- Materials Storage Piles Runoff

FEEDLOTS

- All Subcategories Except Ducks
- Ducks

FERTILIZER MANUFACTURING

- Phosphate

PETROLEUM REFINING

- Topping
- Cracking
- Petrochemical
- Lube
- Integrated

PHOSPHATE MANUFACTURING

- Defluorinated Phosphate Rock
- Defluorinated Phosphoric Acid

STEAM ELECTRIC POWER GENERATING

- Coal Pile Runoff

COAL MINING CATEGORY

- Coal Preparation Plants and Coal prepartion Plant Associated Areas
- Acid or Ferruginous Mine Drainage
- Alkaline Mine Drainage
- Post-Mining Areas

ORE MINING AND DRESSING CATEGORY

Iron Ore	TSS, iron, pH
Aluminum Ore	
Uranium, Radium, and Vanadium Ores	
Mercury Ore	
Titanium Ore	
Tungsten Ore	
Nickel Ore	
Vanadium Ore	
Antimony Ore	
Copper, Lead, Zinc, Gold, Silver, And Molybdenum Ores	

Platinum Ore

MINERAL MINING AND PROCESSING POINT SOURCE CATEGORY

- Crushed Stone
- Construction Sand and Gravel
- Industrial Sand
- Gypsum
- Asphaltic Mineral
- Asbestos and Wollastonite
- Borax
- Potash
- Sodium Sulfate
- Trona
- Phosphate Rock
- Frasch Sulfer
- Magnesite
- Diatomite
- Jade
- Novaculite
- Graphite

PAVING AND ROOFING MATERIALS

- Asphalt Emulsion

Typical activities that can impact the pollution potential of storm water discharges were evaluated for classes of facilities identified in this report. The pollution potential of activities at industrial facilities were ranked as having a high, medium, or equivalent pollution potential relative to discharges of runoff from typical residential and commercial areas. Rankings were based on a consideration of the seven types of activities identified above. Based on these rankings and a consideration of other factors, pollutants with the potential for relatively high concentrations in storm water discharges were identified for the classes of facilities.

Figure 4-2 presents a summary of the pollution potential of evaluated activities at facilities that meet EPA's proposed regulatory definition of "storm water discharges associated with industrial activity". Figure 4-3 presents a summary of the type of pollutants expected to be at relatively high concentrations in the storm water discharges from these facilities. Figure 4-4 presents a summary of the pollution potential of evaluated activities at other facilities evaluated in this Report. Figure 4-5 presents a summary of the type of pollutants expected to be at relatively high concentrations in the storm water discharges from these facilities. Since pollutants from each activity will be specific to the type of facility, and the site-specific importance of any given contribution may be dependent on the particular pollutant involved, attempts at "totalling or averaging" the rankings should be avoided.

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TABLE 4-8. Summary of Potential Pollutants in Storm Water From Commercial Facilities

Category	Nutrients	Oxygen-Demanding Materials	Solids	Metals	Pesticides, PCBs, and Dioxin	Persistent Organics	Other
OTHER INDUSTRIES							
Wholesale Trade							
Automobiles and Other Motor Vehicles	*	X		*		PAHs	O+G
Used Motor Vehicle Parts		X		*		PAHs	O+G
Lumber and Building Materials						Phenols	
Coal and Other Minerals and Ores		X	TSS	*			pH
Recyclers/Scrapyards/Battery Reclaimers		X	TSS	*			pH
Food Products	*	X	TSS				Pathogens
Farm Product Raw Materials	*	X	TSS				
Chemical and Allied Products	*	X		*	*	*	*
Petroleum and Petroleum Products		X		Cr, Zn		Phenols, PAHs	TOC, O+G
Farm Supplies	*	X	TSS		*		Pathogens
Flowers and Nursery Stock and Supplies	*	X	TSS		*		
Retail Trade							
Lumber and Building Materials						Phenols	
Auto Dealers and Gasoline Service Stations		X				PAHs	O+G
Fuel Dealers		X				PAHs	O+G
Auto Repair, Services, and Parking		X				PAHs	O+G
Lawn and Garden Service	*	X	TSS		*		pH
Amusement Services	*	X	TSS		*	*	*
Hospitals							Pathogens
Botanical and Zoological Gardens	*	X	TSS		*		Pathogens
Military Bases	*	X	*	*	*	*	*

*The specific pollutant will depend upon the processes used at an industrial facility.

KEY:
N=Nitrogen
P=Phosphorus
NH_3=Ammonia Nitrogen
BOD=Biochemical Oxygen Demand
COD=Chemical Oxygen Demand
TSS=Total Suspended Solids
TDS=Total Dissolved Solids
As=Arsenic
Ba=Barium
Cr=Chromium
Cu=Copper
Pb=Lead
SB=Tin
Zn=Zinc
PCBs=Polychlorinated Biphenyls
PAHs=Polyaromatic Hydrocarbons
MBAS=Methylene Blue Active Agents
CN=Cyanide
TOC=Total Organic Carbon
O+G=Oil and Grease

TABLE 4-9. Summary of Potential Activities That Can Result in Storm Water Contamination at Commercial Facilities

Category	Loading/Unloading Dry Bulk	Loading/Unloading Liquids	Outdoor Storage of Raw Material Waste or Product	Outdoor Industrial Activity	Dust or Particulate Generating Processes	Illicit Connections/ Industrial Practices	Land Application
Automobiles and Other Motor Vehicles	M	L	H	H	L	L	L
Used Motor Vehicle Parts	M	L	H	H	L	L	L
Auto Dealers and Gasoline Service Stations	M	H	H	M	L	M	L
Auto Repair, Services, and Parking	M	L	H	H	L	L	L
Lumber and Building Materials	H	M	H	M	L	L	L
Coal and Other Minerals and Ores	H	L	H	H	H	L	L
Recyclers/Scrapyards/Battery Reclaimers	H	L	H	H	H	L	M
Food Products	M	M	L	L	L	H	M
Farm Product Raw Materials	H	M	M	M	M	L	L
Chemical and Allied Products	H	H	L	L	L	L	L
Petroleum and Petroleum Products	L	H	H	H	M	H	L
Farm Supplies	H	L	M	M	M	M	L
Flowers and Nursery Stock and Supplies	H	L	H	H	M	L	M
Lumber and Building Materials	H	M	H	M	L	L	L
Fuel Dealers	L	H	H	H	L	L	L
Lawn and Garden Service	H	H	L	H	H	L	H
Amusement Services	L	M	M	H	L	L	L
Hospitals	L	L	M	L	L	H	L
Botanical and Zoological Gardens	M	M	H	H	L	M	M

KEY: H-There is a high potential for this industrial activity to contaminate storm water.
M-There is a moderate potential for this industrial activity to contaminate storm water.
L-There is a low to no potential for this industrial activity to contaminate storm water.

TABLE 4-10. Summary of Potential Pollutants in Storm Water From Industrial Facilities

Category	Nutrients	Oxygen-Demanding Materials	Solids	Metals	Pesticides, PCBs, and Dioxin	Persistent Organics	Other
PRIMARY INDUSTRIES							
Livestock Production							
Poultry and Eggs	N	X	TSS				Pathogens
Mining Industries	NH_3	X	TSS, TDS	*			TOC, Sulfates, ph
Oil and Gas Extraction			TSS	Pb,Ba,As,Sb		PAHs	Chloride
CONSTRUCTION INDUSTRIES							
Building/Heavy Construction	N,P		TSS				
MANUFACTURING INDUSTRIES							
Food and Tobacco Manufacturing							
Meat Products	*	X	TSS				Pathogens
Dairy Products	*	X	TSS				Pathogens
Canned/Preserved Fruits and Vegetables	*	X	TSS				
Grain Mill Products	*	X	TSS				
Canned/Preserved Seafood Processing	*	X	TSS				Pathogens
Textile Mill Products		X					
Lumber and Wood Products							
Logging			TSS				
Wood Preserving		X		Cr,As,Cu		Phenols	
Reconstituted Wood Products		X	TSS				
Furniture and Fixtures							
Metal Furniture and Fixtures				*			
Paper and Allied Products		X				Phenols	TOC, pH, O+G
Chemical and Allied Products							
Industrial Inorganic Chemicals	*	X	*	*	*	*	TOC, O+G

TABLE 4-10. Summary of Potential Pollutants in Storm Water From Industrial Facilities (continued)

Category	Nutrients	Oxygen-Demanding Materials	Solids	Metals	Pesticides, PCBs, and Dioxin	Persistent Organics	Other
Chemical and Allied Products (cont'd)							
Inorganic Dyes and Pigments		X	TSS	*		Phenol	TOC, O+G
Plastics and Synthetics		X	TSS	Cr		Phenols	TOC, O+G
Drugs		X	TSS	*	*	*	TOC, O+G, CN
Soap and Detergents		X				MBAS	TOC, O+G
Industrial Organic Chemicals	N,P	X	TSS	*	*	*	TOC, O+G
Gum and Wood Chemicals		X					TOC, O+G
Organic Dyes and Pigments		X		Cr	*	Phenols	TOC, O+G
Fertilizer Chemicals	N,P	X					Sulfate, Fluoride, pH
Pesticide Chemicals		X			*		TOC, O+G,pH
Miscellaneous Chemicals	*	X	*	*	*	*	TOC, O+G
Explosives	*	X				*	TOC
Ink Formulating		X		*			
Carbon Black	*	X				*	TOC
Petroleum Refining							
Petroleum Refining		X		Cr,Zn		Phenols, PAHs	TOC, O+G
Paving and Roofing Materials		X		Cr,Zn		Phenols, PAHs	TOC, O+G
Rubber and Plastics Products			TSS				TOC
Leather and Leather Products							
Leather Tanning, Curing, or Finishing		X	TSS	Cr			Pathogens
Stone, Clay, Glass, and Concrete Products							
Hydraulic Cement			TSS				pH
Cut Stone, Stone Products, and Abrasives			TSS				
Asbestos			TSS				
Primary Metal Products	*	X	TSS,TDS	*			O+G
Fabricated Metal Products							
Finished/Electroplated/Coated Metals				*			
Porcelain Enameled Metals				*			
Electrical and Electronic Equipment				*			
Batteries				*			

TABLE 4-10. Summary of Potential Pollutants in Storm Water From Industrial Facilities (continued)

Category	Nutrients	Oxygen-Demanding Materials	Solids	Metals	Pesticides, PCBs, and Dioxin	Persistent Organics	Other
Miscellaneous Manufacturing				*			
TRANSPORTATION INDUSTRIES							
Railroads	*		TSS	*		*	O+G
Local and Interurban Passenger Transit		X	TSS				
Trucking and Warehousing	*	X	TSS	*		*	TOC,O+G
Water Transportation			TSS				
Transportation by Air		X	TSS				
Transportation Services		X	TSS				
WATER AND WASTE MANAGEMENT INDUSTRIES							
Water Supply	*		*	*			*
Severage Systems	*		*	*	*	*	*
RCRA Subtitle C TSDFs	*	*	*	*	*	*	*
RCRA Subtitle D Facilities	*	*	*	*	*	*	*
ENERGY INDUSTRIES							
Steam Electric Power Generation		X	TSS	*	PCBs	PAHs	TOC,O+G, Chlorides, Sulfates, CN

*The specific pollutant will depend upon the processes used at an industrial facility.

KEY:
- N=Nitrogen
- P=Phosphorus
- NH_3=Ammonia Nitrogen
- BOD=Biochemical Oxygen Demand
- COD=Chemical Oxygen Demand
- TSS=Total Suspended Solids
- TDS=Total Dissolved Solids
- As=Arsenic
- Ba=Barium
- Cr=Chromium
- Cu=Copper
- Pb=Lead
- Sb=Tin
- Zn=Zinc
- PCBs=Polychlorinated Biphenyls
- PAHs=Polyaromatic Hydrocarbons
- MBAS=Methylene Blue Active Agents
- CN=Cyanide
- TOC=Total Organic Carbon
- O+G=Oil and Grease

TABLE 4-11. Summary of Potential Activities That Can Result in Storm Water Contamination at Industrial Facilities

Category	Loading/Unloading Dry Bulk	Loading/Unloading Liquids	Outdoor Storage of Raw Material Waste or Product	Outdoor Industrial Activity	Dust or Particulate Generating Processes	Illicit Connections/ Industrial Practices	Land Application
PRIMARY INDUSTRIES							
Livestock Production							
Poultry and Eggs	H	H	H	H	H	L	H
Mining Industries	H	M	H	H	H	H	H
Oil and Gas Extraction	L	H	H	H	L	H	H
CONSTRUCTION INDUSTRIES							
Building/Heavy Construction	M	L	H	H	H	L	L
MANUFACTURING INDUSTRIES							
Food and Tobacco Manufacturing							
Meat Products	H	L	H	M	L	H	M
Dairy Products	H	H	L	L	L	H	L
Canned/Preserved Fruits and Vegetables	H	H	H	H	M	H	H
Grain Mill Products	H	H	L	L	H	H	M
Canned/Preserved Seafood Processing	H	H	H	M	M	H	H
Textile Mill Products	H	H	L	L	L	M	L
Lumber and Wood Products							
Logging	M	L	L	H	L	L	L
Wood Preserving	H	H	H	H	M	M	H
Reconstituted Wood Products	H	M	H	L	H	M	M
Furniture and Fixtures							
Metal Furniture and Fixtures	H	H	L	L	H	H	L
Paper and Allied Products	H	H	H	M	H	H	M
Chemical and Allied Products							
Industrial Inorganic Chemicals	H	H	H	H	L	H	L
Inorganic Dyes and Pigments	H	H	H	H	L	H	L
Plastics and Synthetics	H	H	L	L	L	H	L
Drugs	H	H	L	L	L	H	L

TABLE 4-11. Summary of Potential Activities That Can Result in Storm Water Contamination at Industrial Facilities (continued)

Category	Loading/Unloading Dry Bulk	Loading/Unloading Liquids	Outdoor Storage of Raw Material Waste or Product	Outdoor Industrial Activity	Dust or Particulate Generating Processes	Illicit Connections/ Industrial Practices	Land Application
Soap and Detergents	H	H	L	L	L	H	L
Industrial Organic Chemicals	H	H	L	L	L	H	L
Gum and Wood Chemicals	H	H	L	L	L	H	L
Organic Dyes and Pigments	H	H	L	L	L	H	L
Fertilizer Chemicals	H	M	L	L	L	H	L
Pesticide Chemicals	H	H	L	L	L	H	L
Miscellaneous Chemicals	H	H	L	L	L	H	L
Explosives	H	H	L	L	L	H	L
Ink Formulating	H	H	L	L	L	H	L
Carbon Black	H	H	L	L	L	H	L
Petroleum Refining							
Petroleum Refining	L	H	H	H	M	H	L
Paving and Roofing Materials	L	H	H	M	M	M	L
Rubber and Plastics Products	H	H	L	L	L	H	L
Leather and Leather Products							
Leather Tanning, Curing, or Finishing	H	H	L	L	M	H	L
Stone, Clay, Glass, and Concrete Products							
Hydraulic Cement	H	H	H	H	H	L	L
Cut Stone, Stone Products, and Abrasives	H	H	H	H	H	L	L
Asbestos	H	L	M	M	M	M	L
Primary Metal Products	H	M	H	M	H	H	L
Fabricated Metal Products							
Finished/Electroplated/Coated Metals	H	H	L	L	H	H	L
Porcelain Enameled Metals	H	L	H	L	H	H	H
Electrical and Electronic Equipment	L	M	L	L	M	L	L
Batteries	H	H	M	L	M	H	L
Miscellaneous Manufacturing	M	M	M	L	M	M	L

TABLE 4-11. Summary of Potential Activities That Can Result in Storm Water Contamination at Industrial Facilities (continued)

Category	Loading/Unloading Dry Bulk	Loading/Unloading Liquids	Outdoor Storage of Raw Material Waste or Product	Outdoor Industrial Activity	Dust or Particulate Generating Processes	Illicit Connections/ Industrial Practices	Land Application
TRANSPORTATION INDUSTRIES							
Railroads	H	H	H	H	M	L	L
Local and Interurban Passenger Transit	L	L	L	H	M	L	L
Trucking and Warehousing	H	H	H	H	H	M	L
Water Transportation	H	H	M	H	H	L	L
Transportation by Air	H	H	H	H	H	L	M
Transportation Services	H	H	H	H	H	L	L
WATER AND WASTE MANAGEMENT INDUSTRIES							
Water Supply	H	M	H	H	L	L	M
Sewerage Systems	H	H	H	H	H	L	H
RCRA Subtitle C TSDFs	H	H	H	H	H	L	H
RCRA Subtitle D Facilities	H	H	H	H	H	L	H
ENERGY INDUSTRIES							
Steam Electric Power Generation	H	H	H	M	H	L	H

KEY: H-There is a high potential for this industrial activity to contaminate storm water.
M-There is a moderate potential for this industrial activity to contaminate storm water.
L-There is a low to no potential for this industrial activity to contaminate storm water.

4.2 SUMMARY OF THE NATURE AND EXTENT OF DISCHARGES FROM SEPARATE STORM SEWERS FROM INDIVIDUAL FACILITIES

4.2.1 MINING AND OIL AND GAS PRODUCTION

4.2.1.1 Mining Industries

The mining industries include facilities involved in metal mining (SIC Code 10), coal mining (SIC Code 12), and mining of non-metallic minerals (SIC Code 14). As shown in Figure 4-1, the majority of types of mining facilities are currently covered by existing national effluent guidelines limitations.

Mining activities generally occur outdoors exposed to weather conditions. Characteristics affecting pollutants in storm water discharges include the nature of the host material, the type of mining operation, and abandonment of mines.

Nature of the Host Material

The earth materials associated with the ore or mineral being mined are a major source of pollutants in storm water discharges from mine sites (EPA 1975; EPA 1979; EPA 1981). Regardless of the mining methods used, earth materials must be disturbed, moved and handled in the process of accessing the desired ore. Disturbed materials include overburden (soil layers above the target formation) and tailings (waste earth materials left over from mining and ore processing operations). The contents of these materials depend on the nature of the substance being mined, as well as the localized nature of the surrounding geology.

Coal mining in the east, for example, is typically associated with sulfur-bearing earth materials that, when exposed to oxygen and water, create sulfuric acid. The acid then causes metals present in the earth materials to dissolve or leach. This phenomenon creates acid mine drainage, a widely recognized environmental problem associated with both active and inactive mines. Coal mining in the west is generally not associated with acid runoff, but it can impart sodium or other salts to runoff due to the highly alkaline nature of the surrounding soils (Sorensen 1979).

Type of Mining Operation

Mining operations, including surface mining, shaft mining, and open pit mining, are generally exposed to precipitation. In addition, ore processing operations located at mine sites add to the volume and exposure of mining wastes. Depending on the type of mining operations employed, storm water may be affected by contact with exposed ore, disturbed overburden, dust or particulate, or wastes from mining and ore processing operations.

Surface mining is characterized by the removal of protective layers of vegetation and soil, exposing large amounts of unweathered earth materials. These materials contain salts and soluble toxic pollutants that may end up in surface runoff via erosion and leaching.

Mine drainage from shaft mines is generated from water that collects in the mine from ground water seepage, storm water, and any process water used. This drainage may be acid or alkaline, depending on the nature of the host material. During mining activities, mine water is pumped or drained from the mine and, if required, treated prior to discharge or recycle. The type of treatment employed depends on the nature of the effluent, as well as the applicable effluent limitations guidelines (EPA 1975; EPA 1979; EPA 1981). After mining activities are completed, mine drainage may continue unless appropriate closure steps are taken.

Open pit mining operation, like shaft mining, must contend with mine water collecting at the bottom of the pit. Dikes and channels are often constructed to minimize the amount of runoff entering the pit and to facilitate drainage from the bottom of the pit without excessive erosion.

Activities at metal and mineral mine operations include extraction, beneficiation, and processing of ores and minerals. Extraction is the initial removal of the ore from the earth. Beneficiation is the inital attempt at liberating and concentrating mineral from the the extracted ore. Beneficiation can involve by a variety of milling (crushing, gringing, washing, filtration), agglomeration (sintering, pelletizing, briquetting) and other (heap, dump, vat and in situ leaching, precipitation, flotation, magnetic separation, roasting in preparation for leaching) techniques. Mineral processing operations generally follow beneficiation and include techniques that often change the chemical composition of the ore or mineral, such as smelting, electrolytic refining and acid attack or digestion.

Waste Generation

Mining operations create large amounts of wastes, which are generally managed in waste piles, ponds, or dumps. Mining waste is generated from several activities, including but not limited to, removal of overburden in surface mining and removal of earth materials from shaft mines and from ore processing operations. Erosion and leaching of soluble toxic materials caused by runoff from such waste is a widespread problem.

There is a distinction between wastes from extraction and beneficiation operations and minineral processing wastes.

Beneficiation operations often generate high volume solid waste streams that are essentially earhen in character, including tailings and leach piles. The waste material is often physically and chemically similar to the material (ore or mineral) that entered the operation, except that particle size reduction has often occurred. Environmental impacts from beneficiated materials are generally higher than from extracted ore because increased surface area of the ore allows more mobility of toxics and reagents, such as cyanide, that are added to the beneficiation process may be released to the environment.

Mineral processing operations generate waste streams that generally bear little or no resemblance or no resemblance to the material that entered the operation. These operations usually change the physical structure of the mineral. For example, concentrated ores are heated to produce a product metal, a slag, dust, and acid plant blowdown.

Wastes from metal, phosphate, asbestos and uranium mines were studied in the Report to Congress, "Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining and Oil Shale" (EPA, December 1985). Mines in the metal, phosphate, and asbestos segments produce about 1 to 1.3 billion metric tons per year of waste, with total waste accumulated by all active, inactive and abandoned mines since 1910 estimated at 50 billion metric tons. Of the 1.3 billion metric tons of waste produced each year, 61 million metric tons of copper, gold, silver, lead, or zinc wastes exhibit RCRA hazardous characteristics, with 23 million metric tons per year of gold and silver wastes potentially hazardous because they have been leached using cyanide solution. The quantity of waste generated at a given facility can vary from 10 tons per day to 500,000 tons per day.

In the mining Report to Congress, EPA concluded that wastes with the highest acid formation potential are in the copper, gold, and silver industry segments The report indicated that major causes of damage in the cases studied included periodic runoff, spills and sudden releases caused by heavy rains as well as seepage, and that damage to surface waters is often reducible or reversible by use of modified waste management practices or physical controls.

Inactive and Abandoned Mining Facilities

Some inactive and abandoned mining units, many of which are decades old, may pose significant environmental hazardous. Inactive and abandoned mines have been a major source of uncontrolled runoff for many years (Barks 1977; EPA 1987). Sources of pollutants in runoff at abandoned mine sites are essentially the same as those at active mines, including mine drainage and runoff from mining and processing waste piles.

Pollutant concentrations and loadings may be higher than those associated with active sites because the sites may have been mined prior to the development of regulatory controls for mines and appropriate closure procedures were not taken prior to abandonment of the site. In addition, detention ponds and other controls may have never been put in place, or may no longer be functioning correctly. Prior to abandonment, mine owners are often reluctant to cap or bury tailing piles and to take other steps that might make future recovery of minerals more difficult. The runoff from abandoned mines is often uncontrolled and not monitored. Ownership and responsibility for abandoned mines is often difficult or impossible to establish.

Pollutant Description

EPA has identified four metals of concern (lead, arsenic, cadmium, and chromium) that are generally found in wastes from any type of mine site, regardless of the substance being mined. These metals are of particular concern because they are common and thought to have serious human health effects (EPA 1987). Other mining-associated metals of concern include copper, zinc, nickel, molybdenum, and magnesium.

The potential pollutants in storm water runoff from mining sites vary greatly and depend on the segment; the beneficiation process; and site-specific geologic, hydrologic, and climatic factors. Some rock is high in metals or radionuclides. Some beneficiation processes use acids and cyanides. Runoff from mining wastes and tailings can contain these materials and also be acidic or alkaline.

During development of effluent guidelines for the coal mining category, EPA studied runoff from areas associated with coal mining operations, including coal storage piles, refuse piles, and other disturbed areas (EPA 1981). Pollutants found in runoff from these areas included solids, metals, pesticides, and organic compounds. Table 4-3 summarizes the results of this study.

TABLE 3-5. Summary Data From Coal Mining Effluent Guidelines Development: Runoff From Areas Associated With Coal Mining Activities

Pollutant	No. of Observations	Detected Concentrations in mg/L Minimum	Mean	Maximum
Solids				
TSS	7	3.30	67.06	240.0
Dissolved solids	3	580	1,960	3,100
Total volatile solids	4	26	1,398	2,900
Volatile suspended solids	4	22	10.25	28
Settleable solids	2	0.00	0.00	0.00
Total solids	4	180	9,147	22,000
Metals				
Antimony	3	0.002	0.013	0.028
Arsenic	4	0.002	0.350	1.340
Beryllium	4	0.002	0.060	0.220
Cadmium	3	0.013	0.025	0.038
Chromium	7	0.010	0.235	0.980
Copper	7	0.006	0.232	1.000
Cyanide	0			
Lead	4	0.003	0.271	1.000
Mercury	4	0.00002	0.0011	0.0024
Nickel	7	0.038	1.771	10.000
Selenium	4	0.001	0.137	0.450
Silver	2	0.027	0.031	0.036
Thallium	1	0.014	0.014	0.014
Zinc	8	0.019	4.297	30.000
Iron	9	0.275	1,246	9,000
Manganese	9	0.027	17.436	80.000
Pesticides				
BHC-beta	1	0.00033	0.00033	0.00033
BHC-delta	1	0.00010	0.00010	0.00010
Organic Chemicals				
Benzene	2	0.044	0.046	0.048
Chlorobenzene	1	0.012	0.012	0.012
Chloroform	2	0.045	0.261	0.476
Methylene chloride	4	0.162	[illegible]	1.440
Bis (2-ethylhexyl) phthalate	2	0.003	0.007	0.010
Other Pollutants				
pH	7	2.4	5.4	7.2
COD	4	12.675	362.044	1,160
TOC	3	4.125	11.508	19.300

A study of runoff from waste piles at an inactive lead-zinc mining area showed that elevated levels of several metals had migrated to a nearby creek (Barks 1977). Table 4-4 shows a comparison of pollutants measured in waste pile storm water runoff to those measured upstream of the waste piles.

3-4

TABLE [redacted]. Comparison of Pollutants in Runoff From Lead-Zinc Mining Waste Piles to Upstream Pollutant Concentrations

Pollutant[a]	Runoff From Waste Piles	Upstream Concentrations
Dissolved solids (mg/L)	414	134
Bicarbonate (mg/L)	62	136
Sulfate (mg/L)	230	8
Zinc (ug/L)	16,000	20
Aluminum (ug/L)	600	30
Lead (ug/L)	380	4
Copper (ug/L)	46	0
Cadmium (ug/L)	26	1
Nickel (ug/L)	16	2

[a]Dissolved fraction only.

Source: Barks 1977.

4.2.1.2 **Oil and Gas Extraction**

This group (SIC Code 13) includes establishments involved in the exploration, development, and production of crude oil, natural gas, and natural gas liquids. Operations performed by these establishments include well drilling, well logging, completion, and stimulation, as well as oil/gas/water separation and treatment.

Drilling activities may include clearing of land, construction of temporary access roads, installation of drilling and related equipment, and reserve pit construction. The first three of these activities are comparable to those conducted at construction sites.

Reserve pits are primarily used to receive drill cuttings throughout the well drilling operation, and are sized roughly according to the estimated total depth of the well. A pit is typically dug in the open with a backhoe and should be designed to meet State-required specifications, such as inner side slope limits, depth of the pit relative to the nearest ground water aquifer, liner type, and freeboard allowance (i.e., space between the top of the pit contents and the upper lip of the pit). Some States require at least 2 feet of freeboard to prevent possible overflows caused by precipitation or over-filling. In addition to the erosion that can occur due to the disturbed land at a drill site, significant contamination of storm water runoff is possible at sites where reserve pits are poorly constructed, located, or managed. The common practice of land applying reserve pit waste is also a potential source of pollutants in storm water discharges.

Production activities are established once a well has been successfully completed. The primary function of a production unit is to separate the oil, water, and gas received from the well head to the extent that the oil and/or gas is ready for sale and transfer, either by truck or pipeline. Production units, or tank batteries, are usually located outside and may serve numerous wells in a producing field. Separation occurs in a series of tanks and vessels designed to produce increasing degrees of water-free oil and/or gas. Oil that will meet pipeline specifications is then sent to storage tanks known as stock tanks. The number and size of stock tanks depend upon the volume of oil produced, method of selling the oil to the pipeline, and the frequency and rate at which oil is taken by the pipeline company.

For the most part, production operations function without exposing the process streams to storm water. However, the major waste product from separation processes, produced water, is often handled and disposed of in ways that can come in contact with storm water. The choice of disposal methods for produced water depends on various factors, including State regulations, company policies, economics, geological considerations (i.e., feasibility of injection well disposal), and regional precipitation patterns. For example, only States having net evaporation zones allow the use of produced water evaporation pits. Such open pits are generally not allowed in areas of net precipitation. Some States also allow the direct discharge of produced water to surface waters or to unlined drainage ways. In addition to these disposal methods, tank batteries can include produced water holding tanks that are open to the atmosphere.

Wastes from oil and gas extraction activities were studied in a Report to Congress, "Management of Wastes from the Exploration, Development and Production of Crude Oil, Natural Gas and Geothermal Energy" (EPA 1987). This study identified seven chemical constituents of oil and gas field wastes present at levels of potential concern, including the hydrocarbons benzene and phenanthrene, and the inorganic constituents lead, barium, arsenic, fluoride, and antimony. These seven chemical constituents were reported on the basis of their frequency of occurrence in waste samples, and as such, represent only a small percentage of all chemicals to be found in oil and gas field wastes. For example, produced water is an aqueous solution containing many dissolved compounds, including minerals such as sodium chloride and dissolved hydrocarbons in widely varying concentrations. When produced water is discharged to surface waters, the sodium chloride and other dissolved minerals can have serious effects on the receiving streams. This particular problem led EPA to set a water-quality limit for chloride discharged to the waters of Kentucky, citing the major impact that produced water from stripper wells was having on State waters (52 FR 9102). In addition, suspended solids may be a significant constituent of runoff from drill sites where land has been cleared and disturbed.

EPA reported several waste disposal practices that may result in significant contamination of storm water discharges. California permits the discharge of oily wastes to large, unlined sumps or pits and ephemeral streams. Pollutants from wastes discharged to ephemeral streams can become resuspended during storm events and carried to larger receiving waters.

Waste disposal practices on the North Slope of Alaska are very different from those in other areas of the United States. Discharges of excess liquid directly onto the tundra and roads from production reserve pits is allowed under Alaska Department of Environmental Conservation regulation. ADEC estimates that 100 million gallons of this liquid are pumped onto the tundra and roadways on the North Slope each year, carrying reserve pit constituents such as chromium, barium, chlorides, and oil.

Illegal disposal of wastes at oil and gas operations is a pervasive problem that may result in damage to surface waters and wetlands. Incidents of illegal disposal of oil and gas wastes are found throughout the United States.

Nothing in the literature indicates that storm water is routinely collected and treated before discharge from oil and gas extraction facilities.

4.2.3 MANUFACTURING INDUSTRIES

Manufacturing facilities include operations that produce new products from various materials and substances. Examples of manufacturing facilities include food processing facilities, chemicals manufacturing, metal products manufacturing, and petroleum refining.

4.2.3.1 Food and Tobacco Manufacturing

The manufacturing operations conducted by facilities in these groups are related to food (e.g., meat, fish, vegetables, dairy, grain, bakery, confectionery, beverages) and tobacco production, processing, packaging, and storage. Examples include meat, fruit and vegetable canners, grain mills, bakeries, seafood processors, soft drink bottlers, breweries, and rendering plants.

Primary sources of pollutants in discharges from separate storm sewers at food and tobacco manufacturing facilities include the loading and unloading of bulk or liquids, outdoor storage and processing, outdoor industrial activity, illicit connections/industrial practices, and land application of wastes. Examples of these sources include the unloading and care of animals, the loading of packaged goods at meat processing facilities, and pneumatic transfer of grain, generating dust or particulate. Because many of these facilities use large volumes of water in cooling and other process streams, illicit connections between these streams and storm water outlets are common. Land application of wastes onsite is also a common practice which may impact pollutant concentrations in discharges from separate storm sewers.

For the majority of facilities, the pollutants that would most likely be present in discharges from storm sewers from these industrial sources include oxygen-demanding pollutants such as biochemical oxygen demand (BOD) and chemical oxygen demand (COD), and total suspended solids (TSS). Of particular concern within this group is storm water runoff from animal pens located at meat processing facilities. Pollutants of concern in storm water from animal pen areas include oxygen-demanding pollutants, nutrients, and pathogens.

Some food processing facilities use solvents such as hexane, methyl ethyl ketone, and methylene chloride for extraction and leaching operations. Although extraction and leaching operations are expected to be performed indoors, solvent loading and unloading areas and solvent storage areas can be expected to be outdoors.

4.2.3.2 **Textile Mill Products**

The facilities in this group (SIC Code Group 22) are principally engaged in receiving and preparing fibers; transforming these materials into yarn, thread, or webbing; converting the yarn and web into fabric or related products; and finishing these materials at various stages of production. Many facilities produce a final consumer product, such as thread, yarn, bolt fabric, hosiery, towels, sheets, or carpet, while the rest produce transitional products. The category for apparel and other textile products (SIC Code 23) includes industries primarily involved in manufacturing sewn textile products.

In general, processing is dry and little or no discharge of waste water results. Process areas and raw materials and product storage areas are almost always located inside buildings, protected from rainfall. Spilling of chemicals and dyes used to treat fabrics during shipment and transfer into the facility, and from waste treatment plants can add pollutants to storm water discharges. Illicit connections are also possible due to the age of many textile mills.

Textile chemical treatment agents include acid, alkali, starch, polyvinyl alcohol, carbonyl methyl cellulose, polyacrylic acid, bleach, soap, adhesives, silicones, and various other organic and inorganic compounds. The dyes used can be either organic or inorganic and either toxic or nontoxic.

4.2.3.3 **Lumber and Wood Products**

The manufacturing operations conducted by facilities in this group (SIC Code Group 24) are all related to lumber and wood products, except wood furniture manufacturing. Examples of lumber and wood products manufacturing operations include sawmills and planing mills, millwork, and mobile and prefabricated wood buildings.

The activities of these facilities that might contribute to storm water pollution include loading and unloading, outdoor storage, and outdoor industrial activity. This is also true for facilities receiving and storing wood and wood chips for use in the manufacture of wood veneers, plywood, and reconstituted wood products (e.g., hardboard, particleboard, and insulation board [EPA 1981]). Storm water discharges from these facilities are expected to contain significant levels of oxygen-demanding pollutants and TSS.

Wood preserving facilities involve more chemical intensive processes. Wood preservatives are used to delay deterioration and decay of wood caused by organisms such as insects, fungi, and marine borers. A wide variety of chemicals are used to preserve wood. Three broad categories of wood pesticides include creosote or oil-borne preservatives, pentachlorophenol (penta) solutions, and water-soluble inorganic arsenical compound and/or chromate salts (inorganics). Long-lasting protection of wood requires penetration of preservatives to a uniform depth. This deep penetration is usually accomplished by forcing preservative into the wood under pressure, so that "pressure treated" is often used as a synonym for "preserved".

Creosote or mixtures of creosote with petroleum oils or coal tar is the primary wood preservative used in the United States. It is the product of distilled coal tar and is composed of hundreds of polynuclear aromatic hydrocarbons (PAHs) as well as tar acids and bases. Pentachlorophenol, the second most common wood preservative, has been used to treat wood since 1947. It is applied to poles, crossarms, lumber, timbers, fence posts and other wood products in a 5% solution with petroleum solvents where a clean paintable surface is not required.

Inorganic arsenical preservatives account for the third largest category of wood preservatives in the United States. These preservatives, which were developed in the 1930s, consist of mixtures of bivalent copper, pentavalent arsenic, hexavalent chromium or fluorides. The three most widely used compounds for commercial wood treatment include chromated copper arsenate (CCA); ammoniacal copper arsenate (ACA); and fluorochrome-arsenate phenol (FCAP). These preservatives usually color the wood greenish-brown, and provide clean paintable surfaces.

In 1985, three major product groups accounted for 89 percent of the total production of preserved wood in the United States: (1) lumber and timber, mostly preserved with inorganic preservatives; (2) railroad cross ties, switch ties and bridge ties, almost all preserved with creosote; and (3) poles, 60 percent preserved with pentachlorophenol, 23 percent with creosote, and 17 percent with inorganic preservatives. The remainder of production consists of fence posts, piling, plywood, crossarms and other products.

The distribution of preservative use by the wood preserving industry is summarized in Table 4-9. Seventeen percent of the plants treat with more than one preservative. Runoff generated at these plants can be contaminated with constituents of all preservatives used at the plant. The American Wood Preservers Institute reported 571 plants producing preserved wood in 1985. About 60 percent of these plants are in the southeast and southcentral portions of the United States and account for 64 percent of the production of treated wood. Most plants that treat with creosote and/or pentachlorophenol are more than 25 years old; several operating plants are more than 75 years old.

Most surface protection takes place at sawmills, where cut lumber is dip- or spray-treated to prevent surface discoloration (sapstain formation) during short-term storage. In 1983, approximately 3.7 billion board feet of lumber was surface protected, the majority with about 1.5 million pounds of aqueous solutions of sodium pentachlorophenate, at sawmills. This accounted for about 10 percent of the sawmills total production of lumber. Water solutions of sodium pentachlorophenate are applied to wood by dipping or spraying. Commercial chlorophenates have been found to contain polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). EPA estimates that there may be up to 500 sawmills currently surface protecting wood with chlorophenate formulations and a total of 1,500 sawmills that have protected wood with chlorophenates within the past ten years.

Pollutants in storm water runoff from treated material storage yards at wood-preserving facilities were studied by EPA in 1981 in support of effluent guidelines development, and in support of a proposed hazardous waste listing in 1988. Table 4-10 presents a summary of the screening sampling program performed by EPA. Certain metals, including chromium, copper, and arsenic, were found at high levels in storm water from wood-preserving facilities. Several organic pollutants were found at significant concentrations, including pentachlorophenol, fluoranthene, benzo(a)anthracene, chrysene, phenanthrene, and pyrene. EPA proposed to list a number of wood preserving wastes including preservative drippage (free drippage of preservative from treated wood and preservative that is washed-off treated wood by precipitation) as hazardous waste under RCRA, and establish hazardous waste management unit requirements for drip pads (December 30, 1988 (53 FR 53287). Sump, catch basin and drainage ditch sediment data and drippage data for facilities that use chlorophenolic formulations from the proposed listing are shown in Table 4-11.

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TABLE 4-10. Summary of EPA Screening Sampling of Storm Water Runoff at Wood Preserving Facilities

Parameters	Range	Number of Facilities Sampled
Traditional Parameters (mg/l)		
BOD (5-day)	2.4 - 48	6
COD	54 - 600	6
Total Solids	169 - 3,800	6
Volatile Solids	108 - 845	6
Suspended Solids	23.0 - 3,330	6
Dissolved Volatile Solids	<5 - 800	6
Dissolved Solids	105 - 912	6
Total Phenols	0.009 - 1.3	5
Oil and Grease	<5 - 24	6
Metals (ug/l)		
Beryllium	0.7 - 40	6
Cadmium	0.4 - 3.1	6
Chromium	3.2 - 1,500	6
Copper	8.5 - 760	6
Nickel	6.2 - 310	6
Lead	2.9 - 520	6
Zinc	83 - 990	6
Arsenic	19 - 2,200	6
Mercury	<0.40 - 4.9	6
Acid Compounds (ug/l)		
2,4-Dimethylphenol	ND - 18	5
2-Nitrophenol	ND - <10	5
Pentachlorophenol	ND - 440	5
Phenol	ND - 32	5
Base/Neutral Compounds (ug/l)		
Acenaphthene	ND - 340	5
Fluoranthene	ND - 680	5
Naphthalene	ND - 71	5
Bis(2-ethylhexyl) Phthalate	ND - <10	5
Butyl Benzyl Phthalate	ND - <10	5
Di-n-butyl Phthalate	ND - <10	5
Diethyl Phthalate	ND - <10	5
Benzo(a)anthracene	ND - 120	5
Benzo(a)pyrene	ND - 300	5
Benzo(k)fluoranthene	ND - 230	5
Chrysene	ND - 140	5
Acenaphthylene	ND - 15	5
Anthracene	ND - 1,500	5
Benzo(ghi)perylene	ND - 82	5
Fluorene	ND - 110	5
Phenanthrene	ND - 1,300	5
Dibenzo(a,h)anthracene	ND - 14	5
Pyrene	ND - 410	5

ND = Not Detected.
Source: EPA 1981.

4.2.3.4 **Furniture and Fixtures**

This industry group is composed of facilities which manufacture household furniture (SIC Code 251), office furniture (SIC Code 252), public building and related furniture (SIC Code 253), partitions and fixtures (SIC Code 254), and miscellaneous furniture and fixtures (SIC Code 259). Metal finishing occurs among industries described by SIC Codes 2514, 2522, 2531, 2542, 2591, and 2599. Other facilities in this industry group are involved in manufacturing wood furniture and fixtures. Activities associated with these facilities are conducted largely indoors, although chemical and waste storage and handling occur outside and illicit connections or improper dumping of wastes to separate storm sewers can be a problem.

The nature of discharges from separate storm sewers from metal finishing facilities is discussed under the heading Fabricated Metal Products.

4.2.3.5 **Paper and Allied Products**

This industry group is composed of pulp mills (SIC Code 261), paper mills (SIC Code 262), paperboard mills (SIC Code 263), paperboard containers and boxes (SIC Code 265), and miscellaneous converted paper products (SIC Code 267). Most of the activities that can potentially affect storm water at facilities within this industry group are the same from subgroup to subgroup. Industries in the printing and publishing group (SIC Code Group 27) conduct their activities largely indoors.

The major processes in the paper and allied manufacturing are wood preparation, pulping, bleaching, stock preparation, and papermaking. In addition to these basic processes, some mills perform de-inking, which refers to the reclamation of waste paper. De-inking removes ink, fillers, coating, and other non-cellulose materials. De-inking mills often store large volumes of waste paper in uncovered areas.

The potential sources of pollutants in storm water discharges include: transport, loading, unloading, and storage of raw materials, including logs, wood chips, waste paper, and process chemicals; outdoor activities, including waste treatment and residuals management operations, and wood preparation processes; and particulate emissions from burning of fossil fuels.

Wood preparation processes are usually conducted outdoors. These processes generally involve the use of high water volumes. Waste water from these operations is considered process waste water and is treated at waste treatment facilities. During wet weather, however, the capacity of the collection system may be insufficient to provide treatment for runoff. In addition, illicit connections are possible due to the age of most paper mills, and due to the typically close proximity of surface water such as lakes or streams.

4.2.3.6 **Chemicals and Allied Products**

This major industry group (SIC Code Group 28) includes establishments producing basic chemicals and establishments manufacturing products through the use of chemical processes. Facilities included in this major group produce: basic chemicals such as acids, alkalies, salts, and organic chemicals; chemical products to be used in further manufacture, such as synthetic fibers, plastics materials, dry colors, and pigments; and finished chemical products to be used for ultimate consumption or use, such as drugs, cosmetics, and soaps, or to be used as materials or supplies in other industries, such as paints, fertilizers, and explosives.

This group can also be subdivided into facilities that produce inorganic chemicals and related products, and facilities that produce organic chemicals and related products. This distinction is important because each subgroup uses very different raw materials, processes, and methods of materials handling. The facilities in both groups store raw materials, products, and wastes onsite; however, the inorganic chemicals and products segment of the industry is more likely to store materials outdoors.

For several types of facilities, effluent guidelines limiting phosphorus, fluoride and pH, include limitations for storm water discharges. Effluent guidelines for the fertilizer manufacturing industry address precipitation runoff that may come into incidental contact with raw materials, products, or intermediate products. Regulated pollutants in fertilizer manufacturing runoff include ammonia, organic nitrogen, nitrate, phosphorus, BOD, TSS, and pH. Effluent guidelines for the inorganic chemicals industry require all storm water and plant site runoff to be collected and routed to the plant treatment facility if contact is possible with any leakage, spillage, raw materials, or product. Pollutants limited in the inorganic chemicals effluent guidelines include cyanide and various metals, depending on the facility.

Facilities within the chemicals and allied products industry group can contribute to storm water pollution as a result of materials storage and handling, as well as outside manufacturing activities. In general, facilities that produce pharmaceutical preparations, soaps and detergents, paints and ink formulations, and pesticides take stronger precautions to prevent storm water contact with their raw materials and products. Inorganic chemical and fertilizer manufacturers, on the other hand, may store raw materials and products outdoors.

Although organic-chemical-related facilities generally do not store raw materials and products in the open air, outside storage facilities, such as tanks, may release pollutants as a result of floating roof seals, leaking pump seals, and spills. At many organic chemical facilities, outside process areas are commonly diked and the storm water is treated along with process waste water.

Pollutants from the inorganic chemicals industries most likely to be found in storm water include BOD, TSS, acids or bases, and inorganic pollutants and metals, depending on the specific inorganic chemicals manufactured at the facility. In addition, fertilizer manufacturers can be expected to be a source of nutrients. Pollutants from the organic chemicals industries most likely to be found in storm water discharges include BOD, COD, total organic carbon (TOC), TSS, oil and grease, metals, and organic chemicals, depending on the facility.

4.2.3.7 Petroleum Refining and Asphalt

This major group consists of two major subgroups: petroleum refining (SIC Code 2911) and asphalt paving and roofing materials (SIC Codes 2951 and 2592). Because most of the establishments in this group are associated with the processes and products of petroleum refineries, the nature of storm water runoff from petroleum refineries is presented in the following discussion. It is important to note, however, that these subgroups differ with respect to their effects on storm water because petroleum refining is a more outdoor-oriented industry than the manufacture of asphalt paving and roofing materials.

Outside storage areas may contain raw materials, products, or hazardous materials, such as sludge from process or treatment units. Any storm water that comes in contact with any raw material, intermediate product, finished product, byproduct, or waste product located on petroleum refinery property is subject to effluent guidelines and standards developed for the Petroleum Refining Point Source Category (40 CFR Part 419).

Because many operational refineries have been in business for much of this century and process equipment is exposed to the atmosphere at most refineries, leaks and spills are common throughout all process areas. The opportunity for illicit connections to storm sewer systems is significant given the age of most of these facilities. In addition, storm water discharges from storage tank farms can contain high levels of pollutants due to leaks and spills.

The pollutants addressed in the effluent guidelines and standards for storm water discharges within the Petroleum Refining Point Source Category include oil and grease, TOC, BOD, COD, TSS, phenolic compounds, total and hexavalent chromium, and pH. Exceedance of oil and grease and TOC limitations triggers the requirement to comply with limitations for the remaining pollutant parameters.

4.2.3.8 **Rubber and Plastic Products**

The facilities in this group (SIC Code Group 30) manufacture products from manufactured plastic and from natural, synthetic, or reclaimed rubber. Plastic molding and forming facilities consist of plants that blend, mold, form, or otherwise process a wide variety of plastic materials into intermediate or final plastic products. Rubber products manufacturing can be divided into miscellaneous molded, extruded, and fabricated products; reclaimed rubber; and latex products. Regardless of the product being manufactured, most industrial activities that affect storm water runoff are similar at all facilities in this group.

A primary source of pollutants occurs when storm water comes into contact with stored raw materials, products, and process wastes. In addition, leaks and spills of processing agents and hydraulic oil could also result in increased pollutant concentrations in storm water discharges. Reclaimed rubber facilities in particular may store raw materials (e.g., recycled rubber) in the open air.

For the plastics industry, plastic pellets (i.e. plastic material used by processors to make plastic products) are of growing concern. These pellets are generally 1 to 5 millimeters in diameter, and if discharged can pose threats to aquatic life. Individual pellets are not valuable, and many processors have not set up systems to control or reduce their loss.

For the rubber industry, oil and grease in storm water discharges is of particular concern. The bulk storage of recycled rubber can be a source of oil and grease and TSS. An EPA study (EPA 1974) cited several facilities that were experiencing substantial oil in storm water discharges. Oil is used at rubber manufacturing facilities as a fuel, a processing agent, a lubricant, and a hydraulic fluid in molding and extruding machinery. In general, the sources of oil were leaks and spills at bulk storage facilities, and storage and transfer of waste oils in open areas. At another rubber facility, leaking hydraulic systems had seriously contaminated the shallow ground water beneath the facility.

4.2.3.9 **Leather and Leather Products**

This industry group is composed of facilities engaged in leather tanning, curing, or finishing (SIC Code 3111). In addition, facilities that use finished leather to manufacture leather products are included in this group (SIC Code 313-319). With respect to storm water, the leather tanning and finishing facilities are the most significant segment of this industry, and are discussed below.

A source of pollutants in storm water discharges from this group include loading/unloading areas and waste treatment areas. Loading and unloading areas at leather tanning facilities handle hides and the various chemicals used in the tanning process (e.g., sodium sulfide, trivalent chromium, sodium hydroxide, fat liquor, and pigment and dyes). Waste treatment areas that handle the wastes generated at these facilities can also result in high pollutant levels in storm water discharges. In light of the fact that many tanneries are old and water is used extensively in the tanning process and for facility cleanup, the potential exists for illicit discharges to storm water systems.

The pollutants expected to be found in storm water discharges because of their use or generation during the tanning and finishing process include chromium, TSS, BOD, and pathogens. The leather tanning manufacturing process includes three basic steps: beam house operations, where hides or skins are washed, soaked, and the attached hair is removed using chemicals such as sodium sulfate; tanyard process, where tanning agents containing chromium are used to stabilize the proteinaceous matter in the hides or skins; and retanning and wet finishing processes, where further tanning is done with chemical agents, such as sodium hydroxide and fat liquor. Water is essential to the tanning process and is used in virtually all manufacturing processes. A wide range of chemicals are used in the processes, including solvents, detergents, lime, acids, chromium, organic tanning, dyes, and lubricants (EPA 1982).

4.2.3.10 Stone, Clay, Glass, and Concrete Products

This group is composed of establishments involved in the processing and/or manufacturing of stone, clay, and glass products (SIC Code Group 32). Subgroups include flat glass, glass and glassware (pressed or blown), products of purchased glass, hydraulic cement, structural clay products glass, pottery and related products, concrete, gypsum, and plaster products, and miscellaneous nonmetallic mineral products.

A number of activities associated with stone, clay, and glass production can contribute to storm water pollution. These activities include loading/ unloading; storage of raw materials, intermediates, products and residuals; and the generation of dust and particulate. The two subgroups of particular concern in terms of storm water discharges are hydraulic cement and asbestos products manufacturing.

In addition to cement, most hydraulic cement plants produce concrete and cement blocks. The most common product of cement manufacturing, portland cement, is made from a calcareous material, such as limestone or chalk, and from alumina and silica-bearing material, such as clay or shale. The manufacturing process generally consists of: 1) grinding raw materials and mixing in specified proportions, 2) burning in a rotary kiln at a temperature of approximately 1,350°C (2,500°F), 3) cooling and grinding the clinker into a fine powder once the material enters and partially fuses into balls (clinkers), and 4) adding gypsum to control the setting speed when the cement is mixed with water.

Sources of pollutants in storm water associated with cement industry include transport, loading, and unloading of raw materials, products, and residuals; storage of raw materials, products, and residuals; and processing dusts, including kiln dust. Effluent guidelines and standards have been promulgated for storm water discharges from material storage pile runoff from the storage of raw materials intermediate products, finished products, and waste materials at cement manufacturing facilities, is regulated (40 CFR Part 411).

The primary pollutant associated with storm water discharges in cement manufacturing is solids. In addition, due to the use of calcareous materials, the resulting pH of storm water runoff from these facilities can also be of concern. Effluent guidelines for runoff from cement manufacturing specify limitations for total suspended solids and pH.

The asbestos industry can generally be described in terms of the products manufactured: asbestos textiles, including asbestos-bearing yarn, cord, thread, cloth, roofing, lap, wick, rope, tape, and carded fibers; asbestos friction materials, including products used in transportation, mining, and heavy industry; and asbestos gaskets for packing and insulation. The manufacturing processes include various mechanical operations that are mostly dry and relate to grading and forming of asbestos fibers. Major water uses are wet scrubbers and wet mixing of molding materials for the production of asbestos friction materials. Asbestos dust from air exhaust systems and material handling facilities can adversely impact storm water quality.

4.2.3.11 <u>Primary Metals Industries</u>

The facilities in this group (SIC Code Group 33) are engaged in the primary manufacturing of ferrous metals and metal products and the primary and secondary smelting and refining of nonferrous metals. In addition, facilities engaged in the molding, casting, or forming of ferrous or nonferrous metals are included in this group. The following discussion regarding potential sources of pollutants in storm water discharges applies to all industries within the group, and examples for specific facilities are provided.

The primary sources of pollutants in storm water discharges from these facilities will result from the storage and handling of raw materials, finished products, and wastes. Open air storage and handling of raw materials, products, and wastes is a common practice at many of these facilities. In addition, dust and particulate-generating processes, particularly at smelting and refining facilities, are considered potential sources of pollutants in storm water discharges. Slag quench processes performed at metal molding and casting facilities has a high potential to add pollutants to storm water discharges. Also, based on the high process water usage for operations such as spray quenching, heat treating, and die cooling, and the old age of many primary metals industry facilities, there is a reasonable potential for illicit connections and discharges to storm water collection systems.

Storm water from the storage of raw material and waste has the potential to contain leached metals, total dissolved and suspended solids, adverse pH levels, and possibly other inorganic pollutants. A particular area of concern in the primary metals category are coal and coke storage and handling areas. Table 4-12 presents runoff data from coal and coke storage areas at iron and steel manufacturing facilities. As shown, elevated concentrations of TSS, iron, and ammonia are present in storm water runoff. Storm water from the storage of finished products also has the potential to contain metals, oil and grease, adverse pH levels, and TSS.

TABLE 4-12 [redacted]. Summary of Results
From Study of Runoff From Coal and Coke Storage Piles at
Iron and Steel Facilities
(continued)

Pollutant	Site No.	Potential Problem Areas	Average Wet Concentrations (mg/L)
Ammonia	1	Coal storage	36
	2		0.33
	1	Coke storage	2.1
	2		29.3
	1	Coke and coal handling	43
	2		n.a. (c)
Sulfate	1	Coal storage	n.a. (b)
	2		232
	1	Coke storage	n.a. (b)
	2		129 (d)
	1	Coke and coal handling	312
	2		n.s. (c)

(a) n.d. - none detected.
(b) n.a. - not analyzed.
(c) n.s. - no samples collected.
(d) There were two sampling points near the coke storage area at Site 2. The average concentrations for only one (outfall 013) are shown.

Source: Bookman 1979

4-12

TABLE [redacted]. Summary of Results From Study of Runoff From Coal and Coke Storage Piles at Iron and Steel Facilities

Pollutant	Site No.	Potential Problem Areas	Average Wet Concentrations (mg/L)
TSS	1	Coal storage	
	2		4187
	1	Coke storage	853
	2		505
	1	Coke and coal handling	392 (d)
	2		184
			n.s. (c)
TDS	1	Coal storage	
	2		2239
	1	Coke storage	471
	2		745
	1	Coke and coal handling	959 (d)
	2		2158
			n.s. (c)
Total iron	1	Coal storage	
	2		39.3
	1	Coke storage	18
	2		32.3
	1	Coke and coal handling	12.6 (d)
	2		2.4
			n.s. (c)
Dissolved iron	1	Coal storage	
	2		n.d. (a)
	1	Coke storage	0.2
	2		0.1
	1	Coke and coal handling	1.0 (d)
	2		0.1
			n.s. (c)
Phenols	1	Coal storage	
	2		0.39
	1	Coke storage	0.01
	2		0.06
	1	Coke and coal handling	0.03 (d)
	2		0.37
			n.s. (c)
Cyanide (total)	1	Coal storage	
	2		n.d. (a)
	1	Coke storage	n.d. (a)
	2		0.01
	1	Coke and coal handling	0.35 (d)
	2		n.d. (a)
			n.s. (c)

Particulate emissions from smelting and refining operations can also result in high levels of pollutants in storm water discharges. Metals associated with these particulate emissions can generally be related to the primary metal being manufactured. An example of the large potential for pollutants in storm water involves a secondary lead smelter. Levels as high as 350,000 parts per million of lead were detected in a storm drain adjacent to the closed smelting facility (Seattle Metro 1987). Sediment taken from the storm drain had lead concentrations so high that it was sold to another smelter for reprocessing.

4.2.3.12 **Metal Products Industries**

This industry category includes facilities involved in the manufacture of metal and metal-related products. Facilities within this category are classified according to the following major SIC Code Groups: fabricated metal products (SIC Code Group 34), industrial machinery and equipment (SIC Code Group 35), electronic and other electrical equipment (SIC Code Group 36), transportation equipment (SIC Code Group 37), and instruments and related products (SIC Code Group 38).

The sources of pollutants to storm water are similar throughout this industry group. Generally, these sources relate to storage, waste water treatment, emissions from fume exhaust systems, and potential illicit connections to storm water systems.

Metal finishing, electroplating, and coating facilities (SIC Codes 3471 and 3479) generally conduct all manufacturing processes indoors, although in warmer climates some plants operate waste treatment facilities outdoors. Loading/unloading, storage, and air emissions are the major sources of storm water pollutant loadings associated with industrial activity.

Most chemicals purchased by this industry (e.g., acids, caustic, metal salts, cyanide salts, solvents, and paints) are packaged in drums. Some larger facilities purchase bulk quantities of chemicals that are unloaded from rail cars or tank trucks. Most raw material chemicals are stored indoors although, some storage is outdoors (e.g., bulk storage of caustic or acid). Waste residuals (e.g,. sludges, spent solutions) are stored outdoors in drums, rolloffs, or hoppers, which may be exposed to rainfall.

Some of the chemical processes at metal finishing, electroplating, and coating plants require fume exhaust systems. Processes typically included are chromium plating; hard coating of aluminum; aluminum and copper etching; iron and steel pickling; aluminum bright dip; lead plating; copper plating; nickel plating; anodizing; chromating; phosphating; painting; and zinc plating. Exhaust systems may include a wet scrubber system or mesh pad mist eliminator to remove contaminants from the exhausted air stream. The treated or untreated discharge air may contain aerosols contaminated with toxic metals, transient organics, and cyanide. Significant settling of pollutants may occur on areas around exhaust pipes (typically roofs). Also, areas around scrubbers, mist eliminators, and duct work can potentially be contaminated by leaks and/or spills. The pollutants of concern for metal finishing facilities are toxic metals, cyanide, and solvents. EPA PCS data for treated storm water discharges from an electroplating facility showed oil and grease levels to range from 1.6 mg/L to 239.7 mg/L.

Porcelain enameling facilities (SIC Codes 3431 and 364) are involved in the application of porcelain enamel coatings to base metals to provide a decorative and protective finish. The porcelain enameling process involves the preparation of the enamel slip (formed from frit, a glassy raw material, clays and other raw materials); the surface preparation of the base enamel; drying; and firing to fuse the coating to the metal. Process chemicals used include frit, clay, gums, bentonites, colloidal silica, zirconium oxide, electrolytes, solvents, alkaline cleaners, acids, nickel sulfate, cyanide, and chromate.

The potential sources of pollutants to storm water from the porcelain enameling industry are similar to those of the metal finishing industry. These sources include storage of chemicals and waste products, and emissions and leaks from air exhaust systems. In addition, water is used in the porcelain enameling industry for cooling such equipment as bull mills, air compressors, and miscellaneous transport and power installations. The pollutants of concern for the porcelain enameling industry include toxic metals and solvents.

Battery manufacturing operations (SIC Codes 3691 and 3692) involve anode and cathode manufacturing processes and various ancillary operations. Ancillary operations are primarily associated with battery assembly and chemical production of anode and cathode active materials. Anodes are usually zero-valent metals. The active mass for anodes is prepared by directly cutting and drawing or stamping the pure metal or alloyed metal sheet. Cathodes often consist of oxidized metals, such as lead peroxide or nickel hydroxide.

Potential sources of pollutants in storm water include outdoor storage areas, outdoor waste treatment operations, and emissions from air exhaust systems. The pollutants of concern are toxic metals. Waste waters and solid wastes from battery manufacturing often contain one or more of the following toxic metals: cadmium, lead, mercury, nickel, or zinc.

The electrical and electronic components industry segment

(SIC Code Group 36) manufactures products such as electron tubes, phosphorescent coatings, capacitors (fixed), capacitors (fluid-filled), carbon and graphite products, mica paper, incandescent lamps, fluorescent lamps, fuel cells, magnetic coatings, resistors, transformers (dry), transformers (fluid-filled), insulated devices (plastic and plastic laminated), insulated wire and cable (nonferrous), ferrite electronic parts, motors, generators, alternators, resistance heaters, and switch gears (EPA 1983).

The potential sources pollutants in storm water include storage of raw materials, products and process residuals, and waste water treatment systems. The potential storm water pollutants from this industry include toxic metals and solvents.

4.2.3.13 Miscellaneous Manufacturing Industries

This category includes a variety of facilities that manufacture miscellaneous products. Facilities within this category are classified within SIC Code Group 39. Examples of facilities within this group include jewelers, and musical instrument, toy, and sporting goods manufacturers. Most of these facilities employ processes similar to other manufacturing facilities (e.g., the use of the electroplating process in jewelry manufacturing).

4.2.4 CONSTRUCTION INDUSTRIES

4.2.4.1 Construction Practices

Typical construction practices include clearing and grubbing, rough grading, facility construction, pest control, and the restoration of staging and stockpile areas on completion of the job.

Clearing and Grubbing:

Clearing and grubbing are typically the initial phases of a construction activity. These activities create major disturbances to the land surface, with construction of transportation (highways) and energy networks (electric transmission lines, and oil or natural gas pipelines) being some of the largest construction activities. Unwanted vegetation such as trees, shrubs, or tall grasses will be cleared from the site or right of way. In some cases, the surface soil may be stripped and stockpiled for use during site restoration. Unwanted buildings or structures may be demolished or moved.

Cutting of trees, other woody plants, and grasses can produce large volumes of timber and wood waste. Some of the timber can be used for lumber, plywood, or pulpwood. Remnants of trees such as large branches and stumps can be used for wood chips which are buried in disposal sites or burned. Preparation of wood chips is the preferred method of disposal of wood wastes, because they serve as protective mulches on cut and fill slopes, access roads, and certain staging areas.

Rough grading

Rough grading occurs at essentially all construction operations, with grading being particularly important to highway cuts and fills, excavations for dams and pipelines, and housing and related land development.

Grading exposes extensive areas of soil to erosion from rain and wind. For example, up to 30 acres of soil may be exposed per mile of highway constructed. Under heavy rainfall, a road construction site may produce 3,000 tons of sediment per mile.

Heavy construction equipment such as bulldozers and trucks become both a direct and indirect source of storm water pollutants. Diesel fuel, oil and lubricants are direct sources of pollutants. In addition, construction equipment causes severe compaction of clayey soils, lowering water infiltration and making revegetation of graded areas more difficult. Compaction of soils by heavy machinery reduces permeability and surface storage and increases hydrologic activity (Novotny and Chesters 1981).

Site grading also establishes the drainage patterns for the site after construction is completed. A well graded site can reduce the volume and rate of storm water discharged from a site after the construction is completed. However, a site which is graded to remove as much storm water as quickly as possible can result in high storm water volumes being discharged and erosion problems.

Facility construction

Facility construction includes core drilling, foundation grouting and concrete operations during the construction of transmission structures, highways, buildings, and dams. Activities associated with facility construction may also include asphalt operations and the construction of storage areas or workshops.

Washing equipment from concrete operations on site may result in improper disposal or spillage of concrete or washwater into receiving waters or along streambanks. Large volumes of water are also used in washing of sand and stone aggregates. Along with sediments, these materials may contain trace elements such as cobalt, chromium, manganese, and lead.

Facility construction activities generate solid wastes from construction camps, shops and storage areas (including scrap, trash, and sanitary wastes) which may be washed into receiving waters during storm events.

Pest Control and dust control

Pest control can involving spraying sites with insecticides, herbicides, or rodenticide, to remove harmful insects, herbaceous and woody plants, or unwanted animals. Pest control activities are often undertaken at the onset of the construction operation.

Pesticides are also used to protect wooden structures and structural elements from attack by subterranean termites. Persistent chlorinated hydrocarbon insecticides, including chlordane, aldrin, dieldrin, and heptachlor are the insecticides primarily used for protection against subterranean termites. These insecticides provide 18 to 20 years protection in most instances.

Herbicides are sometimes used in construction projects such as paving parking lots, driveways, secondary or county roads or in similar situations where a relatively thin layer of concrete, asphalt, blacktop, or other material is laid down. The herbicides are applied to the soil surface to prevent sturdy weeds from growing through the pavement. However, when properly applied, this type of herbicide use presents little long-term environmental risk because the method of application prevents herbicide transport away from the site.

Dust control activities are often conducted after site grading has been completed and before the site is restored. Water, used or unused oil, and calcium chloride are commonly used for dust control on access and haul roads, and on graded areas subjected to heavy truck traffic.

Site Restoration

Site restoration includes cleanup of the site, final grading, loosening and tillage of compacted soils, establishment of permanent vegetation, restoration of damage to trees and shrubs, removal of temporary stream fording structures or sediment control structures, removal of temporary construction facilities such as access and haul roads, reshaping, stabilization and revegetation of pits and stockpile areas, removal of office and work areas structures, and other practices that reestablish a landscape capable of withstanding erosion.

These operations will vary in detail, but those involving site cleanup, final grading, and establishment of permanent trees, shrubs, grasses, and groundcover should be carried out in accordance with erosion and sediment control plans, storm water management plans, construction contracts and the landscape plans developed for the site. Incomplete or inadequate site restoration may result in the erosion of excess soil piles.

4.2.4.2 Pollutants in Storm Water from Construction Sites

About 1.6 million acres of land are disturbed annually throughout the nation. As a rough approximation, construction sites generate about 50 tons of soil loss per acre on average. Some mismanaged areas on steep slopes may generate several hundred tons of soil loss per acre. Nationwide, storm water discharges from construction activities result in 85 million tons of sediment being discharged to surface waters.

Where construction activities are intensive, the localized impacts on water quality may be severe, and that even a small amount of construction may have a significant negative impact on water quality in localized areas (EPA 1984). For example, Konrad (1978) reported that 37 percent of the total suspended solids load and 48 percent of the total phosphorous load in one watershed originated from 2.6 percent of the total area of the watershed that was under development.

The amount of sediment in storm water discharges from construction sites can depend on a number of factors. Scheduling clearing operations during dry weather seasons can greatly reduce sediment in storm water discharges relative to discharges from poorly planned operations which expose large areas of cleared surfaces during heavy rain. Staging clearing will also reduce the amount of sediment from a site, as will grassed bufferstrips, and retention ponds. Quick revegetation of disturbed soils at construction sites can also minimize sediment production.

The potential for soil erosion is greatest during clearing and grubbing, excavation, rough and final grading, and site restoration/landscaping activities, where stripped topsoils and exposing bare soils with no protection may exist. Where construction activities have drastically altered or destroyed vegetative cover and the soil mantle, sediment derived from these construction sites may exceed 20,000 to 40,000 times that obtained from adjacent, undeveloped farm or woodland in an equivalent period of time (Virginia 1980).

Tables 4-13 and 4-14 presents soil loss data for construction activities (Sullivan 1977, Oberts 1985, Tahoe 1980).

4-13
TABLE [redacted]. Construction Site Soil Loss

Area	Soil loss (MT/km^2/yr)
Maryland residential construction	354-42,350
Washington, DC, residential construction	16,800
Maryland residential, commercial construction	1,000-100,000
Fairfax Co., Virginia, highway construction	12,600
Georgia highway construction	17,500-52,500
Montgomery Co., Maryland, residential construction	8,770-42,000
Menomonee Basin, Wisconsin, residential construction	4,370
Highway construction	12,607
Small urban construction	350-35,019

7-14
TABLE [redacted]. Comparison of Pollutant Concentrations in Construction Site and Residential Town Sediments

Parameter	Urban Residential Construction Site (mg/kg total solids)	Residential Lawn (mg/kg total solids)
COD	25,000	103,000
TKN	160	3,000
Total Phosphate	19	30
Lead	47	220
Zinc	90	154

Some constituents, such as nutrients, will be transferred from a solid to a soluble form. Reported data (Whipple et al. 1983) indicate that the percentages of dissolved nitrogen (N) and phosphorus (P) found in construction site runoff were 84.6 percent and 43.3 percent of total N and P, respectively.

Although most pollutants in storm water discharges from construction sites are associated with soil loss, other sources of pollutants include (EPA 1984):

- o unloading and outdoor storage and processing of construction-related materials. These materials include, aggregate, sand, block, and dirt.
- o Chemicals from fertilizer (phosphorus, nitrogen)
- o Pesticides used to control weeds and insects;
- o Petroleum products and construction chemicals, such as cleaning solvents, paints, concrete, asphalt, acids, and salts; and
- o Solid wastes ranging from employee litter to trees and other debris.

The amount and type of pollutants in storm water discharges depend upon the type and timing of construction practices, soil types, topography, and number of people and machines linked with the construction site.

The Report of the Ecology and Welfare Subcommittee of the Relative Risk Reduction Project (SAB, 1990) indicates that sound environmental planning and management to minimize the ecological impacts of development should be a part of every approved construction project.

4.2.5 WASTE MANAGEMENT AND RECYCLING INDUSTRIES

The waste management group includes waste treatment, storage, and disposal facilities regulated under Subtitles C and D of the Resource Conservation and Recovery Act (RCRA) and land used for management of sludge from POTWs. Many of the facilities within this group can be classified by SIC Code 495.
As discussed above, mining operations, oil and gas operations, feedlots, and many manufacturing facilities manage their wastes on-site. Waste management and recycling activities at these facilities are not addressed in this section, but are considered under the appropriate facility type.

4.2.5.1 Hazardous Waste TSDFs

EPA has developed extensive regulations under Subtitle C for facilities that treat, store, or dispose of hazardous wastes. Commercial facilities providing treatment and disposal of hazardous wastes employ physical/chemical/biological treatment units, incinerators, and landfills. The majority of waste treatment occurs in tanks or lined impoundments, where the possibility exists for spillage if sufficient free board is not maintained. Perhaps more significant are possible releases from leaks or breaks in piping. Other potential sources of pollutants are chemical handling areas (e.g., lime used for neutralization of wastes) and sludge drying areas. In these areas, pollutants can be added to storm water discharges from chemicals or sludges being placed, spilled, or blown to the ground.

The transportation, loading, and offloading of hazardous wastes at these facilities provide some opportunities for spills and leaks. Soil and debris from transportation equipment can contribute to pollutants in storm water discharges. Heavy vehicles, including trucks and earth moving equipment, also have the potential for contributing particulate emissions if roads lack proper dust suppression programs.

Stack emissions from incinerators may result in high pollutant concentrations in storm water discharges.

4.2.5.2 Subtitle D Facilities (Excluding Mining and Oil and Gas Wastes)

Disposal of "nonhazardous" wastes is regulated under Subtitle D of RCRA. These wastes include many different types of waste streams, such as municipal solid waste, industrial waste, and construction and demolition debris.

The Subtitle D waste stream is very diverse and includes different types of wastes such as waste tires, infectious waste, industrial nonhazardous waste, and municipal solid wastes. A wide range of Subtitle D wastes are produced within each industrial section. These waste streams may vary in chemical composition and/or physical form. RCRA does not prohibit the placement of very-small-quantity generator and household hazardous waste in these landfills. Some large-quantity generators may also be illegally disposing of their hazardous wastes in Subtitle D units.

Municipal Solid Waste Landfills

EPA has summarized case studies documenting surface water impacts and ground water contamination incidents. Evaluation of 163 case studies revealed surface water impacts at 73 facilities. Elevated levels of organics, including pesticides, and metals have been found in ground water and/or surface water at many sites. For most of these landfills, information on the waste received either was not available or was incomplete, although a limited number are known to have received hazardous waste before EPA issued regulation under Subtitle C of RCRA.

Examples of ecological damage were also identified. Impacts on fish or other aquatic life have been documented. Acute catastrophic impacts (e.g., major fish kills) are not usually associated with municipal solid waste landfills. Municipal solid waste landfills are more likely to discharge pollutants to surface water that would cause subtle changes to the aquatic environment. A study conducted at one site indicated that the diversity of benthic organisms downstream from the landfill was much less than that found upstream. The few species that survived downstream were more tolerant of the higher metal concentrations from the landfill.

Of the 850 sites listed or proposed for listing on the Superfund National Priorities List (NPL) in May 1986, 184 sites (22 percent) were identified as municipal solid waste landfills. Halogenated organics, aromatics, and metals were found at most of these sites. Releases of hazardous materials to surface waters were documented at 43 percent of these sites.

EPA estimates that annually, approximately 262 million metric tons of nonhazardous industrial wastes were being disposed of in 12,400 landfills, waste piles, and land application units. Study results indicate only sporadic application of design and operating controls at industrial landfills, with run-on/runoff controls employed at fewer than 35 percent of industrial landfills and 70 percent of industrial land application units. The study estimated that only 6 percent of active industrial landfills monitored discharges (storm water runoff or leachate) to surface water.

On a national basis, EPA has found little difference in the location, design, and operation of newer municipal solid waste landfills compared to older landfills. In terms of location characteristics, EPA found no real reduction in the siting of municipal solid waste landfills in sensitive hydrologic areas over the last twenty years, or in a comparison of pre- to post-1980 facilities.

The use of engineering/design controls at municipal solid waste landfills has increased only slightly over the last 20 years. EPA has found that about 50 percent of landfills 15 to 20 years old employ some type of surface water run-on/run-off control system, increasing steadily to about 75 percent for landfills built in the 1980s. For new municipal solid waste landfills, EPA found the number of municipal solid waste landfills that monitor releases to surface water to be about 15 percent, with no increases in percentages for new landfills.

State inspection data, case study evidence, and risk characterization studies, and the current limited use of design controls indicate that some solid waste landfills have degraded surface water quality and that this degradation could continue. Older landfills are of most concern because they may have received large volumes of hazardous waste and, in general, their use of design controls was very limited. States reported that 1,100 municipal solid waste landfills monitored discharges to surface water (12 percent of the total number) and 660 municipal solid waste landfills were cited for surface water impacts.

4.2.5.3 Recycling Facilities

Facilities in this group are involved in significant recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards.

Used motor vehicle parts (SIC Code 5015) includes, but is not limited to, automobile junk yards. Junk yards typically store damaged and/or old automobiles, trucks, and buses on paved, gravel, grassy, or nuded lands. Because of the condition of these vehicles and the activities occurring on the yard, significant losses of fluids, which are sources of toxic metals, oil and grease and PAHs, frequently occur. Weathering of plated and nonplated metal surfaces result in contributions of toxic metals to storm water.

Scrap and waste materials dealers (SIC Code 5093) have large loading/unloading areas and may have outdoor storage. Scrap or waste materials, when stored outdoors, contribute pollutants to storm water discharges. Examples include ferrous and nonferrous metals, used paper, batteries, chemicals, and chemical solutions. Because of the wide range of waste products involved, all pollutants of concern are considered to be potentially present for this group.

Closed Facilities

EPA estimates that there are 32,000 closed solid waste disposal facilities located across the United States. EPA has noted concern about these facilities which represent potential threats to human health and the environment because of their number and because many were poorly designed and managed (see August 30, 1988 (53 FR 33314).

4.2.5.4 Application of Sludges from POTWs

Municipal sewage sludges may be applied to agricultural or forestry lands; used for reclamation of disturbed or marginal lands; used at turf farms, parks, and recreation areas; or used in landscaping. Median and mean pollutant concentrations of sewage sludges are presented in Table 4-15.

TABLE [redacted]. Sewage Sludge Pollutant Concentrations
4-15

Component	Median (Percent)	Mean (Percent)
Total N	3.30	3.90
NH_4^+-N	0.09	0.65
NO_3^--N	0.01	0.05
P	2.30	2.50
K	0.30	0.40

Component	Median (mg/kg*)	Mean (mg/kg*)
Cu	850.00	1,210.00
Zn	1,740.00	2,790.00
Ni	82.00	320.00
Pb	500.00	1,360.00
Cd	16.00	110.00
PCBs	3.90	5.15

*Oven-dry solids basis.

Sludge application programs may contribute to high pollutant loadings in storm water depending on the operation and management of the site. Associated activities of concern are ponding and runoff from sites with poor drainage, sludge spills from transport vehicles and pipelines, the tracking of mud from fields onto highways, and dust generation from the use of haul vehicles and equipment.

4.2.6 **TRANSPORTATION FACILITIES**

Transportation-related facilities including railroad transportation (SIC Code Group 40), local and interurban passenger transit (SIC Code Group 41), motor freight transport and warehousing (SIC Code Group 42), the U.S. Postal Service (SIC Code Group 43), water transportation (SIC Code Group 44), air transportation (SIC Code Group 45), and transportation services (SIC Code Group 47). All facilities within these groups are expected to have a high potential for high pollutant levels in storm water discharges. Table 4-16 lists the major groups in this discussion and summarizes the potential sources of storm water pollutants from various activities within each group.

TABLE [redacted]. 4-16 Summary of Potential Storm Water Pollutant Sources from Transportation Industries

SIC Code	Industry	Potential Storm Water Pollutant Sources
40XX	Railroad Transportation	o Rail yards o Outdoor maintenance areas o Parking lots o Loading/unloading areas
41XX	Local and Interurban Transit	o Outdoor maintenance areas o Parking lots
42XX	Motor Freight Transportation and Warehousing	o Outdoor maintenance areas (motor freight industries only) o Parking lots o Loading/unloading areas (warehousing only)
43XX	U.S. Postal Service	o Outdoor maintenance areas o Parking lots
44XX	Water Transportation (primarily SIC Code 449X, Services Incidental to Water Transportation, such as cargo handling and marina operations)	o Outdoor maintenance areas (boat cleaning, painting, and repair) o Parking lots o Loading/unloading areas

Many transportation facilities are involved in vehicle maintenance and substantial material handling. Depending on the nature of a given operation, vehicle maintenance and material handling practices which occur outside may result in high levels of pollutants in storm water discharges. Perhaps more importantly, illicit connections, spills and improper dumping associated with these operations may result. Floor drains in garages and vehicle maintenance bays are of special concern. In the past, floor drains where often improperly connected to storm sewers because of prevailing construction practices, inappropriate placement of the storm drains so it collects both storm water runoff and maintenance drainage, and prior to the construction of adequate POTWs, a desire to direct heavy greases and solvents which can adversely impact a POTW's performance, away from the POTW. Extensive building inspections by the Huron River Pollution Abatement Program in Washtenaw County, Michigan detected illicit discharges at a rate of 60 percent for automobile related businesses, including service stations, automobile dealerships, car washes and body shops. Materials typically disposed via these illegal connections were oils, greases, radiator fluids, detergents and solvents.

Activities involved in outdoor maintenance areas include vehicle and equipment maintenance and cleaning; vehicle refueling; and storage of oil, fuel, solvents, and wastes. Loading and unloading areas, particularly in the rail and motor freight industries, can also contribute pollutants to storm water discharges. The extent and type of pollutants in storm water discharges will depend upon the types of materials being handled at the various facilities. These materials can range from chemical raw materials or products to food-related materials or products.

4.2.6.4 <u>Airports</u>

Major sources of pollutants in storm water discharges from airports result from aircraft and ground vehicle maintenance, aircraft and ground vehicle cleaning, transport/storage of fuels and other petroleum products, and deicing of aircraft and runways.

Aircraft and ground vehicle maintenance is generally performed in hangers or garages, but some maintenance activities may be performed outdoors. Maintenance activities may result in losses of such vehicle fluids as motor oil, lubricants, and hydraulic fluids used in ground vehicle engines, gear boxes, brake systems, and aircraft hydraulic systems. Petroleum-based cleaning solvents are used in vehicle maintenance for cleaning and degreasing engine parts and other mechanical components (CDM 1987). Pollutants associated with maintenance include toxic metals, PAHs, and volatile organics.

Aircraft and ground vehicle cleaning is typically performed outdoors, but not in all cases. The products used include soap or detergent-based cleaning agents. Pollutants associated with cleaning operations include BOD and TSS.

Various types of fuels and related materials are transported, loaded, unloaded, and stored at airports. These include jet fuel, gasoline, lubricating oil, and hydraulic fluid. Table 4-17 presents data from Stapleton International Airport, Denver, on the storage volumes of these materials (CDM 1987).

TABLE [redacted] 4-17 Quantities of Materials Stored at Stapleton International Airport, Denver, Colorado

Material	Quantity Stored (gallons)
Jet Fuel	
Above ground	14,532,000
Underground	882,100
Piping	300,000
Gasoline	75,000
Lubricating Oil	5,100
Hydraulic Fluid	1,300

TABLE [redacted]. 4-18 Properties of Glycol-Based Fluids

Property	Ethylene Glycol	Diethylene Glycol	Propylene Glycol
Biodegradability (BOD_5)	750,000 mg/L	890,000 mg/L	1,000,000 mg/L
Toxicity LD_{50} (human)	1.4 ml/Kg	1.0 ml/Kg	7.0 ml/Kg
LD_{50} (rats)	5.5-8.5 ml/Kg	14.8-20.9 ml/Kg	32.5 ml/Kg

Source: U.S. Dept. of Transportation, Federal Aviation Administration.

Spills from transport, loading, unloading, and storage are relatively common at Stapleton. Records from 1977 to 1979 show an average of 77 fuel spills at Stapleton per year. Pollutants associated with the transport, loading, unloading, and storage of these materials include PAHs, toxic metals, and transient organics.

Aircraft and runway deicing operations are usually performed with chemical solutions containing up to 50-percent ethylene glycol. Runway deicing operations are performed by the airport authority, while most aircraft deicing operations occur on pads operated by an airlines. The length of the deicing season varies across the country, with airports in Colorado typically performing deicing operations for nine months while airports in Chicago may only deice for six months out of the year. The amount of deicing fluids used depend on temperature and the amount and type of preciptiation (freezing rain may require more deicing fluids than many snowfalls) as well.

Urea and ammonium nitrate are the primary ingredients of other deicing compounds used at airports. Both of these chemicals act as nutrients and are oxygen demanding in water. When deicing operations are performed, large volumes of ethylene glycol are sprayed on aircraft and runways. Data from Stapleton International Airport show that 62,986 gallons of concentrated ethylene glycol were used during the month of February 1988 (Denver Public Works 1988). Properties of glycol-based fluids are shown in Table 4-18. Ethylene glycol is toxic and exerts a high oxygen demand on receiving streams when discharged at significant concentrations. Data from Stapleton International Airport indicate that storm water discharges contained levels of up to 5,050 mg/L ethylene glycol during a monitoring period from December 1986 to January 1987. The highest ethylene glycol concentrations resulted in a BOD_5 concentration of 2,525 mg/L (CDM 1987).

4.2.6.5 Port Facilities

Storm water discharges from port facilities are of concern due to the extremely large amounts of material transfer operations, the proximity of facility to receiving water, waste management practices, and certain washing and material preparation activities that occur.

4.2.7 ELECTRIC POWER GENERATION

This category includes facilities engaged in the generation and transmission of electricity, gas, or steam. Facilities included in this category can be characterized according to SIC Codes 491 (electric services), 492 (natural gas production and distribution), and 493 (electric and gas services combined). The remainder of this subsection discusses the steam electric category.

Steam electric facilities generate energy through the use of fossil and nuclear fuels. Types of steam electric facilities include coal-fired power plants, oil-fired power plants, and nuclear power plants. Transformers and raw materials such as coal may be stored onsite at these facilities.

4.2.7.1 Coal Fired Plants

Coal is stored outdoors by coal fired utilities. Utility stockpiles at the end of August 1980 were at 185,000,000 metric tons. (Coal Outlook) Coal storage is expected to continue to grow as coal consumption increases.

The effluent guidelines for the Steam Electric Power Generating Point Source Category (40 CFR Part 423) address TSS and pH in storm water runoff from coal piles. In addition, coal pile runoff has high levels of total dissolved solids (TDS), sulfate, iron, aluminum, mercury, copper, arsenic, selenium and manganese. Table 4-19 shows storm water data collected from coal piles at two electric power plants. In addition, Table 4-20 lists 1988 PCS data for treated storm water discharge reported by 117 electric service facilities nationwide.

TABLE [redacted]9. 4-38 **Summary Characteristics of Storm Water Runoff at Coal Piles From Two Electric Power Plants[a]**

Pollutant (mg/L)	Penn. Elect. Co. Warren, PA	Metro. Edison Co. Portland, PA
TSS	1,400-23,000	230-3,800
TDS	500-4,600	500-7,500
SO_4^{-}	200-2,700	400-6,000
Iron	200-1,400	20-400
Alumium	70-100	8-90
Manganese	10-40	0.4-2.5
Acidity	3,200-2,000	290-4,600

[a]Pollutants reported as range of concentrations observed over the course of a storm event.

Source:

TABLE 4-20 ~~B-20~~. Summary of Permit Compliance System Data for Storm Water Discharges From Electric Service Facilities

Pollutant	Electric Services (No. of Facilities = 117)[a]			
	Long-Term Average Concentration	Long-Term Average No. Observ.	Daily Maximum Concentration	Daily Maximum No. Observ.
Oxygen-Demanding Pollutants (all in mg/L):				
Dissolved Oxygen	3.9-8.0	59	5.4-8.3	35
BOD		0	7.5-18.5	2
COD	0.6-2,600	127	0.6-2,600	137
Solids (all in mg/L):				
TSS	0.0-6,520	727	0.0-12,944	881
Settleable solids	0.02-1.00	37	<0.1-25.0	37
Metals (all in ug/L):				
Arsenic	0.0-209	37	0.0-209	60
Beryllium	<0.01-0.01	1	<0.0-0.01	13
Cadmium	<0.0-26.0	35	<0.0-26.0	70
Chromium	<0.0-23.0	21	<0.0-23.0	41
Copper	0.00-128	68	0.00-128	101
Iron	0.00-518	57	0.00-3,768	107
Lead	<0.00-30.0	37	0.00-30.0	70
Manganese	0.05-1.75	25	0.05-18.8	14
Thallium	<0.10-0.10	1	<0.10-0.10	1
Nickel	0.01-55.0	16	<0.00-80.0	48
Silver	<0.00-7.70	26	<0.00-7.70	38
Vanadium	0.04-0.50	3	0.04-0.50	3
Zinc	<0.01-506	68	<0.01-506	100
Antimony	<0.30-0.30	1	<0.30-0.30	1
Tin		0	0.10-1.50	9
Aluminum	0.20-0.60	9	0.30-0.60	9
Selenium	0.00-414	30	0.00-414	49
Mercury	0.00-10.0	41	0.00-10.0	59

[a] Data for all facilities in SIC Code 4911 reporting to PCS nationwide during 1988.

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TABLE [redacted]. Summary of Permit Compliance System Data for Storm Water Discharges From Electric Service Facilities (continued)

Pollutant	Electric Services (No. of Facilities = 117)[a]			
	Long-Term Average		Daily Maximum	
	Concentration	No. Observ.	Concentration	No. Observ.
Organics (most in ug/L):				
TOC (mg/L)	4.0-8.0	4	7.0-64.7	8
Cyanide (mg/L)	<0.01-20.0	26	<0.01-20.0	26
Toluene	3.50-5.00	2	<5.00-5.00	2
Benzene	3.50-5.00	2	<5.00-5.00	2
Ethylbenzene	<3.00-5.00	2	<3.00-5.00	2
Methylene chloride	1.00-15.0	2	1.00-15.0	2
1,1,1,-trichloro-ethane	<5.00-5.00	2	<5.00-5.00	2
PCBs in H_2O	<0.05-0.50	19	<0.05-1.00	29
Inorganics (all in mg/L):				
Chloride	6.0-163	8	7.0-234	8
Sulfide	<0.10-0.10	3	<0.10-0.10	3
Sulfate	607-2,710	8	863-4,000	8
Chlorine	0.0-0.15	6	0.0-0.17	6
Other Pollutants:				
pH	0.0-10.9[b]	832	0.0-11.9	838
Turbidity (JTU)	1.2-54.5	48	1.2-57.0	48
Total hardness (mg/L)	829-3,697	8	938-5,975	8
Fecal coliform (cts/100ml)	<2.0-840	2	<2.0-1,600	2
Hydrocarbons (mg/L)	<0.10-7.30	38	<0.10-12.5	40
Oil and grease (mg/L)	0.0-17.8	407	0.0-233	581

[a] Data for all facilities in SIC Code 4911 reporting to PCS nationwide during 1988.

[b] pH range reported in this column is daily minimum, not long-term average.

The pollutants in runoff and drainage from coal piles depend on a number of factors, including: location, size and configuration of the coal pile; composition of coal; climate; and control technology used.

5.0 SUMMARY OF OPTIONS FOR CONTROLLING POLLUTANTS

5.1 Background

Options for controlling pollutants in storm water discharges associated with industrial activities (other than from construction activities) will be discussed in terms of two major pollutant sources: (1) materials discharged to separate storm sewers via illicit connections, improper dumping, and spills; and (2) pollutants associated with runoff collected by separate storm sewers. Options for controlling pollutants in storm water discharges associated with industrial activities from construction activities are addressed separately.

a. Non-Storm Water Discharges to Separate Storm Sewers

As discussed earlier, in some cases, a substantial portion of the pollutant load from separate storm sewers which discharge storm water associated with industrial activity is associated with non-storm water discharges. Non-storm water discharges to separate storm sewers include a wide variety of sources, including illicit connections, improper dumping, spills, or leakage from storage tanks and transfer areas. Measures to control spills and visible leakage can be incorporated into storm water pollution prevention plans (see below).

In many cases, operators of industrial facilities may be unaware of illicit discharges or leakage from underground storage tanks or other non-visible systems. In some cases, illicit connections to storm sewers were installed before their legal prohibition, and forgotten about. For example, illicit connections are often associated with floor drains that are connected to separate storm sewers. Rinse waters used to clean or cool objects, and other process wastewaters may be discharged to the separate storm sewer by an improperly connected floor drain. These non-storm water discharges to a storm sewer may be inadvertent with the operator unaware that the floor drain is connected to the storm sewer. In this case, the key to controlling these discharges is to identify them.

<u>Methods to Identify Non-Storm Water Discharges to Separate Storm Sewers</u>

Several methods for identifying the presence of non-storm water discharges are discussed below[1]. A comprehensive evaluation of the storm sewers at a facility may incorporate several methods.

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[1] A more complete discussion of methods to identify illicit connections can be found in "Draft Manual of Practice: Identification of Illicit Connections", U.S. EPA, Sept. 1990.

- Schematics - Where they exist, accurate piping schematics can be inspected as a first step in evaluating the integrity of the separate storm sewer system. The use of schematics is limited because schematics usually reflect the design of the piping system and may not reflect the actual configuration constructed. Schematics should be updated or corrected based on additional information found during inspections.

- Evaluation of drainage map and inspections - Drainage maps should identify the key features of the drainage system: each of the inlet and discharge structures, the drainage area of each inlet structure, and units such as storage or disposal units or material loading areas, which may be the source of an illicit discharge or improper dumping. In addition, floor drains and other water disposal inlets that are thought to be connected to the sanitary sewer can be identified. A site inspection can be used to augment and verify map development. These inspections, along with the use of the drainage map, can be coordinated with other best management practices discussed below.

- End-of-pipe screening - Discharge points or other access points such as manhole covers can be inspected for the presence of dry weather discharges and other signs of non-storm water discharges. Dry weather flows can be screened by a variety of methods. Inexpensive onsite tests include measuring pH; observing for oil sheens, scums and discoloration of pipes and other structures; as well as colormetric detection tests for chlorine, detergents, metals and other parameters. In some cases, it may be appropriate to collect samples for more expensive analysis in a laboratory for fecal coliform, fecal streptococcus, conventional pollutants, volatile organic carbon, or other appropriate parameters.

- Water balance - Many sewage treatment plants require that industrial discharges measure the volume of effluent discharged to the sanitary sewer system. Similarly, the volume of water supplied to a facility is generally measured. A significantly higher volume of water supplied to the facility relative to that discharged to the sanitary sewer and other consumptive uses may be an indication of illicit connections. This method is limited by the accuracy of the flow meters used.

- Dry weather testing - Where storm sewers do not discharge during dry weather conditions, water can be introduced into floor drains, toilets and other points where non-storm water discharges are collected. Storm drain outlets are then observed for possible discharges.

- Dye testing - Dry weather discharges from storm sewers can occur for a number of legitimate reasons including ground water infiltration or the presence of a continuous discharge subject to an NPDES permit. Where storm sewers do have a discharge during dry weather conditions, dye testing for illicit connections can be used. Dye testing involves introducing fluorometric or other types of dyes into floor drains, toilets and other points where non-storm water discharges are collected. Storm drain outlets are then observed for possible discharges.

- Manhole and Internal TV Inspection - Physical inspection of manholes and internal inspection of storm sewers either physically or by television are used to identify potential entry point for illicit connections. Dry weather flows, material deposits, and stains are often indicators of illicit connections. TV inspections are relatively expensive and generally should be used only after a storm sewer has been identified as having illicit connections.

b. Options for Preventing Pollutants in Storm Water

The following five categories describe options for reducing pollutants in storm water discharges from industrial plants:

i) Providing end-of-pipe treatment;

ii) Implementing Best Management Practices to prevent pollution;

iii) Diverting storm water discharge to municipal sewage treatment plants (where capacity exists to avoid a combined sewer overflow);

iv) Using traditional storm water management practices; and

v) Eliminating pollution sources.

A comprehensive storm water management program for a given plant may include controls from each of these categories. Development of comprehensive control strategies should be based on a consideration of plant characteristics.

i. End-of-Pipe Treatment

End-of-pipe treatment requirements are typically imposed through numeric effluent limitations, which provide the discharger with flexibility to design the most cost effective type of treatment for the given facility.

At many types of industrial facilities, it may be appropriate to collect and treat the runoff from targeted areas of the facility. This approach was taken with 10 industrial categories with national effluent guideline limitations for storm water discharges. There are several basic similarities among the national effluent guideline limitations for storm water discharges:

- o to meet the numeric effluent limitation, most, if not all, facilities must collect and temporarily store onsite runoff from targeted areas of the plant;
- o the effluent guideline limitations do not apply to discharges whenever rainfall events, either chronic or catastrophic, cause an overflow of storage devices designed, constructed, and operated to contain a design storm. The 10-year, 24-hour storm, or the 25-year, 24-hour storm commonly are used as the design storm in the effluent guideline limitations; and
- o most technology-based treatment standards are based on relatively simple technologies such as settling of solids, neutralization, and drum filtration.

Potential ground water impacts should also be considered by operators when designing storage devices.

ii. Best Management Practices

The term best management practices (BMPs) can describe a wide range of management procedures, schedules of activities, prohibitions on practices, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include operating procedures, treatment requirements and practices to control plant site runoff, drainage from raw materials storage, spills or leaks. BMPs can be established in two ways: BMP plans and site or pollutant-specific BMPs.

<u>BMP Plans</u>

EPA has worked with industry to identify the generic BMPs which most well-operated facilities use for pollution control, fire prevention, occupational safety and health, or product loss prevention. EPA often establishes NPDES permit conditions that require generic BMPs to be identified and implemented through BMP plans. Many of the BMPs in a typical BMP plan involve planning, reporting, training, preventive maintenance, and good housekeeping.

Many industrial facilities currently employ BMPs as part of normal plant operation. For example, preventive maintenance and good housekeeping are routinely used in the chemical and related industries to reduce equipment downtime and to promote a safe work environment for employees. Good housekeeping BMPs generally are aimed at preventing spills and similar environmental incidents by stressing the importance of proper management and employee awareness. Experience has shown that many spills of hazardous chemicals can be attributed, in one way or another, to human error. Improper procedures, lack of training, and poor engineering are among the major causes of spills. Experience has shown that BMPs can be used appropriately and BMP plans can effectively reduce pollutant discharges in a cost-effective manner. BMP plans should reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans required under section 311 of the CWA, and may incorporate any part of the SPCC plan into the BMP plan by reference. BMP plans should also ensure that solid and hazardous waste is managed in accordance with requirements established under the Resource Conservation and Recovery Act (RCRA). Management practices required under RCRA should be expressly incorporated into the BMP plan.

In addition, each of the following nine specific requirements should be addressed in the BMP plan to reduce pollutants in runoff from the plant:

- o Statement of policy
- o Spill Control Committee
- o Material inventory
- o Material compatibility
- o Employee training
- o Visual Inspections
- o Preventive maintenance
- o Reporting and notification procedures
- o Housekeeping
- o Security

Additional technical information on BMPs and the elements of a BMP plan is contained in the publication entitled "NPDES Best Management Practices Guidance Document," U.S. EPA, June 1981.

Site or Pollutant-Specific Best Management Practices

In addition to the requirements of BMP plans discussed above, more advanced site or pollutant-specific BMP requirements can be developed. The following four categories describe these site or pollutant-specific BMPs:

- o Prevention
- o Spill Prevention and Containment
- o Mitigation
- o Ultimate Disposition

Table 5-1 lists BMPs associated with each category.

Containment requirements

EPA believes that tank systems for storage of liquid toxic chemicals and truck and rail transfer facilities for liquid toxic chemicals can present a significant risk, if basic accepted engineering practices are not employeed. EPA has concluded on the basis of studies, information from other governmental sources, and supporting information on various rulemakings that many tank systems have leaked and that other are likely to leak in the future[2].

The major causes of releases from tank systems are unrelated to the characteristics of the material stored in the tanks, assuming that the stored material is compatible with the material of construction of the tank system. EPA's "Hazardous Waste Tank Risk Analysis", EPA, 1986 indicates that the principal causes of reported tank failures are external corrosion, installation problesm, structural failure, spills, and overfills due to operator errors, and ancillary equipment failure, and that current practices lead to a substanital prbability of release to the environment from tank failures due to corrosion, rupture, improper intallation, gasket failures, and operator errors. The analysis also indicated that current practices tend to allow releases to continue undetected until the release becomes obvious. The analysis estimated that for all tank systems (including above and below ground), approximately 10 percent or less of the tank system throughput over a 20 year time period would be released using current management practices.

The Spill Prevention Control and Countermeasure (SPCC) database and the Pollution Incident Reporting System (PIRS) database provided valuable information on the causes of failure and releases from aboveground storage tanks[3]. Exclusive of failures caused by operator error and natural phenomena, failure by all forms of corrosion was 2.2 percent in the PIRS database and 6.2 percent in the SPCC database.

The SPCC and PIRS databases indicate that structural failure accounted for between 6 and 7 percent of the reported failures for aboveground tanks. An OSWER study indicates that it is not possilbe to identify specific causes of structural failure. Structural failures can include fabrication defects, design defects, mechanical failures, or structural failures.

Failures of ancillary equipment is a significant cause of releases from above ground systems. The SPCC and PIRS databases indicate over 2,000 incidents of spills of oil or hazardous substances reported. If failures due to operator error and natural phenomena are excluded, between 85 and 90 percent of

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[2] For example, see July 14, 1986 (51 FR 25427).

[3] See July 14, 1986, (51 FR 25429).

theese release incidents result from filures of piping systems (inclduing failures of pumps, flanges, couplings, interconnecting hoses, and valves).

Structural failure problems can be attributed to a large degree to improper design and installation. Certification by a qualified professional engineer that the design and installation is in accordance with sound engineering practices and applicable standards can be of considerable benefit. The major limitation of design and installation standards is that once a tank system is designed, built and installed, improvements in the standards or even errors in applying the standards cannot be retrofitted in most cases. Thus, some form of containment system or release monitoring system is necessary to control these situations.

Most releases associated with ancillary equipment appear to have resulted from mechanical and thermal stresses common to daily operation. These stresses are most evident on the components of the systems that are most susceptible to wear, such as pipes with flanges or threaded connections, valves, and pumps. Pumps and valves, for example, are designed with moving parts and seals that periodically deteriorate with use.

The principal leak prevention measure for ancillary equipment is its proper design and installation. The design should match its intended function taking into consideration the proper material of construction. The material of construction must match the thermal coefficients of expansion and corrosive properties of the substances transported. A quality audit of tank system installation, especially to prevent loose fittings, poor welding, and maligned gaskets, will prevent many leaks. The difficulties of addressing the problems of structural failure and corrosion of ancillary equipment are similar to those of the tanks themselves. Thus, in addition to prop[er design and installation of ancillary equipment, some form of release detection is required to enable an appropriate response in the event of a release from even a well-designed and installed system. In addition, various forms of secondary containment are capable of containing a release in the event of a failure of the primary containment system.

Operator errors are among the most prevalent causes of tank system leaks and releases. Proper training and establishment of standard operating procedures and safety activities can reduce the occurrence of human errors. Spill control and contingency plans, training plans and operating procedures are important. Some operator errors can be averted by installing engineered safeguards. Overflow protection devices can be installed on tank systems to provide warning to the operator and or to shutdown transfer pumps when the tank reaches full capacity. Protective guards can be installed to prevent vehicular or forklift damage to tanks. Proper tagging or labeling valves can help alleviate human error in operating valves. Tank design standards, such as specification of a minimum freeboard requirement and a minimum volume requirement for secondary containment, can also help to reduce the consequences of human error.

In addition to the direct methods for controlling or reducing the likelihood of releases from tank systems there are a number of monitoring methods and backup devices that are capable of addressing, to varying degree, the problems associated with releases due to corrosion, poor design, fabrication, and/or installation of piping and other ancillary equipment, and operator error. These include tank system inspection, leak detection, and secondary containment.

Physical inspections can be conducted in order to detect existing leaks and to identify problem areas that can lead to releases if not repaired. If a release is detected early and response measures are taken, inspections can reduce risks. Inspections can commence at the time a tank system is installed and can be conducted on a periodic basis thereafter. Periodic inspections can include visual inspections of tanks (foundations, connections, coating, and tank walls), internal inspections for tanks which can be entered, and visual inspection of pipes and ancillary equipment. Inspection equipment includes penetrate dyes, vacuum boxes , ultrasound instruments, and radiographic equipment.

While regular visual inspections can reduce risks, they cannot be relied upon completely. There are many problems that visual inspection would not reveal and because visual inspection is an episodic rather than continuous process, detection of releases may occur after significant quantities of toxic pollutants have migrated to the environment.

If a leak is detected early and response measures taken, this approach can reduce risks. There are an umber of leak detection methods that can be applied to tank systems, including pneumatic, valve manometer, liquid level bubble, fabricated float, laser beam, overfill/standpipe, buoyancy sensor, and capacitance probe tests.

Secondary containment is a method of containing releases to enable detection of toxic materials leaking from tank systems. Secondary containment technologies include berms, dikes, liners, vaults and double-walled tanks. When combined with monitoring, the overwhelming advance of secondary containment is that it allows for the detection of releases from the primary containment vessel while providing a secondary barrier that contains the released material before it is discharged.

There are other benefits to secondary containment. Secondary containment can isolate the primary tank from high ground water and saturated soils, thereby protecting the tank from potential corrosion by the combination of water and corrosion-inducing soils. Another important benefit is that the secondary containment system can also be designed to provide for containment and detection of accidental spills and overfills. The secondary containment system designs incorporating vaults and berms, spills and overfills can be easily detected by visual examination and also decontaminated readily. This compensates for human errors and reduces the reliance upon flawless operator performance. Secondary containment prevents spills and overfills whose volume does not exceed the capacity of the secondary containment from being discharges.

Secondary containment can afford security for other causes of tank failure. As a secondary barrier, it can eliminate releases caused by point anode corrosion, collect leakage from loose fitting and worn seals on valves and pumps, and prevent releases due to structural failure of the tank system.

Containment requirements can take a number of forms. EPA has analyzed various models for containment requirements for chemical handling/storage facilities include requirements for: Spill Prevention Control and Countermeasure (SPCC) plans for oil facilities (40 CFR 112); hazardous waste tank requirements for hazardous waste generators (40 CFR 262); hazardous waste tank requirements for treatment, storage and disposal facilities (40 CFR 264 and 265); underground storage tank requirements (40 CFR); Occupational Safety and Health Administration (OSHA) general safety and health regulations for flammable and combustible liquids that require suitable drainage or diking for the area surrounding tanks (29 CFR 1910); the National Fire Protection Association (NFPA) code 30 (widely adopted by localities); Department of Transportation (DOT) requirements for oil pipelines (49 CFR 195); and the Minerals Management Service (MMS) of the Department of Interior requirements for the containment and collection of oil discharges from offshore drilling operations (30 CFR 250).

These requirements have helped establish current engineering practices for millions of tanks[4]. EPA believes that the majority of facilities with large amounts of toxic chemical storage facilities have existing spill prevention and containment systems. For example, the majority of hazardous waste tanks (63% of 9,100 hazardous waste tanks in 1986) were found to have some type of partial or full secondary containment prior to the development of more stringent containment requirements under RCRA Subtitle C (see July 14, 1986 (51 FR 25422)). Many facilities,

[4] For example, SPCC requirements apply to 700,000 on-shore tanks and 190,000 off-shore facilities, and UST requirements apply to over 1,000,000 tanks.

especially medium- and large-sized facilities also perform integrity and leak testing[5].

Containment requirements: SPCC Model

40 CFR 112 establishes pollution prevention requirements, including requirements for Spill Prevention Control and store or handle oil. The requirements associated with 40 CFR 112 are similar to the requirements in the NPDES draft general permits for spill prevention and containment measures at SARA Title III, Section 313 facilities. Costs associated with SPCC plan requirements under 40 CFR 112 where evaluated from a number of sources, including "Economic Impact Analysis of Proposed Revisions to the Oil Pollution Prevention Regulation (40 CFR 112), EPA, draft January 1991, "Supplemental Cost/Benefit Analysis of the Proposed Revisions to the Oil Pollution Prevention Regulation", EPA, May 1991; and data provided by the American Petroleum Institute (API).

The SPCC requirements apply to over 250,000 facilities with significant amounts of oil. These facilities can be described in term of four sectors: 1) production (246,000 facilities with 572,620 tanks); 2) marketing (11,305 facilities with 88,529 tanks); refining (207 facilities 88,529 tanks); and transportation (2,132 facilities with 9,197 tanks). The transportation sector addresses pipeline facilities (also regulated under 49 CFR Part 195). In general, facilities in the transportation sector where not addressed in this analysis, since the NPDES general permits requirements for SARA Title III, Section 313 facilities, in general, do not apply to similar types of faciltiies or practices.

A analysis of the causes of spills that was developed to support SPCC regulations is included in Appendix A.

Numerous Federal regulations, industry standards, and recommended practices were reviewed during the data gathering process for characterizing the regulated community and the causes of oil spills. This section presents a brief summary of each of the regulations, standards, and recommendations reviewed during preparation of this rulemaking. Only a cursory description of each is provided; the complete regulation, standard, or recommended practice should be referred to for additional and more detailed information. Exhibit 1 presents a summary of Federal regulations and industry standards/recommendations which were reviewed and found to contain applicable information pertinent to each of the technical requirements examined in this

[5] U.S. EPA, Regulatory Impact Analysis of Technical Standards for Underground Storage Tanks, Volume 5, 1988, p. 6-20.

rulemaking. These regulations and standards apply to aboveground tanks, pipes, and operations associated with the storage of petroleum. Exhibit 1 identifies specific sections and/or chapters from the regulations and standards which impact each issue.

SUMMARY OF STANDARDS AND RECOMMENDED PRACTICES

API Standard 620 -- Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Seventh Edition, September 1982, Revision 1, April 1985.

The American Petroleum Institute (API) rules are intended to cover the design and construction of large, welded, low pressure, carbon steel, aboveground tanks. The rules only cover those tanks which are of such a shape that can be generated by the rotation of a suitable contour around a single vertical axis. API Standard 620 covers tanks that are operated at metal temperatures not exceeding 200°F and with pressures in their gas or vapor spaces exceeding those permissible under API Standard 650, but not exceeding 15 pounds per square inch gauge. The basic rules provide for installations in areas where the lowest recorded one-day mean atmospheric temperature is as low as -50°F. These rules may be used for tanks intended either for holding or storing liquids with gases or vapors above the surface of the liquid or for holding or storing gases or vapors alone. These rules do not apply to "lift-type" gas holders. Although this Standard does not cover horizontal tanks, it is not intended to preclude the application of appropriate portions to the design and construction of horizontal tanks.

API Standard 650 -- Welded Steel Tanks for Oil Storage, Eighth Edition, November 1988.

API Standard 650 covers material, design, fabrication, erection, and testing requirements for vertical, cylindrical, aboveground, closed- and open-topped, welded steel storage tanks in various sizes and capacities with internal pressures approximating atmospheric pressure, except that a higher internal pressure is permitted when certain additional requirements are met. This standard only covers tanks whose entire bottom is uniformly supported and tanks in non-refrigerated service that have a maximum operating temperature of 200°F.

API RP 651 -- Cathodic Protection of Above-Ground Petroleum Storage Tanks, Final Revision, January 1990.

API Recommended Practice (RP) 651 is a draft document which provides recommended practices to limit potential corrosion problems common to steel aboveground tanks. It presents a description of corrosion problems and methods for evaluating the need for cathodic protection. This publication also describes the design, installation, and maintenance of various types of cathodic protection systems.

API RP 652 -- Lining of Above-Ground Petroleum Storage Tanks Bottoms, Draft 10, May 1990.

API RP 652 presents procedures and recommended practices for improving corrosion control in aboveground storage tanks by the addition of linings to tank bottoms. It includes a description of the various types of corrosion which may affect tank bottoms, and factors which should be considered when evaluating the need for and suitability of different types of linings. It provides general guidance on application of linings.

API Std 653 -- Tank Inspection, Repair, Alteration, and Reconstruction, First Edition, January 1991.

The recently adopted API Standard 653 is applicable to carbon and low-alloy steel tanks built to API Standard 650 and its predecessor 12C. It provides minimum standards to maintain the integrity of aboveground, non-refrigerated, atmospheric tanks which are already in service. Some of the topics covered include suitability for service, brittle fracture, repair and alteration, reconstruction, and inspection and testing.

API 2008 -- Safe Operation of Inland Bulk Plants, Fourth Edition, June 1984.

API 2008 is an informational publication and is focused primarily on worker safety issues. This document addresses operational standards such as inspection of foundations and pipe fittings. This publication is not considered an industry standard.

ASME/ANSI B31.3 -- Chemical Plant and Petroleum Refinery Piping, 1987 Edition.

The American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) B31.3 code is a section of the ASME/ANSI B31 Code for Pressure Piping. It is applicable to piping systems handling nearly all types of fluids, and to nearly all types of service, including oil and other petroleum products. It includes requirements for materials, design, fabrication, assembly, erection, examination, and inspection of piping systems.

ASME/ANSI B96.1 -- Welded Aluminum-Alloy Storage Tanks; 1986

Edition, 1988 Addenda.

ASME/ANSI B96.1 is applicable to field-erected, vertical, cylindrical, welded, aluminum-alloy tanks. Other restrictions are included. It addresses the design, materials, fabrication, erection, inspection, and testing requirements. It does not contain allowances for corrosion.

NACE RP 0285 -- Standard Recommended Practice - Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems, March 1985.

The National Association of Corrosion Engineers (NACE) RP 0285 is applicable to buried, partially buried, or submerged ferrous metal liquid storage systems, It addresses determination of the need for corrosion control, corrosion control design considerations, coatings; and criteria for design, installation, operation, and maintenance of cathodic protection systems.

NFPA 30 -- Flammable and Combustible Liquid Codes, 1987 Edition.

The National Fire Protection Agency (NFPA) has established The Flammable and Combustible Codes (NFPA 30), which apply to all flammable and combustible liquids except those that are solid at 100°F or above. Its provisions are intended to reduce the hazard to a degree consistent with reasonable public safety, without undue interference to public convenience and necessity, for activities which require the use of flammable and combustible liquids. It includes requirements for aboveground, underground, and portable tanks. Requirements concerning design and construction of buildings which contain tanks are also discussed.

NFPA 30A -- Automotive and Marine Service Station Code, 1987 Edition.

The Automotive and Marine Service Station Code (NFPA 30A) applies to automotive and marine service stations primarily with underground but also aboveground storage. Its provisions are intended to reduce hazards which require the use of flammable and combustible liquids. This Code does not apply to those service stations, or portions of service stations, where liquified petroleum gases or compressed natural gases are dispensed as automotive fuels.

NFPA 31 -- Installation of Oil Burning Equipment, 1987 Edition.

The Installation of Oil Burning Equipment Standard (NFPA 31) applies to oil-fired stationary equipment, including but not limited to industrial-, commercial-, and residential-type steam, hot water, and warm air heating plants; domestic-type range burners and space heaters; portable oil burning equipment; and all accessory equipment and control system, whether electric, thermostatic, or mechanical and electrical wiring in connection therewith. This standard does not apply to internal combustion engines, oil lamps, and portable devices such as blow torches, melting pots, and weed burners.

NFPA 78 -- Lightning Protection Code, 1989 Edition.

NFPA 78 presents lighting protection requirements for structures containing flammable vapors and gases, as well as liquids which can give off flammable vapors.

Underwriters Laboratory (UL) 142 -- Steel Aboveground Tanks for Flammable and Combustible Liquids, Sixth Edition, Revised September 1987.

Underwriters Laboratory (UL) 142 is applicable to aboveground, horizontal and vertical, welded steel tanks intended for the outside storage of flammable and combustible liquids at pressures in the vapor spaces between atmospheric and 0.5 psig. These types of tanks are intended for use with only noncorrosive, stable liquids that have a specific gravity not exceeding that of water. These requirements do not apply to tanks covered by API 650, API 12D, API 12F, or vertical tanks elevated by legs or supporting skirts.

SUMMARY OF REGULATIONS

E.O. 11988 -- Floodplain Management

Executive order (E.O.) 11988 was issued in 1977, to serve as a guideline for use by federal agencies to provide effective flood management policies. Its goals are to avoid or minimize adverse impacts associated with occupancy and modifications of floodplains and to avoid direct and indirect support of development on floodplains when there are practical alternatives. Guidelines for implementing E.O. 11988 have been promulgated by the Water Resources Council (1978) and the Interagency Task Force on Floodplain Management (1983).

FEMA 44 CFR 60 -- Criteria for Land management Use

The Federal Emergency Management Agency (FEMA) regulation contained in 44 CFR 60 constitutes part of a set of regulations which establish a system for providing insurance to interested parties in flood-prone areas. Part 60 provides requirements for general structures, including aboveground petroleum storage tanks, located in flood hazard areas, which must be met by flood-prone communities applying for flood insurance eligibility.

OSHA
29 CFR 1910.120 -- Occupational Safety and Health Standards

The Occupational Safety and Health Administration (OSHA) standards at 29 CFR 1910.120 are applicable to certain operations which involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards during; 1) required and voluntary clean-up operations at uncontrolled hazardous waste sites; 2) corrective actions at Resource Conservation and Recovery Act (RCRA) sites; 3) operations at Treatment, Storage, and Disposal (TSD) facilities; and 4) emergency response actions. These regulations address operation of health and safety plans, site characterization and analysis, site control, personnel training, medical surveillance, engineering controls, work practices, and personal protective equipment. The OSHA Standards also cover such items as environmental monitoring, handling of containers, decontamination, and operations conducted at various types of sites. OSHA has decided that petroleum products are covered by these regulations; as a result, petroleum handling facilities must adhere to them.

USCG 33 CFR 154 -- Oil Pollution Prevention Regulations for Marine Oil Transfer Facilities

USCG 33 CFR 154 is applicable to any facility which is capable of transferring oil in bulk to or from a vessel with a capacity of 250 or more barrels of oil. The USCG regulations address the operations manual requirements, equipment requirements, and facility operations.

USCG 33 CFR 156 -- Oil and Hazardous Material Transfer Operations

USCG 33 CFR 156 provides requirements which are designed to prevent the spillage and leakage during the transfer of oil and hazardous materials from, to, or within any vessel (except public vessels) with a capacity of 250 or more barrels of that material. Subpart A addresses pollution prevention regulations for oil transfer operations. Special requirements for the lightering of oil and hazardous material cargoes are discussed in Subpart B.

Containment requirements: Hazardous waste tanks

The RCRA Subtitle C requirements for hazardous wastes is a more stingent model of control than the SPCC approach. The RCRA model requires the use of double-walled tanks, double-walled pipe, corrosion protection and a lined concrete pad and curbing beneath (see July 14, 1986, (51 FR 23466)). In addition, closure, post-closure, and corrective action requirements are required for treatment, storage and disposal facilities.

Exhibit 1

Review of Storage Tank Codes and Standards

Other Tech. Requirements	API 620	API 650 (8TH Ed.)	API RP 651 (Final Rev.)	API RP 652 (Draft 10)	API 653 (1st Ed.)	API PUB.2008 (4TH Ed.)	NFPA 30 (1987 Ed.)	NFPA 30A
Lightning Protection								
General Corrosion Control	3.7	3.3, 3.4, 3.5	All	All	2.4		Chapter 2-1.6	
Tank Integrity Testing	5.0	2, 5, 6			2.0, 3.0, 4.0, 10.0		Chapters 2-7, 3-7	
Certification of Tank Installation		8.3			4.10			
Plant Security								
Flood Protection							Chapter 2-5.6.2	
Detection of Leaks		5.3, 6			10.0			
Training						All	Chapter 5-5.4	
Stringency								
Retention Ponds, Settling Ponds, & Mudpits								
Brittle Fracture	5.0	2.0, 5.0, 6.0			Section 3			

Exhibit 1

Exhibit 1 (Continued)

Review of Storage Tank Codes and Standards

Other Tech. Requirements	NFPA 31 (1987 Ed.)	NFPA RP2003-10/74	NFPA 78	NACE RP0285	OSHA 29 CFR 1910	FEMA 44 CFR 60.3(c)
Lightning Protection		Portions	Chapter 6			
General Corrosion Control				All		
Tank Integrity Testing	Chap. 2-8				1910.106	
Certification of Tank Installation						
Plant Security					1910.106	
Flood Protection						All
Detection of Leaks						
Training					Part 1910,120	
Stringency						
Brittle Fracture						
Retention & Settling Ponds, and Mudpits						

Exhibit 1 (Continued)

Review of Storage Tank Codes and Standards

Other Technical Requirements	E.O. #11988	USCG 33CFR Ch. 1	UL 142	ADME/ANSI 896.1-1986 (as amended)	ASME/ANSI B31.3-1987
Lightning Protection					
General Corrosion Control					
Tank Integrity Testing		156.170	Section 20	Section 6	Chapter VI
Certification of Tank Installation					
Plant Security		154.570			
Flood Protection	All				
Detection of Leaks		156.170	Section 20	Section 6	Chapter VI
Training		154.700			
Stringency					
Brittle Fracture			Section 20		
Retention Ponds & Settling Ponds, and Mudpits					

iii. Diversion of Discharge to Sewage Treatment Plant

Where storm water discharges contain significant amounts of pollutants that can be removed by a sewage treatment plant, the storm water discharge can be discharged to the sanitary sewage system. Such diversions must be coordinated with the operators of the sewage treatment plant and the collection system to avoid worsening problems with either combined sewer overflows (CSOs), basement flooding or wet weather operation of the treatment plant. Where CSO discharges, flooding or plant operation problems can result, onsite storage followed by a controlled release during dry weather conditions may be considered.

iv. Traditional Storm Water Management Practices

In some situations, traditional storm water management practices such as grass swales, catch basin design and maintenance, infiltration devices, unlined retention or detention basins, water reuse, and oil and grit separators can be applied to an industrial setting. However, care must be taken to evaluate the potential of many of these traditional devices for ground water contamination. In some cases, it is appropriate to limit traditional storm water management practices to those areas of the drainage system that generate storm water with relatively low levels of pollutants (e.g., many rooftops, parking lots, etc.). At facilities located in northern areas of the country, snow removal activities may play an important role in a storm water management program. In addition, other types of controls such as spill prevention measures can be considered to prevent catastrophic events that can lead to surface or ground water contamination.

v. Elimination of Pollution Sources

In some cases, the elimination of a pollution source may be the most cost-effective way to control pollutants in storm water discharges associated with industrial activity. Options for eliminating pollution sources include reducing onsite air emissions affecting runoff quality, changing chemicals used at the facility, and modification of material management practices such as moving storage areas into buildings.

c. Options for Controlling Pollutants in Storm Water Discharges Associated with Industrial Activity from Construction Activities.

Most controls for construction activities can be broken into two group: 1) sediment and erosion controls; and 2) storm water controls. Sediment and erosion controls are generally those controls which address pollutants in storm water generated from the site during the time when construction activities are occurring. Storm water controls are generally those controls which are installed during the construction process, but primarily result in reductions of pollutants in storm water discharged from the site after the construction has been completed.

The National Association of Homebuilders (NAHB) comments on the storm water rulemaking indicate that requiring Best Management Practices (BMPs) is the appropriate way to regulate construction site runoff. NAHB recommended that appropriate BMPs should address:

- Environmental Site Planning;
- Non-Structural Management Practices, including Vegetative Controls; and
- Structural Controls.

<u>State Programs</u>: A May 1990 survey by MD DEP indicated:

- 13 States have mandatory sediment and erosion control or storm water management programs effective State-wide;
- 2 States have mandatory programs for portions of the State;
- An additional 9 States had developed State-wide guidance for local governments to use; and
- 7 States indicated they were awaiting EPA regulations before developing or revising a State program.

<u>Municipal Programs</u>:

- Comprehensive estimates of the number of municipalities with erosion and sediment controls are unavailable.
- Most of the State programs require or allow for implementation at the municipal level.
- Over the last ten years, the National Association of Homebuilders (NAHB) has received requests to review over 500 local ordinances. They estimate that the following municipalities have some type of sediment and erosion/ storm water management program:
    - almost all large municipalities
    - almost all municipalities on the West Coast (except Alaska), East Coast and Great Lakes States have some type of sediment/storm water control program.

- most other municipalities in Regions I, II, III and IV States (West Virginia is an exception with few controls).

- About 25% of the municipalities in the Regions VI and VIII States.

- Few municipalities in Region VII and Alaska.

- NAHB believes that sediment and erosion controls have become standard industry practice even where they are not required by law.

Sediment and Erosion Controls.

Vegetative controls are often the most important measures taken to prevent off-site sediment movement, and can provide a six-fold reduction in discharge suspended sediment levels. Erosion controls provide the first line of defense in preventing off-site sediment movement and are designed to prevent erosion by protecting soils. Sediment controls are designed to remove sediment from runoff before the runoff is discharged from the site. Sediment and erosion controls can be further divided into two major classes of controls: vegetative practices and structural practices. Major types of sediment and erosion practices are summarized below. A more complete description of these practices is described in "Draft - Sediment and Erosion Control, An Inventory of Current Practices", U.S. EPA, OWEP, April 20, 1990.

Sediment and Erosion Controls: Vegetative Practices.

Vegetation, as discussed here, refers to covering or maintaining an existing cover over soils. The cover may be grass, trees, vines, shrubs, bark, mulch or straw. The establishment and maintenance of vegetation are one of the most important factors in minimizing erosion while construction activities are occurring. A vegetation cover reduces the erosion potential of a site by: absorbing the kinetic energy of raindrops which would otherwise impact soil; intercepting water so it can infiltrate into the ground instead of running off carrying surface soils; and by slowing the velocity of runoff promoting deposition of sediment in the runoff. Vegetative controls are often the most important measures taken to prevent off-site sediment movement, and can provide a six-fold reduction in discharge suspended sediment levels[6].

[6] "Performance of Current Sediment Control Measures at Maryland Construction Sites", January 1990, Metropolitan Washington Council of Governments.

Temporary Seeding - Temporary seeding provides for temporary stabilization by establishing vegetation of areas of the site which will be disturbed at some time during the construction operation, and where work (other than the initial disturbance) is not conducted until some time later in the project. Soils at these areas may be exposed to precipitation for an extended time period, even though work is not occurring on these areas. In most climates, temporary seeding is typically appropriate for areas exposed by grading or clearing for more than seven to fourteen days. Temporary seeding practices have been found to be up to 95% effective in reducing erosion[7].

Permanent Seeding - Permanent seeding involves establishing a sustainable ground cover at a site. Permanent seeding stabilizes the soil to reduce sediment in runoff from the site. Permanent seeding is typically required at most sites for aesthetic reasons.

Mulching

Mulching is typically conducted as part of permanent and temporary seeding practices. Where temporary and permanent seeding is not feasible, exposed soils can be stabilized by applying plant residues or other suitable materials to the soil surface. Although generally not as effective as seeding practices, mulching, by itself, does provide some erosion control. Mulching in conjunction with seeding practices provides erosion protection prior to the onset of vegetation growth. In addition, mulching protects seeding practices, providing a higher likelihood of their success. To maintain optimum effectiveness, mulches must be anchored to resist wind displacement.

Sod Stabilization

Sod stabilization involves establishing long-term stands of grass with sod in sediment producing areas. When installed and maintained properly, sodding can be 99% effective in reducing erosion[8], making it the most effective vegetation practice available. The higher cost of sod stabilization relative to other vegetative controls typically limits its use to exposed soils where a quick vegetative cover is desired and on sites which can be maintained with ground equipment. In addition, sod is sensitive to climate and may require intensive watering and fertilizing.

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[7] "Guides for Erosion and Sediment Control in California", USDA - Soil Conservation Service, Davis CA, Revised 1985.

[8] "Guides for Erosion and Sediment Control in California", USDA - Soil Conservation Service, Davis CA, Revised 1985.

Vegetative Buffer Strips

Vegetative buffer strips are preserved or planted strips of vegetation at the top and bottom of a slope, outlining property boundaries, or adjacent to receiving waters such as streams or wetlands. Vegetative buffer strips can slow runoff flows at critical areas, decreasing erosion and allowing sediment deposition.

Protection of Trees

This practice involves preserving and protecting selected trees that were on the site prior to development. Mature trees have extensive canopy and root systems which help to hold soil in place. Shade trees also keep soil from drying rapidly and becoming susceptible to erosion. Measures taken to protect trees can vary significantly, from simple measures such as installing tree fencing around the drip line and installing tree armoring, to more complex measures such as building retaining walls and tree wells.

Sediment and Erosion Controls: Structural Practices

Structural practices either: divert flow to prevent runoff across exposed areas; stabilize soils; or remove sediment from flows. Structural practices which divert flow are preventative, and reduce pollutants directly proportional to the amount of flow diverted. Structural practices which stabilize soils, such as outlet protection or graveled road entrances, can effectively mitigate extreme erosion problems in localized areas. Structural practices which remove sediment, such as sediment traps or silt fences, can remove from 60-80% of sediment in flows.

Structural practices involve the installation of devices to divert flow, store flow or limit runoff. Structural practices can have several objectives. First, structural practices can be designed to prevent water from crossing disturbed areas where sediment may be removed. This involves diverting runoff from undisturbed upslopes areas by use of earth dikes, temporary swales, perimeter dike/swales, or diversions that outlet in stable areas. A second objective of structural practices can be to remove sediment from site runoff before the runoff leaves the site. Several approaches to removing sediment from site runoff include diverting flows to a trapping or storage device, or filtering diffuse flow through straw bale dikes, silt fences, or brush barriers before it leaves the site. All structural practices require proper maintenance (removal of sediment) to remain functional.

Earth Dike

Earth dikes are temporary berms or ridges of compacted soil which channel water to a desired location. Earth dikes should be stabilized with vegetation.

Straw Bale Dike

Straw bales are temporary barriers of straw or similar material used to intercept sediment in runoff from small drainage areas of disturbed soil. When installed and maintained properly, straw bale dikes can remove approximately 67% of the sediment in runoff. This optimum efficiency can only be achieved through careful maintenance with special attention to replacing rotted or broken bales.

Silt Fence

Silt fences are a barrier of geotextile fabric (filter cloth) used to intercept sediment in diffuse runoff. Care must be taken in maintaining silt fences with an emphasis on maintaining the structural stability of the silt fence and removal of excessive sedimentation.

Brush Barriers

Brush barriers are sediment barriers composed of tree limbs, weeds, vines, root mat, soil, rock and other cleared materials placed at the toe of a slope.

Drainage Swales

A drainage swale is a drainage way with a lining of grass, riprap, asphalt, concrete, or other materials. Drainage swales are installed to convey runoff without causing erosion.

Check Dams

Check dams are small temporary dams constructed across a swale or drainage ditch to reduce the velocity of runoff flows, thereby reducing erosion of the swale or ditch. Check dams should not be used in a live stream. Check dams reduce the need for more stringent erosion control practices in the swale due to the decreased velocity and energy of runoff. Materials which can be used to install a check dam include rock, logs and covered straw bales.

Level Spreader

Level spreaders are outlets for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. Level spreaders convert concentrated runoff into diffuse runoff and release it onto areas stabilized by existing vegetation.

Subsurface Drain

Subsurface drains transport water to an area where can be managed effectively. Drains can be made of tile, pipe or tubing.

Pipe Slope Drain

A pipe slope drain is a temporary structure placed from the top of a slope to the bottom of a slope to convey surface runoff down slopes without causing erosion.

Temporary Storm Drain Diversion

Temporary storm drain diversions are used to re-direct flow in a storm drain to discharge into a sediment trapping device.

Storm Drain Inlet Protection

Storm drain inlet protection can be provided by a sediment filter or an excavated impounding area around a storm drain inlet. These devices prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

Rock Outlet Protection

Rock protection placed at the outlet end of culverts or channels can reduce the depth, velocity and energy of water such that the flow will not erode the receiving downstream reach.

Sediment Traps

Sediment traps can be installed in a drainageway, at a storm drain inlet, or other points of discharge from a disturbed area.

Other Controls

Other controls include temporary sediment basins, sump pits, entrance stabilization measures, waterway crossings, and wind breaks.

Storm Water Management Controls

Storm water controls are generally those controls which are installed during the construction process, but primarily result in reductions of pollutants in storm water discharged from the site after the construction has been completed. Construction activities often result in a significant change in land use. These changes in land use typically involve an increase in the overall imperviousness of the site, which can result in dramatic changes to the runoff patterns of a site. As the amount of runoff from a site increases, the amount of pollutants carried by the runoff increases. In addition, activities such as automobile travel on roads can result in higher pollutant concentrations in runoff then preconstruction levels. Traditional storm water management controls do not influence the change in land use associated with construction. Rather, traditional storm water management controls attempt to limit the increases in the amount of runoff and the amount of pollutants discharged from a site associated with the change in land use.

Major classes of storm water management controls include: infiltration of runoff onsite; flow attenuation by vegetation or natural depressions; outfall velocity dissipation devices; storm water retention structures and artificial wetlands; and storm water detention structures. For many sites, a combination of these controls may be appropriate.

Infiltration of Runoff Onsite

A variety of infiltration technologies can be used to reduce the volume and pollutant loadings of storm water discharges from a site, including infiltration trenches and infiltration basins. Infiltration devises tend to mitigate changes to pre-development hydrologic conditions. Properly designed and installed infiltration devices can reduce peak discharges, provide groundwater recharge, augment low flow conditions of receiving streams, reduce storm water discharge volumes and pollutant loads, and protect downstream channels from erosion. Infiltration devices are a feasible option where soils are permeable and the water table and bedrock are well below the surface. Infiltration basins can also be used as sediment basins during construction[9]. Infiltration trenches can be more easily placed into under utilized areas of a development, and can be used for small sites and infill developments. However trenches may require regular maintenance to prevent clogs, particularly where grass inlets or other pollutant removing inlets are not used. In some situations, such as low density areas of parking lots, porous pavement can provide for infiltration.

Flow Attenuation by Vegetation or Natural Depressions

Flow attenuation provided by vegetation or natural depressions can provide pollutant removal, infiltration, and

[9] "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs", July, 1987, Metropolitan Washington Council of Governments.

lower the erosive potential of flows[10]. In addition, these practices can enhance habitat values and the appearance of a site. Vegetative flow attenuation devises include grass swales and filter strips as well as trees that are either preserved or planted during construction.

Typically the costs of vegetative controls are small relative to other storm water practices. The use of check dams incorporated into flow paths can provide additional infiltration and flow attenuation[11]. Given the limited capacity to accept large volumes of runoff, and potential erosion problems associated with large concentrated flows, vegetative controls should typically be used in combination with other storm water devices.

Grass swales are typically used in low or medium residential development and highway medians as an alternative to curb and gutter drainage systems[12].

Outfall Velocity Dissipation Devices

Outfall velocity dissipation devises include riprap and stone or concrete flow spreaders. Outfall velocity dissipation devices slow the flow of water discharged from a site to lessen the amount of erosion caused by the discharge.

Storm Water Retention Structures

Properly designed and maintained storm water retention structures, also referred to as wet ponds, can achieve a high removal rate of sediment, BOD, organic nutrients and metals. Retention basins are most cost-effective in larger, more intensively developed sites. Retention ponds can also create wildlife habitat, recreation, and landscape amenities, and corresponding higher property values.

Retention Structures/ Artificial Wetlands

Retention structures include ponds and artificial wetlands that are designed to maintain a permanent pool of water. Properly installed and maintained retention structures (also

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[10] "Urban Targeting and BMP Selection", United States EPA, Region V, November 1990.

[11] "Standards and Specifications for Infiltration Practices", 1984, Maryland Water Resources Administration.

[12] "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs", Metropolitan Washington Council of Governments, July 1987.

known as wet ponds) and artificial wetlands[13][14] can achieve a high removal rate of sediment, BOD, organic nutrients and metals, and are most cost-effective when used to control runoff from larger, intensively developed sites[15]. These devises rely on settling and biological processes to remove pollutants.

Water Quality Detention Structures

Storm water detention structures include extended detention ponds, which control the rate at which the pond drains after a storm event. Extended detention ponds are usually designed to completely drain in about 24 to 40 hours, and will remain dry at other times. They can provide pollutant removal efficiencies that are similar to those of retention ponds[16]. Extended detention systems are typically designed to provide both water quality and water quantity (flood control) benefits[17].

d. Coal Pile Runoff Treatment Technology

The primary technology options for treating coal pile runoff considered in the final "Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category", (EPA-440/182/029), November 1982, EPA, were: 1) equalization, pH adjustment, settling; and 2) equalization, chemical precipitation treatment, settling, pH adjustment.

Metals may be removed from wastewater by raising the pH of the wastewater to precipitate them out as hydroxides. Typically, wastewater pH's of 9 to 12 are required to achieve the desired precipitation levels. Lime is frequently used for pH adjustment. Wastewaters which have a pH greater than 9 after lime addition will require acid addition to reduce the pH before final discharge. Polymer addition may be required to enhance the settling characteristics of the metal hydroxide precipitate.

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[13] "Wetland basins for Storm Water Treatment: Discussion and Background", Maryland Sediment and Stormwater Division, 1987

[14] "The Value of Wetlands for Nonpoint Source Control - Literature Summary", Strecker, E., et.al., 1990.

[15] "Controlling Urban Runoff, A Practical Manual for Planning and Designing Urban BMPs", Metropolitan Washington Council of Governments, 1987.

[16] "Urban Targeting and BMP Selection", United States EPA, Region V, November 1990.

[17] "Urban Surface Water Management", Walesh, S.G., Wiley, 1989.

Typical polymer feed concentrations in the wastewater are 1 to 4 ppm. The metal hydroxide precipitate is separated from the wastewater in a clarifier or a gravity thickener. Unlike settling ponds, these units continually collect and remove the sludge formed. Filters are typically used for effluent polishing and can reduce suspended solids levels below 10 mg/l. Sand or coal are the most common filter media. Vacuum filtration is a common technique for dewatering sludge to produce a cake that has good handling properties and minimum volume.

The major equipment requirements for such a system include a lime feed system, mix tank polymer feed system, flocculator/ clarifier, deep bed filter, and acid feed system. For wastewaters which have a pH of less than 6, mixers and mixing tanks are made of special materials of construction (stainless steel or lined-carbon steel). For wastewaters with pH's greater than 6, concrete tanks are typically used. The underflow from the clarifier may require additional treatment with a gravity thickener and a vacuum filter to provide sludge which can be transported economically for landfill disposal.

e. Salt Storage

Salt is readily dissolved by precipitation. The Salt Institute highly recommends that salt stockpiles, whether large or small, should never be left exposed to the elements-rain or snow. A permanent under-roof storage facility is best for protecting salt. If this is not possible, then outside piles should be build on impermeable bituminous pads and covered with one of the many types of temporary covering materials, such as tarpaulin, polyethylene, poly urethane, polypropylenes or Hypalon. These materials are also available with reinforcement for added strength. (see "The Salt Storage Handbook", Salt Institute, 1987). Storage facilities will result in reductions of lost product and easier handling of materials (and thus reduced labor costs) which will offset the cost of the storage.

Options for storing and handling salt are discussed at length in the following:

- o "Manual for Deicing Chemicals: Storage and Handling", EPA, 1974, EPA-670/2-74-033
- o "An Economic Analysis of the Environmental Impact of Highway Deicing", EPA, 1976, EPA-600/2-76-105
- o "Manual for deicing Chemicals: Application Practices", 1974, EPA, EPA-670/2-74-045

6.0 SELECTION OF DRAFT PERMIT CONDITIONS

6.1 Summary of permit conditions

Based on a consideration of the appropriate factors for BAT and BCT requirements, and a consideration of the factors and options for controlling pollutants in storm water discharges associated with industrial activity, the draft general permits proposes two prohibitions, a set of tailored requirements for developing and implementing storm water pollution prevention plans, and for selected discharges, two effluent limitations[1].

The conditions of these draft permits have been designed to comply with the technology-based standards of the CWA (BAT/BCT), as well as to ensure compliance with applicable State water-quality standards.

Based on a consideration of the appropriate factors for BAT and BCT requirements, and a consideration of the factors and options discussed in Chapter 5 for controlling pollutants in storm water discharges associated with industrial activity, the draft general permits proposes two prohibitions, a set of tailored requirements for developing and implementing storm water pollution prevention plans, and for selected discharges, two effluent limitations[2].

Chapter 5 summarizes the options for controlling pollutants

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[1] Part I.C.2 of the draft general permits provide that facilities with storm water discharges associated with industrial activity which, based on an evaluation of site specific conditions, believe that the appropriate conditions of these permits do not adequately represent BAT and BCT requirements for the facility may request to be excluded from the coverage of the general permit by either submitting to the Director an individual application (Form 1 and Form 2F) with a detailed explanation of the reasons supporting the request, including any supporting documentation showing that certain permit conditions are not appropriate, or participating in a group application (see 40 CFR 112.26(c)).

[2] Part I.C.2 of the draft general permits provide that facilities with storm water discharges associated with industrial activity which, based on an evaluation of site specific conditions, believe that the appropriate conditions of these permits do not adequately represent BAT and BCT requirements for the facility may request to be excluded from the coverage of the general permit by either submitting to the Director an individual application (Form 1 and Form 2F) with a detailed explanation of the reasons supporting the request, including any supporting documentation showing that certain permit conditions are not appropriate, or participating in a group application (see 40 CFR 112.26(c)).

in storm water discharges associated with industrial activity. The draft general permit proposes numeric effluent limitations for two classes of discharges, coal pile runoff, and runoff that comes into contact with certain chemical storage or handling facilities at SARA Title III, Section 313 facilities. For other discharges covered by the permit, the draft permit conditions reflect EPA's decision to rely primarily on requiring best management practices to prevent pollution in storm water discharges and using traditional storm water management practices. The draft permit conditions applicable to these discharges are not numeric effluent limitations, but rather are flexible requirements for developing and implementing site specific plans to prevent pollutants in storm water discharges associated with industrial activity.

In developing these draft permit conditions, EPA considered a range of control options, including providing end-of-pipe treatment, best management practices, diverting storm water discharges to sewage treatment plants, traditional storm water management practices, and eliminating pollutant sources (see Chapter 5). EPA's consideration of these options is briefly summarized below.

At many types of industrial facilities, it may be appropriate to collect and treat runoff from targeted areas of the facility. This approach has been taken with the 10 industrial categories with national effluent limitations guidelines for storm water discharges. As noted above, end-of-pipe treatment requirements typically are focussed on targeted areas of an industrial facility. End-of-pipe treatment typically requires the collection of the storm water to be treated, and providing for some type of treatment such as settling, neutralization or precipitation of metals. The Agency currently does not have sufficient data to develop appropriate discharge standards needed to require end-of-pipe treatment from all of the sources of storm water discharges associated with industrial activity covered by these permits.

The Agency has selected a number of best management practices and traditional storm water management practices as the BAT/BCT level of control for the majority of storm water discharges covered by these permits. Unlike other control options considered, the Agency believes that the practices addressed in the draft permit are flexible enough to allow site-specific application to all of the varied discharges covered. A complete description of these provisions is provided below.

Diverting storm water discharges to a sewage treatment plant can be a cost-effective approach to controlling pollutants in storm water discharges in some situations. This approach would require the installation of storm water containment for runoff followed by controlled discharge to the sewage treatment plant in a manner that did not exceed the capacity of the treatment plant collection system or the plant itself. However, this option is not available to facilities that are not provided service by a sewage treatment plant. In addition, the Agency does not have sufficient information to evaluate the existing capacity of sewer systems to accept storm water discharges.

EPA encourages the elimination of pollutant sources where feasible to reduce the risk of pollutants in storm water discharges. As discussed below, the Agency believes that elimination of pollutant sources such as leaking values and pipes will assist SARA Title III, Section 313 facilities with water priority chemicals in meeting the whole effluent toxicity limitation in the draft permits. However, some industrial activities, such as operating landfills, may not be readily amenable to this approach. Thus, the Agency is generally hesitant to rely on this technology when developing permit conditions that are generally applicable to all discharges covered by the permit. Rather, EPA will continue to evaluate the appropriate role of this technology in Tier II, III and IV permitting activities.

EPA believes that the draft permit conditions, including the prohibition on non-storm water discharges and requirements for BMPs in the storm water pollution prevention plans combine to meet the BAT/BCT tests specified in 40 CFR 125.3 for permits issued on a BPJ basis. For BAT requirements, the following factors were significant to the Agency in making this determination:

- o the age of equipment and facilities involved;
- o the process employed;
- o the engineering aspects of the application of various types of control techniques;
- o the cost of achieving such effluent reduction; and
- o non-water quality environmental impacts.

For BCT requirements, the following factors were significant to the Agency in making this determination:

- o The reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits;
- o The age of equipment and facilities involved;
- o the process employed;
- o the engineering aspects of the application of various types of control techniques; and
- o non-water quality environmental impacts.

The BPJ determination was made by the work group for the permit which included experienced permit writers from each EPA Regional office as well as other professionals from various EPA offices.

The draft permit conditions require discharges to develop and implement BMP oriented storm water pollution prevention plans rather than meet numeric effluent limitations. EPA is authorized under 40 CFR 122.44(k)(2) to impose BMPs in lieu of numeric effluent limitations in NPDES permits when they Agency finds numeric effluent limitations to be infeasible. EPA may also impose BMPs which are "reasonably necessary . . . to carry the purposes of the Act" under 40 CFR 122.44(k)(3). Both of these standards for imposing BMPs were recognized in NRDC v. Costle, 568 F.2d at 1380. The conditions in the draft general permits are proposed under the authority of both of these regulatory provisions.

EPA believes that it is not feasible at this time to establish a set of generic numeric effluent limitations that would be universally appropriate to all of the varied classes of storm water discharges associated with industrial activity covered by these permits. As discussed above, a number of varied pollutant sources can be identified as major potential sources of pollutants in storm water discharges associated with industrial activity. Variations in types and concentrations of pollutants input from many different sources make establishing generic concentration-based effluent limitations applicable to all discharges covered by this permit difficult. The Agency also believes that while the baseline BMPs required in these permits are generally appropriate for all facilities covered by the permits, some components of the BMPs plan will be more successful at preventing pollution at certain types of facilities than at other types of facilities. Further, EPA has limited quantitative data on the pollutant removal efficiencies of the BMPs required in this permit. These factors make the development of either concentration-based or pollution removal-based numeric effluent limitations technically infeasible.

EPA recognizes that it could require individual applications from most facilities in lieu of the permit to collect site specific information, including data describing pollutants in storm water discharges. However, this would not necessarily provide sufficient data regarding the pollutant removal efficiencies of the BMPs or other control options to support a numeric effluent limitation. In addition, such an approach would be inconsistent with the four tiered strategy for issuing permits outlined above and would result in fundamentally unworkable administrative burdens. Ultimately, this could intolerably delay imposition of NPDES storm water controls and the water quality benefits to be gained, which in turn is inconsistent with the goals and purposes of the CWA, particularly Section 402(p). EPA views the draft baseline permits as an important tool for developing some of the information necessary to establish numeric controls where appropriate.

The Court in NRDC v. Costle made clear, that BMPs can serve as an acceptable substitute for numeric effluent limitations in appropriate contexts such as storm water permits. EPA notes that, in the storm water general permit context, EPA has always planned to rely on BMPs as a primary source of controls. See, e.g., 42 FR 6846 (Feb. 4. 1977) (proposing the creation of general permit programs for storm water oriented towards use of BMPs).

EPA is not arguing, of course, that it will always be infeasible to establish numeric effluent limitations for storm water discharges associated with industrial activity. As discussed earlies, the Agency has developed ten effluent limitations guidelines for storm water discharges from specific industrial categories. In addition, the draft general permits contain numeric (or toxicity) effluent limitations for two classes of discharges, coal pile runoff and certain discharges from SARA Title III, Section 313 facilities. Numeric limitations can be clearly appropriate for well defined classes of storm water discharges where sufficient data indicates that the numeric limitations represent the appropriate BAT/BCT or water quality-based standard.

Development of industry-specific and watershed-specific permits under Tiers II and III will be based on collection of more detailed monitoring, sampling, and qualitative information, much of which will be collected either through the terms of today's draft permit or through EPA's group application process. EPA is indicating only that such numeric effluent limitations are not possible for all storm water discharges at all facilities in the Tier I permits (and that issuance of Tier I permits is authorized by the CWA and EPA regulations).

In addition, EPA believes the requirements in today's permit are reasonably necessary to carry the purposes of the Act and hence are authorized pursuant to 40 CFR 122.44(k)(3). For example, many of the requirements of the BMP oriented storm water pollution prevention plan are directed towards identifying sources of pollutants. This information will supplement monitoring data required under Section 308 of the Act and will assist facilities in developing cost-effective efforts directed at reducing pollutants in storm water discharges.

Furthermore, the BMP requirements in these permits operate as limitations on effluent discharges that reflect the application of BAT/BCT. This is because certain BMPs mandate the use of source control technologies which may, in certain instances, be the best available of the technologies economically achievable (or the equivalent BCT finding). See, e.g., NRDC v. EPA, 822 F.2d 104, 122-23 (D.C. Cir. 1987) (EPA has substantial discretion to impose non-quantitative permit requirements pursuant to Section 402(a)(2)).

6.2 Prohibitions

The draft general permits prohibit non-storm water discharges as a component of discharges authorized by this permit. These permits are intended to authorize discharges composed entirely of storm water associated with industrial activity. The prohibition on non-storm water discharges in these permits ensures that non-storm water discharges are not inadvertently authorized by these permits. Where a storm water discharge is mixed with process wastewaters or other sources of non-storm water prior to discharge, and the discharge is currently not authorized by an NPDES permit, the discharger should submit the appropriate application forms to obtain permit coverage. The Agency believes that these mixed discharges are addressed more appropriately through individual NPDES permits or other general permits as individual or other general permits will allow development of more tailored and specific permit conditions appropriate for such discharges.

The draft general permits also prohibit discharges that contain a hazardous substance in excess of reporting quantities established at 40 CFR 117.3 or 40 CFR 302.4, and clarifies that where such a discharge occurs, the permit does not relieve the permittee of the reporting requirements of 40 CFR 117 and 40 CFR 302. The Agency believes that the vast majority of discharges that contain a hazardous substance in excess of reporting quantities will be associated with non-storm water sources (e.g. chemical spill events). Where a discharge composed entirely of storm water associated with industrial activity containing a hazardous substance in excess of reporting quantities occurs or is expected to occur, the Agency believes that the potential risks associated with the discharge are such that it is more appropriate to address the discharge with an individual permit which contains more specific permit conditions based on industry specific or site specific factors and a consideration of receiving water characteristics. Since discharges containing a hazardous substance in excess of reporting quantities are not authorized by these permits, such releases are not exempted from reporting requirements by 40 CFR 117.12(a)(1), and hence the permits do not relieve the permittee of the reporting requirements of 40 CFR 117 and 40 CFR 302.

EPA anticipates that storm water discharges that contain oil in excess of reporting quantities established under 40 CFR 110.6 (e.g. exhibit an oil sheen) will be more common. For example, many storm water discharges from parking lots or roads, as well as from industrial facilities, contain an oil sheen. Although discharges composed entirely of storm water associated with industrial activity are authorized by these permits where the discharge complies with the other applicable requirements of the permit, it should be noted that where a discharge of oil in excess of reporting quantities is caused by a nonstorm water discharge (e.g. a spill of oil into a separate storm sewer), the spill is not authorized by this permit, and the discharger is not relieved of their obligation to report the spill under 40 CFR 110.

6.3 Tailored Pollution Prevention Plan Requirements

All facilities covered by the draft general permits must prepare, retain and implement a storm water pollution prevention plan. The draft permits address tiered sets of pollution prevention plan requirements for a number of categories of industries: construction activities; baseline requirements for all industries except construction activities; special requirements for certain facilities subject to SARA Title III, Section 313; special requirements for storm water discharges associated with industrial activity to large and medium municipal separate storm sewer systems; and special requirements for facilities with outdoor salt storage piles. These tailored requirements have been developed to address specific features or activities associated with the identified storm water discharges.

The proposed requirements for developing and implementing storm water pollution prevention plans are based primarily on traditional storm water management, pollution prevention and BMP concepts which have been tailored to prevent pollutants in storm water discharges associated with industrial activity.

The requirements for storm water pollution prevention plans in the draft general permits have two major objectives: (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from the facility; and (2) describe and ensure that practices are implemented to reduce pollutants in storm water discharges associated with industrial activity from the facility and to ensure compliance with the terms and conditions of this permit.

In developing these tiered requirements, the Agency believes that it is not appropriate, at this time, to require a single set of effluent guidelines or a single design or operational standard for all facilities which discharge storm water associated with industrial activity. Rather, this permit establishes a framework for the development and implementation of site-specific storm water pollution prevention plans. This framework provides the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with the different types of industrial activity that are addressed by these permits, while ensuring procedures to prevent storm water pollution at a given facility are appropriate given the processes employed, engineering aspects, functions, costs of controls, location, and age of facility. The approach taken allows flexibility to establish controls which can appropriately address different sources of pollutants at different facilities.

Plan Requirements for Construction Activities

The requirements for storm water pollution prevention plans for operations that discharge storm water associated with industrial activity from construction activities differ from the requirements for other types of facilities.

In developing these draft permits, the Agency has reviewed a significant number of existing State and local requirements for sediment and erosion controls, and storm water management controls for construction activities/new development addressing a wide range of climates and types of construction activities.
Source Identification

Storm water pollution prevention plans must be based on an accurate understanding of the pollution potential of the site. The first part of the plan requires an evaluation of the sources of pollution at a specific construction site. The source identification components for pollution prevention plans for construction activities proposed in these permits include, at a minimum, a description of the following:

- A description of the nature of the construction activity, including a proposed timetable for major activities;
- Estimates of the total area of the site and the area of the site that is expected to undergo excavation or grading;
- An estimate of the runoff coefficient of the site and the increase in impervious area after the construction is completed, a description of the nature of fill material to be used, and existing data describing the soil or the quality of any discharge from the site;
- A site map indicating, at a minimum, drainage patterns and approximate slopes anticipated after major grading activities, areas used for the storage of soils or wastes, the location of major control structures identified in the plan, the location of impervious structures after construction is completed, and springs and other surface waters; and
- The name of the receiving water(s), or if the discharge is to a municipal separate storm sewer, the name of the municipal operator of the storm sewer and the ultimate receiving water(s).

ii. Controls to Reduce Pollutants

Many municipalities and States have developed sediment and erosion control requirements. A significant number of municipalities and States have also developed storm water management controls. These permits require that facilities which discharge storm water associated with industrial activity from construction activities must include in their storm water pollution prevention plan procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by State or local officials. Upon the applicant's submittal of an NOI to be authorized to discharge under this permit, applicable requirements specified in sediment and erosion plans or storm water management plans approved by State or local officials are incorporated by reference and are enforceable under this permit even if they are not specifically included in a storm water pollution prevention plan required under this permit[3].

The controls for construction activities proposed in these permits have three goals: 1) to divert upslope water around disturbed areas of the site; 2) to limit the exposure of disturbed areas to the shortest duration possible; and 3) to remove sediment from storm water before it leaves the site.

Each construction operation covered by the permits is required to develop a description of three classes of controls appropriate for inclusion in the facility's plan, and implement such controls. The description of controls must address erosion and sediment controls, storm water management and a specified set of other controls.

Erosion and sediment controls include both vegetative practices and structural practices. Vegetative practices are the first line of defense for preventing erosion. These controls are based on a consideration of temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffer strips, and protection of trees. Temporary seeding practices are often cited as the single most important factor in reducing erosion at construction sites[4]. Since vegetative practices play such a

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[3] Facilities with storm water discharges associated with industrial activity related to construction activities which, based on an evaluation of site specific conditions, believe that State and local plans do not adequately represent BAT and BCT requirements for the facility may request to be excluded from the coverage of the general permit by submitting to the Director an individual application with a detailed explanation of the reasons supporting the request, including any supporting documentation showing that certain permit conditions are not appropriate.

[4] "New York Guidelines for Urban Erosion and Sediment Control", USDA - Soil Conservation Service, March, 1988.

important role in preventing erosion, it is critical that they are rapidly employed in appropriate areas. The draft permits provide that at a minimum, temporary seeding, permanent seeding, mulching or sod stabilization procedures, or their equivalent, must be conducted on all disturbed areas within 7 calendars days of the last activity at that area.

Structural controls provide a second line of defense by capturing pollutants before they leave the site. Structural controls are necessary because vegetative controls cannot be employed at areas of the site which are continually disturbed and because a finite time period is required before vegetative practices are fully effective. The permits require that structural practices must be based on a consideration of straw bale dikes, silt fences, earth dikes, brush barriers, drainage swales, check dams, subsurface drain, pipe slope drain, level spreaders storm drain inlet protection, rock outlet protection, sediment traps, and temporary sediment basins. For sites with more than 10 disturbed acres at one time which are served by a common drainage location, at a minimum, a detention basin providing storage for runoff from disturbed areas from a one inch storm, shall be provided. For drainage locations serving 10 or less acres, at a minimum, silt fences, straw bale dikes, or equivalent sediment controls are required for all sideslope and downslope boundaries of the construction area or a detention basin providing storage for runoff from disturbed areas from a one inch storm shall be provided. Although sediment basins are generally viewed as being more effective than other structural controls, flexibility has been added to the proposed requirements for drainage locations serving 10 or less acres since these smaller sites may have more difficulty finding an appropriate location for a basin.

Storm water management controls are to include a description of measures to control pollutants in storm water discharges that will occur after construction operations have been completed. In developing structure practices, the operator is to consider the appropriateness of: infiltration of runoff onsite; flow attenuation by use of open vegetated swales and natural depressions; storm water retention structures and storm water detention structures.

When developing a plan, a combination of practices should be used. Schueler advocates that a management practice system combosed of a combination of structural and non-structural measures must be considered when evaluating the impact of a given development on a watershed over a long time. Under this system approach, the components of the system are designed in an integrated manner to address each of the following:

- o Runoff Attention: Site imperviousness is reduced by reducing the distrubed area and protecting site tree cover and disconnecting impervious areas. Stream buffers and wetlands are also protected.

- o Runoff Conveyance: The runoff conveyance can mitigate flows in a number of ways, including using vegetated swales, and level spreaders.

Developing land often significantly increases peak discharge volumes and velocities. These increased discharge velocities can greatly accelerate erosion near the outlet of on-site structural controls. To mitigate these effects, the draft permits require velocity dissipation devices to be placed at the outfall of all detention or retention structures and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a water course. A typical standard for a non-erosive velocity is 4 feet per second calculated based on a 10 year frequency storm (see MD DNR requirements).

Justification shall be provided by the permittee for rejecting each practice based on site conditions. These permits do not establish specific standards for storm water management (other than requirements in approved State and local storm water site plans).

Other controls to be addressed in pollution prevention plans for construction activities require that all wastes composed of building materials must be removed from the site for disposal in licensed disposal facilities. No building material wastes or unused building materials can be buried, dumped, or discharged at the site, unless the facility is licensed for such disposal. These provisions will help ensure that State or local waste disposal requirements are adhered to and that wastes are not improperly or illegally dumped at the construction site.

Each site is required to have graveled access entrance and exit drives and graveled or paved parking areas to reduce the tracking of sediment onto public or private roads. All unpaved roads on the site carrying more than 25 vehicles per day must also be graveled. These measures will limit erosion and the transport of sediment offsite from these areas.

In addition, the plan shall ensure and demonstrate compliance with applicable State or local sanitary sewer or septic[5] system regulations.

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[5] In rural and suburban areas that are served by septic systems, malfunctioning septic systems can contribute pollutants to storm water discharges. Malfunctioning septic tanks may be a more significant surface runoff pollution problem than a ground water problem. This is because a malfunctioning septic system is less likely to cause ground water contamination where a bacterial

Erosion and sediment controls can become ineffective if they are inappropriately disturbed or otherwise damaged. Maintenance of controls has been identified as a major part of effective erosion and sediment programs. Plans are required to provide a description of procedures to maintain in good and effective condition and promptly repair or restore all grade surfaces, walls, dams and structures, vegetation, erosion and sediment control measures and other protective devices identified in the site plan. At a minimum, procedures in a plan must provide that all erosion controls on the site are inspected at once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. Diligent inspections are necessary to assure adequate implementation site sediment and erosion controls, particularly in the later stages of construction when the volume of runoff is greatest and the storage capacity of the sediment basins has been reduced[6].

Plan Requirements for Facilities other than Construction Activities.

In 1979, EPA completed a technical survey of industry best management practices (BMPs) which was based on a review of practices used by industry to control the non-routine discharge of pollutants from non-continuous sources including runoff, drainage from raw material storage area, spills, leaks, and sludge or waste disposal. This review included analysis and assessment of published articles and reports, technical bulletins, and discussions with industry representatives through telephone contacts, written questionnaires and site visits.

The review identified two classes of pollution control measures. The first class of controls are those management practices generally considered to be essential to a good BMP program, are low in cost, and applicable to broad categories of industry and types of substances. These practices are independent of the type of industry, ancillary sources, specific chemicals, group of chemicals, or plant-site locations. The

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mat in the soil retards the downward movement of wastewater. Surface malfunctions are caused by clogged or impermeable soils, or when stopped up or collapsed pipes forces untreated wastewater to the surface. Surface malfunctions can vary in degree from occasional damp patches on the surface to constant pooling or runoff of wastewater. These discharges have high bacteria, nitrate and nutrient levels and can contain a variety of household chemicals. This permit does not establish new criteria for septic systems, but rather adopts existing State or local criteria.

[6] "Performance of Current Sediment Control Measures at Maryland Construction Sites", January, 1990, Metropolitan Washington Council of Governments

survey concluded that these controls were broadly applicable to all industry types and activities, and should be viewed as minimum requirements in any effective BMP program. The second class of controls are those management practices controls which provide a second line of defense against the release of pollutants and included prevention measures, containment measures, mitigation and cleanup measures, and treatment methods[7].

Since that time, EPA has, on a case-by-case basis, imposed BMP requirements in NPDES permits. The Agency has also continued to review and evaluate case studies involving the use of BMPs[8] and the use of pollution prevention measures associated with spill prevention and containment measures for oil[9]. During the development of NPDES permit application requirements for storm water discharges associated with industrial activity, the Agency evaluated appropriate means for identifying and evaluating the potential risk of pollutants in storm water from industrial sites. Public comments received during the rulemaking provided additional insight regarding storm water risk assessment, as well as appropriate pollution prevention and control measures and strategies. During this time, the Agency again reviewed storm water control practices and measures. These experiences have shown the Agency that pollution prevention measures such as BMPs can be appropriately used and that permits containing BMP requirements can effectively reduce pollutant discharges in a cost-effective manner.

i. Source Identification

Storm water pollution prevention plans must be based on an accurate understanding of the pollution potential of the site.

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[7] For a complete description of the BMP survey, see "NPDES Best Management Practices Guidance Document", U.S. EPA, December 1979, EPA-600/9-79-045. See also the 1981 document of the same name, "NPDES Best Management Practices Guidance Document" which provides a more complete discussion of baseline BMPs.

[8] For example, see: "Best Management Practices: Useful Tools for Cleaning Up", Thron, H., Rogoshewski, P., 1982, Proceedings of the 1982 Hazardous Material Spills Conference; "The Chemical Industries Approach to Spill Prevention" Thompson, C., Goodier, J., 1980, Proceedings of the 1980 National Conference on Control of Hazardous Material Spills; and a series of EPA memorandum entitled "Best Management Practices in NPDES Permits - Information Memorandum", 1983, 1985, 1986, 1987, 1988.

[9] See Oil Pollution Prevention requirements, including Spill Prevention, Control, and Countermeasure Plan requirements, at 40 CFR 112.

The first part of the plan requires an evaluation of the sources of pollution at a specific industrial site. The source identification components proposed in this permit include:

- o A drainage site map;
- o An estimate of the area of impervious surfaces and the total area drained by each outfall;
- o A narrative description of specified features that may impact the pollution potential of a discharge;
- o A list of significant spills and leaks of toxic or hazardous pollutants that occurred at the facility after the effective date of the permit;
- o A prediction of the direction of flow, and an estimate of the types of pollutants that may be present in storm water discharges associated with industrial activity, prediction of the direction, rate of flow and total quantity of pollutants that may be present in storm water discharges associated with industrial activity; and
- o A summary of existing sampling data describing pollutants in storm water discharges.

ii. Practices and Program Elements to Reduce Pollutants

The second major section of the storm water pollution prevention plan addresses practices and program elements to reduce pollutants in areas identified as being potential pollutant sources for storm water discharges associated with industrial activity. In developing these requirements, the Agency has selected those practices identified in studies of BMPs which are appropriate for all facilities with storm water discharges associated with industrial activity. In addition, the Agency has also addressed commonly used, low-cost pollution prevention measures for storm water discharges (traditional storm water management and sediment and erosion prevention) and a requirement for facilities to certify that storm water discharges have been tested for the presence of non-storm water pollution sources[10].

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[10] The certification requirement that storm water discharges associated with industrial activity have been tested for the presence of non-storm water pollution sources is similar to the certification requirement in the Form 2F application for storm water discharges associated with industrial activity (see November 16, 1990 (55 FR 47990). EPA is including this certification provision in these general permits since dischargers may obtain coverage under these permits without the submittal of Form 2F.

(1). pollution prevention committee;

(2). risk identification and assessment\material inventory;

(3). preventive maintenance;

(4). good housekeeping;

(5). spill prevention and response procedures;

(6). traditional storm water management;

(7). sediment and erosion prevention;

(8). employee training;

(9). visual inspections; and

(10). record keeping and internal reporting procedures; and

(11). certification that storm water discharges have been tested for the presence of non-storm water pollution sources.

These permits establish the framework and the basic elements for storm water pollution prevention measures. However, the plan requirements provide flexibility to allow the development of site-specific measures. At a given site, specific measures incorporated into the pollution prevention plan will reflect the sources of pollutants that have been identified at the site. For example, a facility that has identified dust and particulate generating processes as potential sources of storm water pollution will incorporate appropriate good housekeeping and traditional storm water management practices to address these sources. However, a facility without dust and particulate generating processes would not have to incorporate measures to address dust and particulate generating processes into their plan.

Pollution Prevention Committee

The Storm Water Pollution Prevention Committee identifies specific individuals within the plant organization who are responsible for developing the storm water pollution prevention plan and assisting the plant manager in its implementation, maintenance, and revision. The activities and responsibilities of the committee should address all aspects of the facility's storm water pollution prevention plan. However, it is preferred that plant management, not the committee, has overall responsibility and accountability for the quality of the storm water pollution prevention plan.

Risk Identification and Assessment\Material Inventory

The storm water pollution prevention plan should assess the potential of various sources at the plant to contribute pollutants to storm water discharges associated with industrial activity. These activities should assist in assessing the pollution potential of runoff from specific areas of the plant. The plan should inventory the types of materials handled, the location of material management activities, and types of material management activities.

The pollution prevention committee should assess the layout and activities at the plant identified as high-priority areas with a significant potential for contributing pollutants to the drainage system. Factors to consider when evaluating the pollution potential of runoff from various portions of an industrial plant include:

- loading and unloading operations;
- outdoor storage activities;
- outdoor manufacturing or processing activities;
- dust or particulate generating processes; and
- waste disposal practices.

Other factors to consider are the toxicity of chemicals; quantity of chemicals used, produced, or discharged; history of NPDES permit violations; history of significant leaks or spills of toxic or hazardous pollutants; and nature and uses of the receiving waters.

Chemicals should be compatible with the materials used in storage and process equipment, including the piping, valves and pumps. Incompatibility of materials can cause equipment failure resulting from corrosion, fire, or explosion. Equipment failure can be prevented by ensuring that the materials of construction for containers handling hazardous substances or toxic pollutants are compatible with the container's contents and surrounding environment.

Preventive Maintenance

A preventive maintenance program involves inspection and maintenance of storm water management devices (cleaning oil/water separators, catch basins) as well as inspecting and testing plant equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters. A good preventive maintenance program includes identifying equipment or systems used in the program; periodically inspecting or testing equipment and systems; adjusting, repairing, or replacing items; and maintaining complete records on the equipment and systems.

Good Housekeeping

Good housekeeping requires the maintenance of a clean, orderly facility. Training of employees in housekeeping techniques and establishing housekeeping protocols reduces the possibility of mishandling chemicals or equipment. These measures also ensure that discharges of wash waters to separate storm sewers are avoided.

Spill Prevention and Response Procedures

Areas where potential spills can occur, and their accompanying drainage points should be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures and storage requirements in the plan should be considered. Procedures for cleaning up spills should be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel. Spill response procedures should avoid discharging to separate storm sewers where safety considerations allow.

Appropriate Storm Water Management

After measures have been taken to minimize pollutant sources to storm water, traditional storm water management practices should be considered. For the purposes of these permits, traditional storm water management practices are measures which reduce pollutant discharges by reducing the volume of storm water discharges associated with industrial activity, such as directing storm water to existing vegetative swales, or preventing storm water to run onto areas of the site which conduct industrial activity. Low-cost measures that can be applied to an industrial setting may include diverting rooftop or other drainage across available grass swales, cleaning catch basins, and installing and maintaining oil and grit separators. Other measures that may be appropriate in some cases include infiltration devices and unlined retention and detention basins. Traditional storm water management practices can include water reuse activities, such as the collection of storm water for later uses such as irrigation or dust control. Appropriate snow removal activities may be considered, such as selecting a site for removed snow and selecting and using deicing chemicals.

However, care must be taken to evaluate whether these traditional devices cause ground water contamination. In some cases, it is appropriate to limit traditional storm water management practices to those areas of the drainage system that generate storm water with relatively low levels of pollutants (e.g., many rooftops, parking lots, etc.).

Sediment and Erosion Prevention

The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for soil erosion, and identify and ensure the implementation of measures to limit erosion.

Employee Training

Employee training programs are necessary to inform personnel at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. A pollution prevention plan should identify periodic dates for such training.

Visual Inspection and Records

Qualified plant personnel should be identified to inspect designated equipment and plant areas. Typical inspections should include examination of pipes, pumps, tanks, supports, foundations, dikes, and drainage ditches. Material handling areas should be inspected for evidence of, or the potential for, pollutants entering the drainage system. A tracking or followup procedure should be used to ensure that adequate response and corrective actions have been taken. Records of inspections should be maintained.

Record Keeping and Reporting Procedures

A record keeping system ensures adequate implementation of the storm water pollution prevention plan. Incidents such as spills, leaks and improper dumping, along with other information describing the quality and quantity of storm water discharges should be included in the records. Inspections and maintenance activities such as cleaning oil and grit separators or catch basins should be documented and recorded.

Non-Storm Discharges

Plans shall include a certification that the discharge has been tested for the presence of non-storm water discharges. The certification shall include a description of the results of any test for the presence of non-storm water discharges, the method used, the date of any testing, and the on-site drainage points that were directly observed during the test. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution plan shall indicate why the certification required by this part was not feasible.

b. Special Requirements for Storm Water Discharges Associated with Industrial Activity from Facilities Subject to SARA Title III, Section 313 Requirements

The Superfund Amendments and Reauthorization Act (SARA) of 1986 resulted in the enactment of Title III of SARA, the Emergency Planning and Community-Right-to-Know Act. Section 313 of Title III of SARA requires operators of certain facilities that manufacture, import, process, or otherwise use listed toxic chemicals to report annually their releases of those chemicals to any environmental media. Listed toxic chemicals include 329 chemicals listed at 40 CFR 372.

Facilities that meet all of the following criteria for a calendar year are subject to Title III reporting requirements for that calendar year and must report under 40 CFR 372.30:

- o The facility has 10 or more full-time employees;
- o The facility is a multi-establishment complex where all establishments have a primary SIC code of 20 through 39;
- o The facility is a multi-establishment complex in which one of the following is true:
  - The sum of the value of products shipped and/or produced from those establishments that have a primary SIC code of 20 through 39 is greater than 50 percent of the total value of all products shipped and/or produced from all establishments at the facility;
  - One establishment has a primary SIC code of 20 through 39 and contributes more in terms of value of products shipped and/or produced than any other establishment within the facility;
- o The facility manufactured (including imported), processed, or otherwise used a toxic chemical in excess of an applicable threshold quantity of that chemical set forth in 40 CFR 372.25.

After 1989, the threshold quantity of listed chemicals that the facility must manufacture, import or process in order to be required to submit a release report is 25,000 pounds per year. The threshold for a use other than manufacturing, importing or processing of listed toxic chemicals is 10,000 pounds per year. EPA estimates that 35,000 facilities nationwide will be subject to SARA Title III reporting requirements after 1990. EPA promulgated a final regulation clarifying these reporting requirements on February 16, 1988 (53 FR 4500). EPA believes that the information received through reporting is a "front end" of the toxics program to which EPA is already committed and ultimately will assist in better controls for routine toxics releases and improved industrial practices to prevent and respond to accidents involving toxics.

Of the 329 toxic chemicals listed at 40 CFR 372 which are used to define the scope of SARA Title III, Section 313 requirements, the Agency has identified approximately 175 chemicals which it is classifying, for the purposes of these general permits, as 'Section 313 water priority chemicals'. For the purposes of these general permits, "Section 313 water priority chemicals' are defined as chemicals or chemical categories which also: 1) are listed at 40 CFR 372.65 pursuant to SARA Title, Section 313; 2) are present at or above threshold levels at a facility subject to SARA Title III, Section 313 reporting requirements; and 3) that meet at least one of the following criteria: (i) are listed in Appendix D of 40 CFR 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or (iii) are pollutants for which EPA has published an acute or a chronic toxicity criteria.

The large amounts of toxic chemicals at facilities with Section 313 water priority chemicals raises concerns regarding the potential of material handling and storage operations to add pollutants to storm water discharges associated with industrial activity. The material management practices associated with the storage and use of toxic chemicals is a major potential source of pollutants in storm water discharges associated with industrial activity. The Agency believes that the threshold criteria established in SARA Title III, Section 313, along with the regulatory definition of storm water discharge associated with industrial activity, identify potential risks in a manner that is appropriate for use in developing priorities for establishing the applicability of specialized monitoring and pollution prevention measures for facilities which use and manage toxic chemicals.

In evaluating risks and establishing regulatory priorities for facilities with storm water discharges associated with industrial activity, the Agency believes that the large amounts of toxic chemicals found at facilities with Section 313 water priority chemicals pose sufficient risk to warrant specific permit conditions establishing: 1) containment-oriented requirements for areas of the facility used for material management of these chemicals; and 2) acute whole effluent toxicity (WET) monitoring requirements and associated limits for storm water associated with industrial activity discharged from the containment areas. (Any untreated overflow from containment facilities designed, constructed and operated to treat the volume of runoff associated with a 25 year, 24 hour rainfall event is not subject to the WET effluent limitation).

Under the draft general permits, facilities with Section 313 water priority chemical storage facilities which are exposed to storm water discharges are subject to specialized containment provisions and the WET effluent limitation.

The draft general permits provide that storm water pollution prevention plans for facilities with Section 313 water priority chemicals must, in addition to the requirements associated with the baseline pollution prevention plans, provide for containment-oriented controls[11]. Containment involves the use of physical structures or collection/drainage equipment used to confine a release of material after it escapes from its physical location or containment. Dikes surrounding material storage tanks are the most common example of containment. The containment-oriented provision of these general permits are designed to mitigate the discharge of toxic chemicals to waters of the United States from both significant spill events and from more routine material management practices and leaks.

EPA believes that tank systems for storage of liquid toxic chemicals and truck and rail transfer facilities for liquid toxic chemicals can present a significant risk, if basic accepted engineering practices are not employeed. EPA has concluded on the basis of studies, information from other governmental sources, and supporting information on various rulemakings that many tank systems have leaked and that other are likely to leak in the future[12].

The containment-oriented control requirements only apply to priority areas of facilities with Section 313 water priority chemicals (e.g. portions of the facility where Section 313 water priority chemicals are stored or managed and which generate storm

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[11] The containment oriented provisions of these permits are based on a review of the 1979 survey of BMPs (see "NPDES Best Management Practice Guidance Document", U.S. EPA, December 1979, EPA-600/9-79-045); Oil pollution prevention requirements, including Spill Prevention, Control, and Countermeasure (SPCC) plan requirements at 40 CFR 122.12; "The Oil Spill Prevention, Control, and Countermeasures Program Task Force Report", EPA, May 1988; and the draft "Analysis of Implementing Permitting Activities for Storm Water Discharges Associated With Industrial Activity", EPA, 1991.

[12] For example, see July 14, 1986 (51 FR 25427).

water discharges associated with industrial activity[13]). In establishing the containment-oriented provisions of the draft general permits, the Agency has provided flexibility to allow facilities to use or modify appropriate existing containment approaches that facilities currently employ.

The evaluated a number of technical options for addressing releases of SARA Title III, Section 313 water priority chemicals. These options are summarized in Table 6-1.

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[13] It should be noted that many facilities which are subject to SARA Title III, Section 313 reporting requirements because they manage Section 313 water priority chemicals do not generate storm water discharges associated with industrial activity. The regulatory definition of 'storm water associated with industrial activity' (40 CFR 122.26(b)(14)(xi)) addresses facilities in all Standard Industrial Classification (SIC) codes between 20 and 39 (as well as additional classes of facilities). However, facilities under SIC codes 20, 21, 22, 23, 2424, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39 which are not otherwise addressed by in the regulatory definition only generate storm water associated with industrial activity where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. Such facilities which do not generate storm water discharges associated with industrial activity are not subject to these permits.

TABLE 6-1
Summary of Control Techologies

Problem	Technology	Function	Ability to contain release prior to discharge
External corrosion	Cathodic protection	slows corrosion rate	No
	Coatings	slows corrosion rate	No
	Secondary containment	barrier against corrosive soils and collects releases	Maybe
Internal corrosion	Materials standards	slow corrosion	No
	Coatings	slow corrosion	No
	Liners	protective barrier	No
	Secondary containment	collects releases	Maybe
Leaks (Tanks and ancillary equipment)	leak detection	early warning	No
	visual inspection	early warning	No
	ground water monitoring	detection	No
	secondary containment with monitoring	early warning, detection and contain.	Yes
Loss of structural integrity	design standards	proper design	No
	quality audit	eliminate flaws	No
	installation standards	proper installation	No
	secondary containment	early warning, detecection and containm.	Yes
Overfill	protective controls	prevent overfill	No
	secondary containment	early warning and containment	Yes
Operator error	operator procedures and training	reduce errors	No
	secondary containment	early warning and containment	Yes

The draft permit provides permittees the opportunity to submit to the Director of the NPDES program a proposed alternative spill contingency and integrity testing plan if the operator believes that the containment provisions of the permit are not economically practicable. Where the Director of the NPDES program approves of an alternative plan, the provisions of the alternative plan serve in lieu of secondary containment requirements in the permit.

Proposed alternative spill contingency and integrity testing plans must provide a detailed description that shows that such requirements are not economically practicable. At a minimum, such description of economically impracticability should address the estimated costs of implementing the containment provisions of the permit, and any other impacts on the processes of the facilities associated with implementing the containment provisions of the permit. In addition, proposed alternative plans must provide for conducting integrity testing of storage tanks at least once every five years, conducting integrity and leak testing of valves and piping a minimum every year, establish site-specific contingency measures, and a written commitment of manpower, equipment and materials required to respond expeditiously to any release.

The storm water pollution prevention plans at facilities with Section 313 water priority chemicals and with storm water discharges associated with industrial activity must be reviewed and certified by a Registered Professional Engineer. With the certification, the Engineer must attest that: the Engineer has visited and examined the facility and is familiar with the provisions of this part; the plan has been prepared in accordance with good engineering practice; and the plan is adequate for the facility. Such certifications will in no way relieve the owner or operator of a facility covered by the plan of their duty to prepare and fully implement such a plan.

The containment-oriented provision of these general permits are designed to mitigate the discharge of toxic chemicals to waters of the United States from both significant spill events and from more routine material management practices and leaks.

Storm water collected in containment areas can pick up significant levels of pollutants where material management practices result in leaks, spills or other exposure to chemicals. Rather than attempt to establish specific numeric limits and multiple monitoring requirements for each pollutant subject to Section 313, the Agency believes that it is more appropriate and potentially cost effective to establish a single acute whole effluent toxicity limit and monitoring requirement for these discharges. This approach is consistent with the Agency's policy of limiting whole-effluent toxicity where generic effluent toxicity is caused by multiple chemical toxicants intermingled in an effluent.[14] For this reason, the draft general permits would establish an acute whole-effluent toxicity effluent limit for storm water discharged from containment structures at these facilities applied as a technology-based performance standard.

Toxicity monitoring and WET limits have been used in the NPDES program to address a wide range of discharges, including intermittent discharges. The workgroup has considerable experience in writing toxicity limitations. The Agency has evaluated a number of permits with toxicity limits for intermittant sources in developing these toxicity limit in the draft permit[15]. Applying numeric or toxicity limits on a technology-basis to intermittent discharges such as storm water protects against periodic releases of high levels of pollutants. Establishing limits for intermittent discharges is consistent with the approach taken in the NPDES program which does not allow for periodic exceedances of limits by continuous discharges.

Using the chemical specific approach to limiting pollutant discharges has kept significant amounts of toxic compounds out of surface waters. However, over time, it has become apprarent that a chemical-specific approach, by itself, cannot adequately protect all surface waters because many toxic compounds cannot be measured by available detection methods. In addition, toxicological data are unavailable for thousands of toxic compounds that are routinely discharged to surface waters. Finally, data on the effects of individual compounds do not account for the interactions among pollutants that may occur in complex mixtures of toxicants[16].

The Agency anticipates that most rainfall is not toxic prior to contact with surfaces or structures. (Note that the test EPA uses to characterize toxicity involves neutralizing the sample prior to testing, so that the effects of acidity are not measured). Where storm water discharges exhibit toxicity, it is anticipated that the toxicity is associated with chemical toxicants picked up from runoff surfaces. The Agency anticipates

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[14] "Permit Writer's Guide to Water Quality-Based Permitting for Toxic Pollutants," EPA Office of Water (EPA 440/4-87-005), July 1987.

[15] For example, see TX0074438, TX0091855, LA0000493, TX0103292, LA0004090, and TX0073954.

[16] "Biological testing to control toxic water pollutants", Wall, T.M., Hanmer, R.W., Journal WPCF, Volume 59, Number 1, page 7.

that most storm water discharges from these areas at well-maintained facilities with good housekeeping practices will not exhibit acute toxicity. For the majority of storm water discharges that do exhibit acute toxicity, the toxicity can be reduced by improving storage or material handling procedures, practices or equipment[17].

Since these discharges are generated from limited-sized, specific storage and material handling areas, a wide range of technologies are available to reduce the toxicity of the limited volume of storm water that is subject to the WET effluent limitation. Other classes of discharges may require various types of end-of-pipe treatment or various offsite disposal options such as discharging to a POTW.

The draft general permits provide that any untreated overflow from containment facilities designed, constructed and operated to treat the volume of runoff associated with a 24 hour, 25 year rainfall event is not subject to the WET limitation.

In developing the WET limitation, the Agency has also evaluated a number of other regulatory standards for discharges from storage tanks. The Occupational Safety and Health Adminstration (OSHA) has implemented general safety and health regulations for flammable and combustible liquids that require sutitable drainage or diking for area surrounding tanks. These regulations are intended to "prevent accidental discharge of liquid from endangering adjoing property or reaching waterways (29 ?CFR 1910.106). SPCC plan requirements for oil facilties establish the standard of preventing the "discharge [of] oil in harful quantities . . . into or upon the navigable waters of the United States". The National Fire Protection Association code 30 requires that "where provision is made for draing water from diked area, such drains shall be controlled . . . so as to prevent flammable or combustible liquids from entering natural water courses, public sewers, or public drains, if thier presence would constitute a hazard".

c. Special Requirements for Storm Water Discharges Associated with Industrial Activity from Salt Storage facilities

Salt is readily dissolved by precipitation. The Salt Institute highly recommends that salt stockpiles, whether large or small, should never be left exposed to the elements-rain or snow. A permanent under-roof storage facility is best for protecting salt. If this is not possible, then outside piles should be build on impermeable bituminous pads and covered with

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[17] "Biological testing to control toxic water pollutants", Wall, T.M., Hanmer, R.W., Journal WPCF, Volume 59, Number 1, page 7.

one of the many types of temporary covering materials, such as tarpaulin, polyethylene, poly urethane, polypropylenes or Hypalon. These materials are also available with reinforcement for added strength. (see "The Salt Storage Handbook", Salt Institute, 1987). Storage facilities will result in reductions of lost product and easier handling of materials (and thus reduced labor costs) which will offset the cost of the storage.

In 1991, EPA surveyed the Department of Transportation in NH, SD, ME, MA, and ID regarding the use of salt storage facilities. In Maine, all DOT salt piles are covered by buildings, and 25 of 130 mixed salt-sand piles are covered by buildings, but DOT was in the process of covering the remaining mixed salt/sand piles. MA DOT indicated that 98% of its salt piles were covered. The remaining 2 percent of the salt piles are not covered because they are located on privately-owned land which is not accessible to the State government for construction. Idaho DOT uses a mixture of salt and aggregate material, with a low concentration of salt for snow and ice maintenance activities and estimated that 15% of these piles of this mixture piles are covered.

Based on a consideration of current industry practices, the draft permits provide that storm water pollution prevention plans for facilities with storage piles of salt used for deicing or other commercial or industrial purposes must, in addition to the requirements associated with the baseline pollution prevention plans, enclose or cover their salt storage to prevent exposure to precipitation. Proper storage of salt, either under roof or by covering outside stockpiles, can assist in the protection of the environment as well protect the salt supply and ease the handling of salt[18]. The Agency believes that this requirement is appropriate as salt storage is an accepted and recommended practice by industries and municipalities (see "The Salt Storage Handbook", Salt Institute, 1987).

d. Special Requirements for Contaminated Storm Water Discharges Associated with Industrial Activity from Oil and Gas Production or Exploration Facilities

Information from sources such as nonpoint source assessments developed pursuant to Section 319(a) of the CWA indicate that significant water quality impacts can be caused by wet-weather failure of on-site waste disposal systems at oil and gas exploration and production operations (such as storm induced overflows of reserve pits used to hold spent drilling muds and cuttings). These draft general permits contain two provisions to address these events. First, where an operator of a contaminated

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[18] See "Salt Storage", and "The Salt Storage Handbook", Salt Institute, Alexandria, VA, 1987.

storm water discharge associated with industrial activity from an oil and gas production or exploration operation selects to obtain a Professional Engineer (PE) certification instead of conducting annual sampling, the PE certification must attest that reserve pits used to hold spent drilling muds or cuttings have been designed and built to prevent storm induced overflows. Second, pollution prevention plans for oil and gas exploration or production operations are to include a schedule for qualified personnel to inspect any reserve pit used to hold spent drilling muds and cuttings at least once every thirty calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period to evaluate the potential of storm enduced overflows.

The draft permits provide that pollution prevention plans for oil and gas production or exploration operations include a schedule for qualified personnel to inspect any reserve pit used to hold spent drilling muds and cuttings at least once every thirty calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period to evaluate the potential of storm enduced overflows.

e. Special Requirements for Storm Water Discharges Associated with Industrial Activity through Large and Medium Municipal Separate Storm Sewer Systems

Facilities covered by these permits must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge of the municipal separate storm sewer system that receives the facility's discharge, provided the discharger has been notified of such conditions. Permits for discharges from large and medium municipal separate storm sewer systems will typically require municipal permittees to develop storm water management programs which address storm water associated with industrial activity which discharges through their system.

f. Special Requirements for Storm Water Discharges Associated with Industrial Activity composed of Coal Pile Runoff

The draft general permits establish effluent limitations of 50 mg/l total suspended solids (TSS) and a pH range of 6 to 9 for storm water discharges associated with industrial activity composed of coal pile runoff. This effluent limitation is similar to the effluent guideline limitation for coal pile runoff from facilities in the steam electric power generating point source category (see 40 CFR 423.12(b)(9)). EPA believes that, with the exception of pile size, the operation of coal piles by the steam electric industry is similar to the operation of coal piles by other facilities with storm water discharges associated with industrial activity. The most significant feature distinguishing coal pile operation is the size of the pile. The

Agency believes that the technologies for addressing coal pile runoff, and the costs of implementing those technologies are similar regardless of the type of industrial facility operating the pile. For these reasons, the Agency believes that the effluent limitations for coal pile runoff should be the same for all facilities covered by the permit and should be equivalent the effluent guideline limitation for coal pile runoff from facilities in the steam electric power generating point source category.

The limitation does not apply to any untreated overflow from facilities designed, constructed and operated to treat the volume of coal pile runoff which is associated with a 25 year, 24 hour rainfall event. The effluent limitations guidelines for coal pile runoff from facilities in the steam electric power generating point source category at 40 CFR 423.12(b)(9) incorporates a 10 year, 24 hour design storm into a best practicable control technology currently available (BPT) limit. BCT and BAT effluent limitation guidelines for coal pile runoff are currently reserved. The Agency believes that the appropriate design storm for coal pile runoff addressed by these permits is the more stringent 25 year, 24 hour design storm as these permits establish BAT/BCT limits (which are typically more stringent than BPT limits), and the 25 year, 24 hour storm is more commonly used in effluent guideline limitations based on the BAT or BCT standards.

Design Storms

Several provisions of the draft general permit incorporate design storms. These provisions include: sediment pond requirements for certain construction activities; effluent limitations for coal pile runoff; and effluent limitations and containment requirements for SARA Title III, Section 313 facilities. Design storms are used for technology-based requirements to allow a facility to size any control structures necessary to meet a specified limitation. In general, the larger the design storm, the larger the capacity of storage or control necessary to meet a requirement, thereby raising the costs of compliance.

Without design storms, the discharger would face uncertainty in designing the volume of controls, and would have to arbitrarily select a rare event on which to develop a design. In some cases, limited historic rainfall data exists, making it impracticable to estimate extremenly rare storm events such as a 100 year or 200 year storm event, again creating uncertaintly for control designers, and possibly resulting in the development of extremely large volume controls where the entire design volume is never used.

To avoid this uncertainty and provide dischargers with an appropriate opportunity to comply with permit conditions, a number of alternatives for design storms have been evaluated, including the following storm events:

- o 24-hour, 100-year storm;
- o 24-hour, 25-year storm;
- o 24-hour, 10-year storm;
- o 24-hour, 2-year storm;
- o 1 inch storm; and
- o 1/2 inch storm.

The average intesity of storm events can vary significantly in different parts of the country. A desing storm based on a return period accounts for this regional variablility. In general, the design of drainage systems (e.g. water volume control systems) will vary in different parts of the country to accomadate the rainfall characteristics of that part of the country. Use of a design storm based on a return period will allow the coordination of the development of storm water quality measures with storm water quantity controls.

Peak discharge control is often required as a flood control measure for one or more design storm under local regulations for new development (including residential and commercial development)[19]. The most common used design storm used for this purpose is the 2 year storm storm. In natural watersheds in many eastern parts of the United States, the two year storm produces a flood that fills a stream to the top of its banks. The 2 year storm creates an erosive condition in these channels. Some jurisdictions also require control of the 10 or 100 year design storm.

EPA has selected the 24 hour, 25 year storm for use for BAT controls in these draft general permits. The 24 hour, 25 year rainfall event is the most commonly used design storm for BAT national effluent limitations guidelines which address storm water. The 24 hour, 25 year rainfall event provides a reasonable margin of safety when sizing secondary containment units[20]. A design capacity for a 24 hour, 25 year rainfall is fairly consistant with other regulatory programs for tank containment. For example, SPCC requirements require containment structures to be based on 110% capacity of the largest tank. The SPCC requirement will be more stringent in cases such as where the containment area for a 30 foot tank is twice the area of the

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[19] "Controlling Urban Runoff: A practical manual for planning and designing urban BMPs", July, 1987, Metropolitan Washington Council of Governments.

[20] "NPDES Best Management Practices Guidance Document", EPA, 1979, (EPA-600/9-79-045).

tank, and the area has a 24 hour, 25 year storm of 10 inches.

EPA has selected the 24 hour, 10 year storm for use as a BCT control of sediment basins for construction activities which discharge from an area which disturbs more than 10 acres. The sediment basins focus primarily on the control of sediment from construction sites, and hence a BCT control is appropriate. The control is limited to larger sites (those with a discharge serving more than 10 acres) because such sites will generally have more flexiblity in selecting an appropriate location for the basins.

MONITORING REQUIREMENTS

The Agency considered a number of factors, including those listed below, in developing monitoring requirements

- o Discharge variablility;
- o Environmental significance and nature of the pollutant or pollutant parameter;
- o cost of monitoring relative to the discharger's capabilities and benefit obtained; and
- o Support of future permitting activities.

Impacts on Small Businesses

The general permits are not expected to have a significant economic impact on a substantial number of small businesses. The baseline general permit requirements provide considerable flexibility

Although the construction industry involves many small businesses, the large majority of small businesses represent trades associated with subcontractors. The general permit generally does not directly impact such businesses, with most compliance costs ultimately being paid by developers. Small developments under 5 acres are excluded from the regulatory definition of storm water discharge associated with industrial activity.

The costs of requirements for those construction activities covered by the permit generally are directly related to size of construction operation, with larger sites incurring larger costs. Generally, the most expensive control, sediment basins, is limited to larger sites (those with a discharge serving more than 10 acres).

7. COST ESTIMATES

a. Pollution prevention plan implementation

Storm water pollution prevention plans for the majority of facilities will address relatively low cost baseline controls for the majority of industrial facilities. EPA's analysis of storm water pollution prevention plans indicates that the cost of developing and implementing the costs of these plans is variable and will depend on a number of factors, including: the size of the facility, number of employees, chemicals stored or used at a facility, the nature of the plant operations and plant designs and the housekeeping measures employed. Table 7-1 provides estimates of the range of costs of preparing and implementing a storm water pollution prevention plan. It is expected that the low cost estimates provided in Table 7-1 is appropriate for the majority of smaller facilities. High cost estimates are also provided.

b. SARA Title III Facilities

Table 6-2 provides estimates of the range of costs of preparing and implementing a storm water pollution prevention plan for facilities which are subject to the special requirements for facilities subject to SARA Title III Section 313 reporting requirements for chemicals which are classified as 'Section 313 water priority chemicals'. EPA anticipates that the majority of facilities are expected to have existing spill prevention and containment systems that will meet the majority of the requirements of these permits.

High cost estimates correspond to facilities that are expected to be required to undertake some actions to upgrade existing spill prevention and containment systems to meet the requirements of these permits. Costs associated with meeting the toxicity limit of these permits are based on an assumption that the toxicity of discharge can be reduced by: modifying material handling practices; by modifying existing storage equipment to eliminate leaks and other sources of chemical exposure; or by discharging waters collected by a containment system to a POTW. Costs of treatment where the facility does not have existing treatment capacity or off site disposal is typically expected to be higher.

Some facilities are expected to have more than one tanks or other unit operation which uses SARA Title III, Section 313 water priority chemicals. In these cases, the costs per unit operation is expected to be lowered, because some measures, such as containment units, can be consolidated to address more than one unit.

TABLE 7-1
SUMMARY OF ESTIMATED COSTS FOR COMPLIANCE WITH STORM WATER POLLUTION PREVENTION PLANS WITH BASELINE REQUIREMENTS

Control Measure	Costs in 1988 dollars Minimum fixed	Minimum annual	Maximum fixed	Maximum annual
Plan Preparation (Annualized Costs[1])	2,000	-	75,000	19,650
Plan Revisions (Annualized Costs[2])	200	-	7,500	1,965
Material Inventory/ Risk Assessment	-	90	-	640
Spill prevention/response Procedures	-	90	-	700
Employee Training	-	100	-	1,115
Visual Inspections	-	100	-	1,025
Preventive Maintenance/ Housekeeping	-	-	-	4,160
Storm Water Management	-	-	5,000	500
Sediment and Erosion Prevention	-	100	500	1,000
Recordkeeping	-	50	100	100
Non-storm water certification	200	-	14,000	-
Total Fixed cost[3]	2,400		102,100	
Total Annual Costs		530		30,855

This table identifies estimated minimum and maximum costs to develop and implement storm water pollution prevention plans.

Minimum costs of implementing program components are zero where existing programs, procedures or security is assumed adequate.

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[1] Annualized cost based upon a 5 year permit and 10% discount rate.

[2] Annualized cost based upon a 5 year permit and 10% discount rate.

[3] Total costs only address situation where storm water pollution plan needs to be developed and not the lower cost situation where a plan is existing and needs revision.

TABLE 7-2
SUMMARY OF ESTIMATED COST PER UNIT OPERATION FOR COMPLIANCE WITH STORM WATER POLLUTION PREVENTION PLANS FOR FACILITIES SUBJECT TO SECTION 313 OF SARA TITLE III WITH WATER PRIORITY CHEMICALS

Control Measure	Costs in 1988 dollars			
	Minimum		Maximum	
	fixed	annual	fixed	annual
Liquid Storage Curbing (Annualized Costs)	0	-	1,120	-
Raw Material Storage Tarpaulin (Annualized Costs)	0	0	400	160
Runon Diversion Trench (Annualized-costs)	0	0	1,100	250
Collection System	0	0	15,000	3,000
Toxicity Reduction Evaluation/Remediation	0	0	25,000	500
Total Fixed Costs	0		42,620	
Total Annual Costs		0		3,910

In addition to the costs shown, containment may result in substantial savings over the long-term by reducing clean-up and corrective action costs.

Verification of Spill Prevention/Containment Costs

The costs of the spill prevention and containment requirements were compared with several other models for containment controls to ensure accuracy and reasonableness. Containment requirements can take a number of forms. Two models were analyzed, the SPCC model for containment and the RCRA Subtitle C model for hazardous waste tanks.

Containment requirements: SPCC Model

40 CFR 112 establishes pollution prevention requirements, including requirements for Spill Prevention Control and Countermeasure (SPCC) plans for certain facilities which store or handle oil. The requirements associated with 40 CFR 112 are similar to the requirements in the NPDES draft general permits for spill prevention and containment measures at SARA Title III, Section 313 facilities. Costs associated with SPCC plan requirements under 40 CFR 112 where evaluated from a number of sources, including (1) "Economic Impact Analysis of Proposed Revisions to the Oil Pollution Prevention Regulation (40 CFR 112), EPA, draft January 1991, (2) "Supplemental Cost/Benefit Analysis of the Proposed Revisions to the Oil Pollution Prevention Regulation", EPA, May 1991; and data provided by the American Petroleum Institute (API).

The SPCC requirements apply to over 250,000 on-shore facilities and 187,000 offshore facilities with significant amounts of oil. On-shore facilities can be described in term of four sectors: 1) production (246,000 facilities with 572,620 tanks); 2) marketing (11,305 facilities with 88,529 tanks); refining (207 facilities 88,529 tanks); and transportation (2,132 facilities with 9,197 tanks). The transportation sector addresses pipeline facilities (also regulated under 49 CFR Part 195). In general, facilities in the transportation sector where not addressed in this analysis, since, in general, the NPDES general permits requirements for SARA Title III, Section 313 facilities, in general, do not apply to similar types of facilities or practices.

Cost data from the "Supplemental Cost/Benefit Analysis of the Proposed Revisions to the Oil Pollution Prevention Regulation", EPA, May 1991 and data on the number of tanks per facility from API data were used to generate the estimated costs of compliance with spill prevention and containment requirements found shown in Table 7-3. Estimated compliance costs per facility or per unit operation is expected to vary based on the number and size of the tanks.

These cost estimates were compared to cost proposals provided by SPCC for the installation of secondary containment for two tank systems. The first tank system was a 1,000,000 gallon steel tank which was 44 feet high and 66 feet in diameter. The cost of installing a 6.5 foot berm (which included 6 inches freeboard) was $74,694. This included costs for gravel ($30,607), pavement ($23,140), a dual drainage system ($6,000), and engineering ($14,939). The second tank system was a 100,000 gallon steel tank which was 27 feet high and had a diameter of 24 feet. The cost of installing a 5 feet berm (which includes 6 inches freeboard) was $17,495. This included costs for gravel ($7,222), pavement ($3,773), drainage ($3,000) and engineering ($3,500).

TABLE 7-3
SUMMARY OF ESTIMATED COST PER UNIT OPERATION FOR COMPLIANCE WITH SPCC REQUIREMENTS FOR OIL FACILITIES

Control Measure	Costs in 1991 dollars First Year Cost	Subsequent Year Cost
Drainage System for Tank Truck Loading/ Unloading areas	$50,000	$100
Valves for drainage from diked areas (per diked area)	$500-$1,000	$40-$70
Drainage system from undiked areas	$2,000-$69,000	small
Secondary containment for Bulk Storage Tanks	$430-$820	small

Containment requirements: Hazardous waste tanks

The RCRA Subtitle C requirements for hazardous wastes is a more stringent model of control than the SPCC approach. The RCRA model requires the use of double-walled tanks, double-walled pipe, corrosion protection and a lined concrete pad and curbing beneath. EPA analyzed costs of the RCRA hazardous waste tank requirements as part of the process of developing regulations for such units (July 14, 1986, (51 FR 23466), and see "Cost Analysis of RCRA Regulations for Hazardous Waste Tank Facilities and Economic Impact Analysis of RCRA Regulations for Hazardous Waste Tank Facilities", EPA 1986). In that study, EPA estimated the capital cost of above ground facilities for small businesses to be $4,795, with a cumulative operation and maintenance cost of $966 for years 1 through 8 and a cumulative operation and maintenance cost of $1,200 for years 9 through 10. This amounts to an annualized costs of $1,661 before taxes, and $1,434 after taxes. The EPA estimated costs of RCRA requirements for above ground tanks is shown in Table 3-

Table 7-4 - Installed before Tax costs for new carbon steel above ground tank with full secondary containment

Size	Tank without secondary containment ($)			Tank with secondary containment ($)			Increm. cost of secondary containment ($)		
(gal)	initial	O&M	Annualiz.	initial	O&M	Annualiz.	initial	O&M	Annualiz.
275	690	0	100	1260	250	430	570	250	330
550	1480	0	210	2160	250	560	670	250	350
3000	7000	0	1000	10000	250	1600	3000	250	600
10000	14000	0	1400	20000	250	3100	6000	250	1700
125000	114000	0	16200	151000	250	21600	37000	250	5400
10000*	51000	0	7200	74000	250	10700	23000	250	3500

* consists of 4 tanks in an operation

Integrity testing and Leak detection

The number of possible compliance alternatives increases the difficulty of estimating an appropriate cost for integrity testing.

Buried pipe integrity testing is estimated to cost $155 per tank[4]. The estimated cost of a leak detector that is retrofitted is $465 per tank, based on equipment cost of $155 per tank and installation costs of $310 per tank to retrofit existing tanks.

Monitoring methods for underground storage tanks systems include automatic in-tank monitoring, monitoring for petroleum vapors in soil and groundwater monitoring.

c. Construction Sites.

The two major costs associated with pollution prevention plans for construction activities include the costs of sediment and erosion controls (see Table 7-5), and the costs of storm water management controls (see Table 7-6). The draft general permits provide flexibility in developing controls for construction activities. Typically, most construction sites will employ several types of sediment and erosion controls and storm water management controls, but not all of the controls listed in Tables 7-5 and 7-6. In general, sites which disturb a larger area will incur higher pollution prevention costs.

For construction sites greater than 10 acres, the most significant costs are generally expected to be those associated with plan preparation sediment basins, outlet stabilization, temporary stabilization, and permanent stabilization. For smaller sites, the most significant costs are generally expected to be those associated with outlet stabilization, temporary stabilization, and permanent stabilization.

Table 7-7 provides estimates of the costs for several model construction sites. The data in this table indicates that costs can vary even at similarly sized sites. The data also indicates that costs can be dramatically reduced by good site planning (e.g. Sites A and C) where fingerprinting and vegetation preservation can reduce the total area disturbed and the area where temporary vegetative practices are necessary. In addition, good planning can reduce the costs of storm water management devices. In most cases, some costs, such as the costs of permanent stabilization typically increases the value of the site.

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[4] U.S. EPA, Regulatory Impact Analysis of Technical Standards for Underground Storage Tanks, Volume 5, 8/24/88, p. 6-18.

TABLE 7-5 Sediment and Erosion Control Costs

Vegetative Practices	
temporary seeding	$1.00 per square yard
permanent seeding	$1.00 per square yard
mulching	$1.25 per square yard
sod stabilization	$4.00 per square yard
vegetative buffer strips	$1.00 per square yard
protection of trees	$30.00 to $200 per tree set
earth dikes	$5.50 per linear foot
straw bale dikes	$5.00 per linear foot
silt fences	$6.00 per linear foot
brush barriers	
drainage swales-grass	$3.00 per square yard
drainage swales-sod	$4.00 per square yard
drainage swales-riprap	$45.00 per square yard
drainage swales-asphalt	$35.00 per square yard
drainage swales-concrete	$65.00 per square yard
check dams-rock	$100 per dam
check dams-covered straw bales	$50 per dam
level spreader-earthen	$4.00 per square yard
level spreader-concrete	$65.00 per square yard
subsurface drain	$2.25 per linear foot
Pipe slope drain	$5.00 per linear foot
Temporary storm drain diversion	variable
storm drain inlet protection	$300 per inlet
rock outlet protection	$45 per square yard
sediment traps	$500 to $7,000 per trap
temporary sediment basins.	$5,000 to $50,000 per basin
sump pit	$500 to $7,000
Entrance stabilization	$1,500 to $5,000 per entrance
Entrance wash rack	$2,000 per rack
Temporary waterway crossing	$500 to $1,500
Wind breaks	$2.50 per linear foot

Practices such as sod stabilization and tree protection increase property values and satisfy consumer aesthetic needs.

Table 7-6 - Costs of Storm Water Management for Construction Sites

	Cost for 5 Acre Developed Area	Cost for 20 Acre Developed Area
Wet Ponds	$5,770	$16,300
Dry Ponds	$12,000	$29,330
Dry Ponds with extended detention	$5,950	$15,500
Infiltration Trenches	$8,500	$34,100

Estimates based on methodology presented in "Cost of Urban Runoff Quality Controls", Wiegand, C., Schueler, T., Chittenden, W., and Jellick, D., Urban Runoff Quality-Impact and Quality Enhancement Technology, Proceedings of an Engineering Foundation Conference, ASCE, 1986, edited by B. Urbonas and L.A. Roesner.

TABLE 7-7 ESTIMATED COSTS FOR MODEL SITES

Parameters For Model Sites

	Site Size (acres)	Area Disturb. 7 days (acres)	Site Entrances	Downgrad. Perimeter (feet)	Pervious area of finished site (acres)
Site A	9	5	1	950	1
Site B	9	9	1	1,250	4
Site C	20	10	2	1,500	2
Site D	20	20	2	1,900	7

Estimated Site Costs in Dollars

Control	Site A	Site B	Site C	Site D
temporary seeding	4,840	24,200	14,520	48,400
permanent seeding	4,840	19,360	9,680	33,400
entrance stabiliz.	3,000	3,000	5,000	5,000
entrance wash rack	-	-	2,000	2,000
sediment trap	-	-	25,000	35,000
silt fences	6,000	6,000	-	-
storm water management devices	6,000	7,000	5,000*	10,000*
tree protection	250	-	400	-
rock outlet prot.	2,250	2,250	4,500	5,500
pipe slope drain	-	-	500	-
Site Cost	27,180	61,810	66,600	139,780
Per Acre Cost	3,020	6,850	3,330	6,989

* Assumes conversion of sediment basin to storm water management pond

d. Oil and Gas Production or Exploration Operations

Facilities with contaminated storm water discharges associated with industrial activity, in addition to the baseline requirements for storm water pollution prevention plans, are required to conduct inspections of reserve pits used to hold spent drilling muds or cuttings which is estimated to have an annual cost of $800. Not all oil and gas exploration or production facilities are expected to have such structures, and hence this additional cost is not applicable.

e. Salt Storage Facilities

Salt pile covers or tarpaulins are anticipated to have a fixed cost of $400 and an annual cost of $160 for medium sized piles, and a fixed cost of $4,000 and an annual cost of $2,000 for very large piles.

Representatives of the Department of Transportation in Maine, New Hampshire, South Dakota, and Massachusetts where surveyed in 1991 regarding the costs of building storage facilities for salt piles. Estimates from ME, NH, SD were:

- o small facilities (less than 1,000 cubic yards): $30,000-$50,000; $70-80/cubic yard;
- o medium facilities (between 1,000 and 2,500 cubic yards), $70,000, $20-30/cubic yard;
- o large facilities (5,000 cubic yards), $100,000, $18/cubic yard.

The Massachusetts DOT indicated that the cost to complete construction for a typical pole barn building for salt storage (40x84 feet) which can store between 1,400 and 1,500 tons of salt is estimated at $100,000. The cost to complete the typical dome facility (72 feet in diameter) which can store between 1,400 and 1,500 tons of salt is estimated at $85,000.

Maine DOT indicated that all salt piles operated by Maine DOT which are composed solely of salt compounds are currently covered by buildings, and 25 of 130 mixed salt-sand piles are covered by buildings, however the State is in the process of covering the remaining mixed salt-sand piles. South Dakota DOT indicated that all salt piles utilized by that agency are covered by buildings. MA DOT indicated that 98% of its salt piles are covered. Idaho DOT estimated that 15 percent of its salt-aggregate mixture piles are covered.

f. Coal Pile Runoff.

The effluent limitations for coal pile runoff in the draft permits can be achieved by two primary methods: by limiting exposure to coal by use of covers or tarpaulins; and by collecting and treating the runoff. In some cases, coal pile runoff may be in compliance with the effluent limitations without covering the pile or collecting or treating the runoff. In these cases, the operator of the discharge would not have a control cost.

The use of covers or tarpaulins to prevent or minimize exposure of the coal pile to storm water is generally expected to be practical only for relatively small piles. Coal pile covers or tarpaulins are anticipated to have a fixed cost of $400 and annual cost of $160.

Table 7-5 provides estimates of the cost of treating coal pile runoff[5]. These costs are based on a consideration of a treatment train requiring equalization, pH adjustment and settling, including the costs for impoundment (for equalization), a lime feed system and mixing tanks for pH adjustment, and a clarifier for settling. The costs for the impoundment area include diking and containment around each coal pile and associated sumps and pumps and piping from runoff areas to impoundment area. The costs for land are not included. The lime feed system employed for pH adjustment includes a storage silo, shaker, feeder, and lime slurry storage tank, instrumentation, electrical connections, piping and controls.

Additional costs may be incurred if a polymer system is needed. In such a case, costs would include impoundment for equalization, a lime feed system, mixing tank, and polymer feed system for chemical precipitation, a clarifier for settling and an acid feeder and mixing tank to readjust the pH within the range of 6 to 9. The equipment and system design, with the exception of the polymer feeder, acid feeder and final mixing tank, is essentially the same as shown in Table 7-5. Two tanks are required for a treatment train with a polymer system, one for precipitation and another for final pH adjustment with acid. The cost of mixing is therefore twice that shown in Table 7-5. The polymer feed system includes storage hoppers, chemical feeder, solution tanks, solution pumps, interconnecting piping, electrical connections and instrumentation. The costs of clarification is identical to that of Table 7-5. A treatment

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[5] It should be noted that the type and degree of treatment required to meet the effluent limitations of these permits will vary depending upon factors such as the amount of sulfur in the coal. This section describes a model treatment scheme for the purposes estimating costs for compliance with the proposed effluent limitations. Dischargers may implement other less expensive treatment approaches to enable them to discharge in accordance with these limits where appropriate.

train with a polymer system requires the use of an acid addition system to readjust the pH within the range of 6 to 9. The components of this system include a lined acid storage tank, two feed pumps, an acid pH control loop, and associated piping, electrical connections and instrumentation.

Additional information regarding the cost of these technologies can be found in: "Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category", ((EPA-440/182/029), November 1982, EPA).

TABLE 7-8
SUMMARY OF ESTIMATED COSTS FOR
TREATMENT OF COAL PILE RUNOFF

	30,000 cubic meter coal pile	1,200,000 cubic meter coal pile
IMPOUNDMENT		
Installed Capital Cost ($)	6,300	12,600
Operation and Maintenance ($/year)	negligible	negligible
LIME FEED SYSTEM		
Installed Capital Cost ($)	127,700	361,200
Operation and Maintenance ($/year)	5,300	16,100
Energy Requirements (kwh/yr)	3.6 x 10**4	3.6 x 10**4
Land Requirements (ft**2)	5,000	5,000
MIXING EQUIPMENT		
Installed Capital Cost ($)	60,500	107,500
Operation and Maintenance ($/year)	2,100	2,400
Energy Requirements (kwh/yr)	1.3 x 10**3	1.3 x 10**3
Land Requirements (ft**2)	2,000	2,000
CLARIFICATION		
Installed Capital Cost ($)	168,000	260,500
Operation and Maintenance ($/year)	3,000	3,800
Energy Requirements (kwh/yr)	1.3 x 10**3	1.3 x 10**3
Land Requirements (ft**2)	3,000	7,000

Source: "Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category", (EPA-440/182/029), November 1982, EPA). Costs estimates have been revised to account for inflation.

Appendix A

ANALYSIS OF THE CAUSES OF OIL SPILLS

INTRODUCTION

EPA identified several areas requiring further study to support the Phase Two SPCC proposed rule. Spill notification reports from the Emergency Response Notification System (ERNS), Accidental Release Inventory Program (ARIP) questionnaires, and case studies of past oil spills were reviewed and evaluated to gather the supporting data.

The Phase Two data collection effort provided the data to support the following elements of the Phase Two rulemaking:

- **Requirements for preparing and approving a facility-specific response plan.** The OPA requires that facility-specific response plans be prepared and that certain plans be approved by EPA. EPA has developed criteria for preparing a response plan, for determining when a facility must submit a response plan, and for identifying which plans must be reviewed.

- **Definition of a "worst case discharge."** Because response plans are required by the OPA to respond to a worst case discharge, data were collected to develop a definition of a worst case discharge.

- **Determining "significant and substantial harm."** Facilities whose discharges may cause substantial harm must submit their response plans to EPA. Of the submitted response plans, some must be approved by EPA. The Agency has prepared a framework for determining: 1) which plans must be submitted (i.e., what constitutes substantial harm); and 2) which plans should be reviewed (i.e., what constitutes significant and substantial harm).

- **Additional technical requirements.** Because the Phase Two rule will implement many of the remaining SPCC Task Force report[1] recommendations, data has been collected to determine the most effective oil pollution prevention measures. These proposed technical requirements address spills caused by human error, equipment failure, and other documented causes of spills.

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[1] The Oil Spill Prevention, Control, and Countermeasures Program Task Force Report, (EPA Interim Final Report), May 13, 1988.

METHODOLOGY FOR DATA COLLECTION

Described below are the steps used in collecting and analyzing the technical data to support each element of this rulemaking.

Obtain basic information from current EPA databases and from available reports. The information from this step provided the basis for the Agency's decisions regarding various technical issues, "worst case discharge," "substantial harm," and "significant and substantial harm." The ERNS database and the ARIP database were analyzed to obtain these data.

The ERNS database has been examined for information about causes of oil spills. Further examination of this database may also help EPA determine what types of facilities are most likely to have oil spills.

ARIP is a data collection system used to learn more about the causes and effects of accidental releases of hazardous materials from fixed facilities. Although the information gathered through this program is not necessarily from oil spills, a comparison of Standard Industrial Classification (SIC) codes indicates that approximately half of the facilities responding to questionnaires from this program are likely to be regulated by the SPCC program. EPA assumes that the causes of spills for hazardous materials are similar to the causes of oil spills.

Case Study Review. Case studies were gathered from *The Oil Spill Intelligence Reports, Golob's Oil Pollution Bulletin,* ERNS, spill conference proceedings, and conversations with On-Scene Coordinators (OSC) to support the rationale for selected regulatory options. **Discussed in Section 5.** Kevin, No Section 5

Application of "worst case discharge" and "significant and substantial harm." (may or may not happen) The "worst case discharge" and "significant and substantial harm" decision matrices were applied to selected case studies and existing facilities to validate the matrices. This test involved scoring a number of case study facilities using the matrices. Additionally, several facilities from various locations in the United States were scored. The scores for each facility were evaluated to determine how well the matrices predicted the need to review the specific response plan.

FACILITY SIZE VERSUS SPILL SIZE

Prior to gathering supporting data for the SPCC proposed rule, an effort to determine if facility size and/or tank capacity size is a reliable predictor of oil spill size was performed through a statistical analysis of the ERNS database. The data in the ERNS database provide oil spill information reported from SPCC-regulated facilities between 1988 through the middle of November 1990.

Formal statistical analysis of possible correlations between various database parameters is difficult because of inter-dependencies. There are three parameters of concern: spill size, tank capacity, and facility size. Clearly tank capacity can not exceed facility size, and in fact tank capacity is a component of facility size. Therefore, either tank capacity or facility size, but not both, should be used in any type of correlation analysis. Since tank size is a component of facility size and spills can involve more than one tank facility, size was chosen.

A linear regression analysis was performed on the data, with the null hypothesis that spill size is dependent upon, and in fact, can be predicted by, facility size. Because of the wide variation between facility sizes and spill sizes the data were log-transformed. The linear regression model equation is as follows:

$$S = Constant + A * X$$

where

S = Log Transformed Spill Size
A = Regression Coefficient
X = Log Transformed Facility Size

The **graph located below shows spill size plotted against facility size in log-scale. The calculated linear regression line is the straight line in the middle; the outer curved lines are the approximate 95th percentile confidence bound on the regression line. The plot shows a wide dispersion of data points around the regression line indicating that the simple linear regression does not adequately explain spill size.** The results of the regression are given in the tables on the following page.

The t-statistic and the associated probability level for Log(Facility) indicate that there is significant evidence that the regression coefficient is not zero, meaning that Log(Facility) has a significant effect upon Log(Spill) and that the two parameters are not independent of each other. Since there is a physical limitation on spill size because a spill can not exceed the size of the facility, the interpretation of the t-statistic for the regression coefficient for the constant is meaningless. From this information, the associated probability level indicates that facility size is a factor in the size of a spill.

The adjusted squared multiple r statistic for the regression is 0.121. The adjusted squared multiple r statistic is a measure of the proportion of the dependent variable's variation that is

ANALYSIS.VAR

Parameter	Coefficient	Standard Error	Standard Coefficient	T-Statistic	Prob. Level
Constant	2.541	0.976	0.000	2.604	0.011
Log(Facility)	0.313	0.090	0.363	3.489	0.001

ANALYSIS OF VARIANCE

Source	Sum of Squares	df	Mean Square	F-Ratio	Prob. Level
Regression	62.15	1	62.15	12.17	0.001
Residual	408.49	80	5.11		

removed after fitting the regression line. The adjusted squared multiple r statistic has a range of zero to one, where zero indicates that the regression line explains no portion of the dependent variable's variation and one indicates that the regression line explains all of the dependent variable's variation. In our case, 0.121 would indicated that only a small amount of the variation in the spill size data can be explained by facility size. This analysis suggests that although facility size is a significant factor in the size of reported spills, facility size alone is insufficient to predict likely spill sizes.

Exhibit 2

Frequency and Percentage of Oil Spill Causes from Fixed Facilities in ERNS 1989

Release Cause	Total Number of Reports	Percentage of Total
Unknown	1095	20.5
Ancillary Equipment[2] Failure	1082	20.3
Other Operator Error	531	10.0
Ancillary Equipment Leak	441	8.3
Overflow: Alarm/Mechanical Failure	426	7.98
Dumping[3]	364	6.8
Other[4]	200	3.75
Tank Leak/Seep/Bottom	188	3.5
Ancillary Equipment Corrosion	158	3.0
Underground Storage Tank Leak	157	2.9
Flooding	143	2.7
Overflow: Operator Error	99	1.9
Fire/Explosion/Lightning	85	1.6
Vandalism	72	1.3
Tank Rupture	60	1.1
Tank Replacement	46	0.9
Transformer	39	0.73
Other Natural Disaster	40	0.7
Pits/Settling Ponds	32	0.6
Electrical/Power Outage	24	0.4
Overflow: Truck Operator Error	24	0.4
Tank Corrosion	22	0.4
Hurricane	6	0.1
Secondary Containment: Failure	1	0.02
Secondary Containment: Overflow	1	0.02
Total	5,336	100

Source: ERNS Database

[2] Includes piping, valves, pumping, etc.

[3] Dumping refers to the willful, conscious dumping of oil for reasons that were unspecified.

[4] Includes causes not defined by other fields.

Exhibit 3

Frequency of Oil Spill Causes by Spill Size in ERNS 1989

	Spill Size Frequency					
Release Cause	< 10K	10-20K	20-50K	50-100K	> 100K	TOTAL
Tank Corrosion	21	0	1	0	0	22
Tank Leak/Seep/Bottom	182	1	3	1	1	188
Tank Rupture	55	1	2	0	2	60
Ancillary Equipment Failure	1,049	17	16	0	0	1,082
Ancillary Equipment Corrosion	156	0	0	1	1	158
Ancillary Equipment Leak	439	2	0	0	0	441
Dumping	363	1	0	0	0	364
Electrical/Power Outage	21	1	1	0	1	24
Fire/Explosion/Lightning	79	0	2	1	3	85
Flooding	143	0	0	0	0	143
Hurricane	5	0	0	0	1	6
Other Natural Disaster	40	0	0	0	0	40
Other Operator Error	522	4	3	1	1	531
Overflow/Alarm Mechanical Failure	411	4	6	3	2	426
Overflow: Operator Error	91	3	4	0	1	99
Overflow: Truck Operator Error	24	0	0	0	0	24
Secondary Containment: Failure	1	0	0	0	0	1
Secondary Containment: Overflow	1	0	0	0	0	1
Underground Storage Tank Leak	153	2	1	0	1	157
Unknown	1,086	5	4	0	0	1,095
Vandalism	69	1	1	1	0	72
Other	198	0	0	0	2	200
Pits/Settling Ponds	32	0	0	0	0	32
Transformer	39	0	0	0	0	39
Tank Replacement	46	0	0	0	0	46
Total	5,226	42	44	8	16	5,336

Source: ERNS database

ARIP

ARIP is a data collection system used to learn more about the causes and effects of accidental releases of hazardous materials from fixed facilities. The data gathered by the program also indicate what actions have been effective in preventing spills, and what actions could have been implemented to minimize the impacts of spills that had already occurred. ARIP is administered by EPA.

For ARIP, EPA developed a questionnaire that specifically addresses the causes of accidental releases; the questions focus on the practices facilities use to prevent releases, and on the methods they may employee to assess hazards. These questionnaires are sent to facilities that have experienced a release demonstrating one or more of the following criteria:

- the quantity released is in excess of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) reportable quantity (RQ) for the substance;
- the release results in deaths or injuries;
- the release indicates a trend of related releases from the same facility; and
- the release involves extremely hazardous substances as designated under the Emergency and Community Right-to-Know Act.

The fields found in the ARIP database track the individual questions that appear on the aforementioned survey. These include:

- facility-specific information (facility name, address, SIC code, etc.);
- the name(s) of the released substance(s);
- time of day of the release;
- location within the facility where the release occurred;
- cause of release;
- how the release was discovered;
- the quantity of each chemical into each medium (that is, the amount of a certain substance released to air, surface water, or land, etc.);

- any deaths or injuries caused by the release;
- what, if any, hazard assessments were performed; and
- what, if any management activities directly related to safety and loss prevention were performed.

Other fields are also included within the database, most having to do with less critical details of the release event and what activities are planned for the facility's future in terms of safety and spill prevention.

The ARIP database was used to evaluate the proposed Phase Two amendments to the Oil Pollution Prevention regulation. No critical data were deleted, but the questions requiring long responses were removed to accommodate space limitations. The database file initially contained 1454 records describing events from 1988 through 1990. Many of these records had completely blank fields, and many more were for facilities that are not subject to the SPCC regulations. The number of facilities found in the database with SIC codes and non-blank records that are affected by the proposed Oil Pollution Prevention regulation is 497. Although the ARIP database consists of spill quantity in pounds, the quantity was converted into gallons to be consistent throughout. This sample provided the data reported here.

To examine the characteristics of the spills contained in the ARIP database, the database files were manipulated in several ways. First, a matrix was developed to correlate release cause and release locations within a facility. Exhibit 4 presents a matrix correlating release causes and release locations. In this manner, specific problem areas in facilities can be highlighted. For example, if a high percentage of all spills occurring at valves on a storage vessel were a result of human error, this would be revealed in the matrix. This example might indicate that the manual manipulation of storage vessel valves is a critical area requiring additional attention during personnel training. A number of additional matrices were also developed to identify:

- spills occurring during certain hours (to determine the differences in spill characteristics between daytime and nighttime releases);
- spills occurring at facilities that did not employ certain safety-related management activities (to determine differences in the size of these spills and the size of all spills);

- spills occurring at facilities that did not perform certain hazard assessments (to determine differences in the size of these spills and the size of all spills); and

- spills occurring during different facility operations (such as during normal production/storage operation during maintenance operations, etc.)

Finally, some of the above criteria were examined more closely. For example, the environmental media that received the hazardous substances were determined and compared. Also, for all facilities that did not employ safety-related management activities for a release, a check was made on whether they did enact management activities at some later date. If a single facility experienced a release in the absence of safety-related activities, and then later experienced a release after certain activities had been implemented, the size and severity of the releases were compared. The same procedure was followed for releases occurring at facilities that did not perform hazard assessments, and then later experienced releases after such assessments were initiated.

Exhibit 5 offers a comparison of average spill sizes for releases occurring at different times of the day, and into different environmental media. The data show that daytime (defined as 6:00 AM to 6:00 PM) substance released onto land are roughly one third the size of those that occur into surface waters or sewers, and they occur about twice as often. At night, the quantity and frequency of both types of spills decrease. This information is contrary to the ERNS database which showed a larger number of spills affecting water than land. Under section 311 of the CWA, only certain oil discharges must be reported to ERNS. These are, if the discharge:

- causes a sheen to appear on the surface of the water;

- violates applicable water quality standards; or

- causes a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines.

Thus, unless the oil spill is in, or threatens, the waters of the U.S., it is not required to be reported through ERNS.

Exhibit 4

Release Cause and Locations within the Facility

RELEASE LOCATION	RELEASE CAUSE							
	Equipment Failure	Operator Error	Bypass Condition	Upset Condition	Fire	Maintenance Activity	Unknown	Other
Process vessel	44	22	1	20	0	4	2	2
Storage vessel	28	16	0	5	0	1	0	3
Valves on process vessel	23	14	0	8	0	2	0	4
Valves on storage vessel	23	10	0	2	1	0	1	0
Piping on process vessel	30	5	1	3	0	2	0	3
Piping on storage vessel	24	8	0	1	0	4	1	2
Pumps	11	3	0	1	0	0	0	1
Joints	21	3	0	0	0	2	0	0
Unknown	0	0	0	0	0	0	0	0
Other	39	21	3	9	2	4	2	6
Valve	12	9	0	4	0	1	0	1
Piping	15	3	0	1	0	1	0	2

Source: ARIP

Exhibit 5

Average Release Sizes: Daytime vs. Nighttime Spills

Average Spill Size in gallons

Release Medium	All Facilities; 497 Reports[5]	Daytime Spills; 310 Reports	Nighttime Spills 174 Reports
Primary Material on Land	6,684 (130 spills)	3,297 (86 spills)	2,726 (37 spills)
Secondary Material on Land	744 (17 spills)	1,004 (11 spills)	320 (1 spill)[6]
Primary Material in Surface Water	4,756 (30 spills)	6,172 (22 spills)	960 (5 spills)
Secondary Material in Surface Water	1,337 (5 spills)	1,750 (3 spills)	1,104 (1 spill)
Primary Material in Sewer	4,542 (42 spills)	2,935 (25 spills)	6,927 (17 spills)
Secondary Material in Sewer	1,182 (10 spills)	2,349 (5 spills)	14 (5 spills)

Source: ARIP

[5] Note that the total number of spills to land and surface water do not add up to the total number of respective reports. This is because some spills entered environmental media not listed on this table.

[6] Since there was only one nighttime spill of secondary materials, this number is not an average, but the individual spill size, and therefore not suitable for comparison.

Exhibit 6 shows an analysis of release frequency segregated by facility or SIC category. The number of releases within a specific range of SIC numbers indicates the relative threat of release that each type of industrial category imposes. As shown in the table, chemicals and allied products manufacturing spills are the most frequent, accounting for over 60% of all releases reported in this database. Other types of manufacturing, including oil refining and food manufacturing, account for 30% of the remaining releases.

Because such a high percentage of the facilities described by the ARIP database are involved in manufacturing (nearly 95%), a comparison was made between manufacturing facilities that do, and those that do not perform hazard assessments at least once a year. Examples of hazard assessments that facilities may perform are:

- cause-consequence analysis;
- Dow and Mond Hazard Indices;
- HAZOP/hazard and operability analysis;
- failure modes, effects, and criticality analysis; and
- what-if analyses.

Several other hazard assessment techniques are used, through not as frequently as those listed above. As shown in Exhibit 7, facilities that perform hazard assessments at least once a year manufacture comparable materials to facilities that perform hazard assessments less often that once a year. Of the 472 facilities classified as manufacturing, only 46 (9.7%) perform hazard assessments at least yearly. The average spill size (into water or on land) for these facilities is less than half of the average spill size for the other 426 facilities that do not perform yearly hazard assessments. While production and storage volumes vary greatly among facilities, the actual products that these two sets of facilities produce are very similar. Thus, the data provided in Exhibit 7 suggest that hazard assessments, when performed regularly, may play an important role in helping to reduce spill sizes.

Exhibit 8 shows the frequency and percentage of spill causes reported to ARIP for facilities with applicable SIC codes. Equipment failure and operator error account for more than 75% of all spills. Exhibit 9 presents the frequency of spill causes by spill size categories. More than 80% of the spills reported in ARIP involve discharges of less than 10,000 gallons. Equipment failure and operator error are listed as the spill cause of over 75% of spills under 10,000 gallons. Tabular representation of spill sizes sorted by spill cause are presented in Exhibit 10. The primary causes of spills in all size categories are equipment failure and operator error.

Exhibit 6

Release Frequency/Standard Industrial Code Category Analysis

Facility Category	Number of Releases	Percent of Total Releases
Chemicals and Allied Products Manufacturing	306	61.5
Other Manufacturing	75	15.1
Petroleum Refining and Related Industries	44	8.9
Food and Kindred Products Manufacturing	29	5.8
Primary Metal Industries	16	3.2
Electric Utility Plants	10	2.0
Trucking and Warehousing/Water Transportation	7	1.4
Farms	3	0.6
Oil Production	3	0.6
Stone, Clay, Glass and/or Concrete Manufacturing	2	0.4
Coal Mining/Nonmetallic Minerals Mining	1	0.2
Contract Construction	1	0.2
	497	100

Source: ARIP

Exhibit 7

Hazard Assessment Utilization Analysis

		Facilities that Perform Hazard Assessments at Least Once per Year	Facilities that do not Perform Hazard Assessments at Least Once per Year
Number of Facilities		49	448
Number of Facilities that are Classified as Manufacturing		46	426
Percentage of Facilities that are Clasified as Manufacturing		94%	95%
Manufacturing Category by Percentage	Food and Kindred Products	6.5%	6.1%
	Chemicals and Allied Products	78.3%	63.4%
	Petroleum Refining and Related Industries	4.3%	9.9%
	Stone, Clay, Glass, and Concrete	0.0%	0.5%
	Primary Metal Industries	6.5%	3.0%
	Other Manufacturing	4.3%	17.1%

Average spill size for manufacturing-facilities that perform hazard assessments at least once per year:
(into surface water and on land--9 spills total)

3,126 gallons

Average spill size for manufacturing-facilities that do not perform hazard assessments at least one per year:
(into surface water and on land--136 spills total)

6,947 gallons

Source: ARIP

Exhibit 8

Frequency and Percentage of Spill Causes in ARIP

Release Cause	Total Number of Reports	Percentage of Total
Equipment Failure	269	54
Operator Error	114	23
Upset Condition	54	11
Other	24	5
Maintenance Activities	21	4
Unknown	6	1
Bypass Condition	5	1
Fire	3	1
TOTALS	496	100

Source: ARIP

Exhibit 9

Frequency of Spill Causes by Spill Size in ARIP

	Spill Size Frequency (in gallons)					
Release Cause	< 10K	10-20K	20-50K	50-100K	> 100K	TOTAL
Equipment Failure	259	5	2	1	2	269
Operator Error	110	1	2	1	0	114
Bypass Condition	4	0	0	0	1	5
Upset Condition	54	0	0	0	0	54
Fire	3	0	0	0	0	3
Maintenance Activities	21	0	0	0	0	21
Unknown	6	0	0	0	0	6
Other	23	0	0	0	1	24
TOTAL	480	6	4	2	4	496

Source: ARIP

Exhibit 10

Distribution of Spill Causes by Spill Size in ARIP

	Spill Size Frequency (in gallons)					
Release Cause	< 10K	10-20K	20-50K	50-100K	> 100K	TOTAL
Equipment Failure	54%	83%	50%	50%	50%	54%
Operator Error	23%	17%	50%	50%	0%	23%
Bypass Condition	1%	0%	0%	0%	25%	1%
Upset Condition	11%	0%	0%	0%	0%	11%
Fire	1%	0%	0%	0%	0%	1%
Maintenance Activities	4%	0%	0%	0%	0%	4%
Unknown	1%	0%	0%	0%	0%	1%
Other	5%	0%	0%	0%	25%	5%
TOTAL	100%	100%	100%	100%	100%	100%

Source: ARIP

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Statistical Analysis of the Spill Size Distribution as Reported to ERNS

In the options paper for tiered response planning, one of the options was to establish absolute planning quantities regardless of facility type and size. In the proposed option, an average discharge and maximum most probable discharge would serve as threshold values corresponding to a small spill and a medium spill, respectively. This paper supplements the options paper by providing a discussion of the statistical analysis performed and the resulting calculated values which may be used to define the additional planning quantities.

Spill size data was extracted from the Emergency Response Notification System (ERNS) database for the four year period between 1987 and 1990. Spill sizes reported as 0 or unknown amounts were considered incomplete and eliminated from the analysis. The number of non-zero size reports over the four year period is 17,654. Reported spill sizes ranged from a minimum of 0.145 gallons (1 lb.) to a maximum of 5.965 million gallons (41.16 million lbs.). The distribution of spill sizes is heavily skewed with a large majority of spills at the smaller end of the range.

Statistical analysis performed on the data indicates a lognormal distribution of spill sizes. The estimated mean value and the gallon amounts associated with specific quantiles were calculated in order to define average discharge and maximum most probable discharge, respectively. The estimated mean value of 1,300 gallons could be used to define the average discharge. Therefore a small spill would be defined as any spill volume up to 1,300 gallons, but not to exceed the calculated worst case discharge.

Maximum most probable discharge could be defined by a gallon amount associated with a specific quantile. A quantile is a point within a distribution which delineates the upper bound of a specified probability density (i.e., the distribution predicts that 95 percent of future spills will be less than the gallon amount associated with the 95th quantile). The following table lists the gallon amount associated with a given quantile.

Parameters	Parameter Estimate (Gallons)	Observed Frequency (Percent of Total)
Mean (Average)	1,296	- -
25th Quantile	8	627.6
50th Quantile	44	50.7
75th Quantile	253	76.0
90th Quantile	1,231	89.6
95th Quantile	3,168	94.2
99th Quantile	18,653	98.6
99.5th Quantile	35,763	99.2
99.9th Quantile	136,342	99.8

Maximum most probable discharge could be defined by the 99th quantile of this distribution, (i.e., approximately 19,000 gallons). A gallon amount associated with a lesser quantile would not sufficiently discriminate between an average discharge and a maximum most probable discharge. A quantile representing a larger percentage may be too great a quantity, not unlike a worst case discharge for many facilities. For example, factory-built tanks are a common tank size, which do not usually exceed 20,000 gallons. Using the 99.5th quantile (i.e., approximately 36,000 gallons) would probably be greater than the calculated worst case discharge for a given facility, and therefore the facility would only have to plan for two tiers of response. Furthermore, according to a cleanup contractor, different equipment is needed for releases involving more than 20,000 gallons, so this figure represents a breaking point in the response planning effort.

Given this discussion of the statistical analysis, a revised definition for a small spill and a medium spill could be stated as follows:

- The estimated mean spill value, which could be used to define average discharge, is 1,300 gallons.

  Small spill - Any spill volume up to 1,300 gallons, but not to exceed the calculated worst case discharge.

- Maximum most probable discharge could be defined by the 99th quantile, with an assigned value of 19,000 gallons.

  Medium spill - Any spill volume between 1,300 gallons and 19,000 gallons, but not to exceed the calculated worst case discharge.

In addition to these two planning quantities, facilities are required to plan for a worst case discharge. This method requires only one or two tier planning when the calculated worst case discharge overlaps with the lesser planning quantities, thus easing the burden on smaller facilities.