WATER QUALITY, URBAN DEVELOPMENT AND SOCIAL EQUITY

Southern California Coalition
for Pollution Prevention

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Introduction

Maintaining the vitality of America's urban communities is a challenge which confronts all of us.

In light of an ever-changing global economy, advances in communications technology and information delivery systems, inexorable pressure is being exerted on the marketplace to provide products and services in the most efficient and cost-effective manner possible.

A variety of interrelated factors including land costs, labor availability and costs, transportation costs and quality of life issues must be considered in such business decisions.

An overarching element in all of these scenarios is the role of environmental regulation and its effect in either promoting or discouraging a sustaining involvement with our urban centers.

This report provides a framework to explore such issues in the context of current trends in stormwater and water quality regulation. This report is not, nor was it intended to be, an exhaustive review.

It does suggest that with creativity, proper planning, research and stakeholder involvement, we can achieve "smart growth" which both protects the environment and provides the levels of certainty necessary for economically sound decisions.

The Coalition wishes to express its appreciation to its members and project sponsors: City of Long Beach – Department of Public Works, County of Los Angeles – Department of Public Works, Metropolitan Water District of Southern California, National Water Research Institute, Southern California Edison Company and The Irvine Company for their support in making this report possible.

Chapter One

Chapter One

Water Quality, Urban Development and Social Equity

Water quality has been a federal priority since the late 19th century. Legislation passed in the 1930's and 1950's reduced harmful runoff and soil erosion threatening the nation's rivers. In the post-war era, the Clean Water Act (CWA) of 1972 mandated water quality standards and cleanup programs for America's inland and coastal resources.

Water quality improved. The National Pollutant Discharge Elimination System (NPDES), for example, a permit program authorized under the CWA, reduced "point-source" pollution originating from factories, sewer outfalls and other readily identifiable dischargers. Federal and state point-source programs helped maintain, and in many cases enhanced, water quality as the country's population expanded.

Even point-source pollution controls, however, involve difficult tradeoffs. Bigger dischargers tend to be important employers clustered in urban areas, where the country's most diverse populations and the most effective wastewater treatment and control facilities are located. Many entities affected by point-source regulations leave urban areas altogether in favor of rural communities or other nations where water quality issues are pursued with less diligence. Employment shifts from urban to suburban and rural regions. Sensitive environmental activities move from closely regulated urban communities to pristine, habitat-rich parts of the nation and the world.

(1) Ex-Urban Development Patterns

Since 1980, there has been a marked out-migration of industry, employment and people from major urban areas to the once less-populated, more pristine periphery. In 1980, for example, America's major urban regions, including Cleveland, Chicago, Milwaukee, Detroit, Pittsburgh, New Orleans, San Francisco, Newark, Los Angeles County, New York City, Baltimore, and Philadelphia, accounted for 19 million nonfarm jobs. Over the next 18 years, total employment in these "Slower Growth" areas grew by just 15%, *one-third* the rate of the overall American economy. [1]

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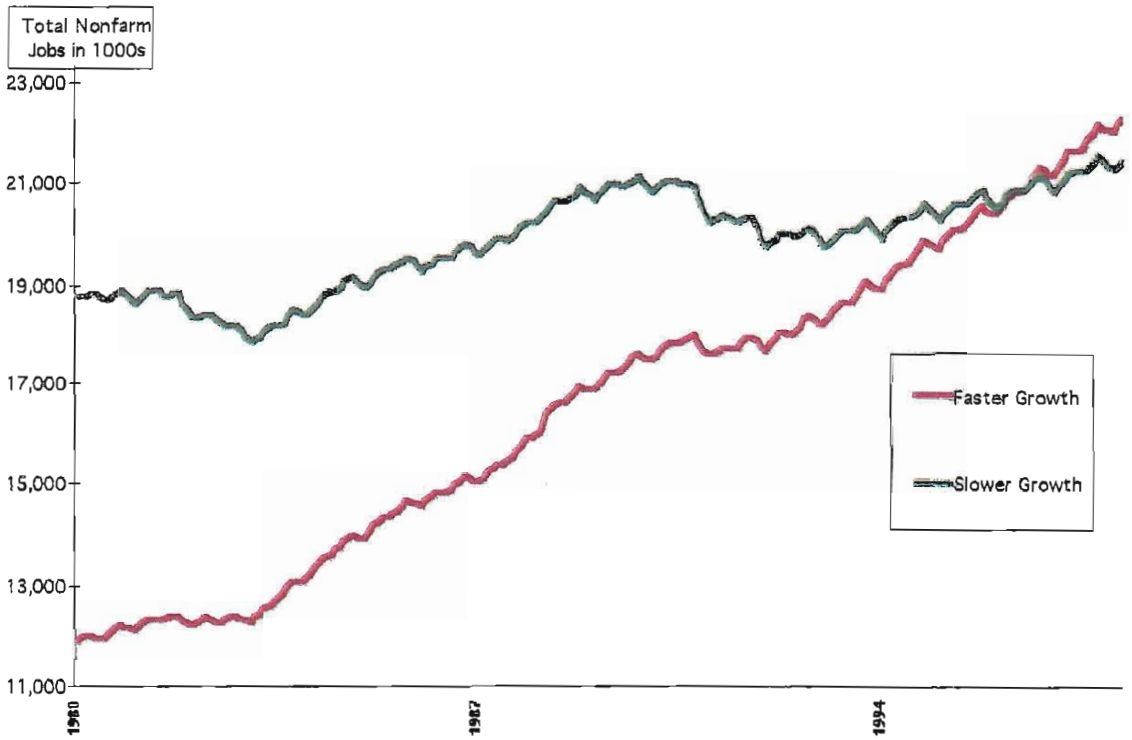
[1] "Slower Growth" regions correspond to the definitions utilized by the US Bureau of Labor statistics and include (by descending rate of growth) Cleveland, Chicago, Providence, Milwaukee, Toledo, Detroit, Pittsburgh, New Orleans, San Francisco, Newark, Los Angeles County, New York City, Santa Barbara, Flint, Baltimore, Philadelphia. These regions experienced the lowest level of nonfarm employment growth during 1980-1998 in a sample of more than seventy regions representing approximately 50% of total US employment. The

In contrast, employment in once-peripheral "Faster Growth" areas like Las Vegas, Riverside-San Bernardino, Orlando, Memphis, Nashville and Phoenix, America's most rapidly expanding regions since 1980, rose by 88%, or from 11.9 million to over 22 million jobs.[2] In 1996, for the first time ever, employment in Faster Growth peripheral regions exceeded the number of jobs in America's Slower Growth urban core (Figure 1).

Figure 1
Nonfarm Employment Growth, 1980-1998
"Fast Growth" and "Slow Growth" Regions



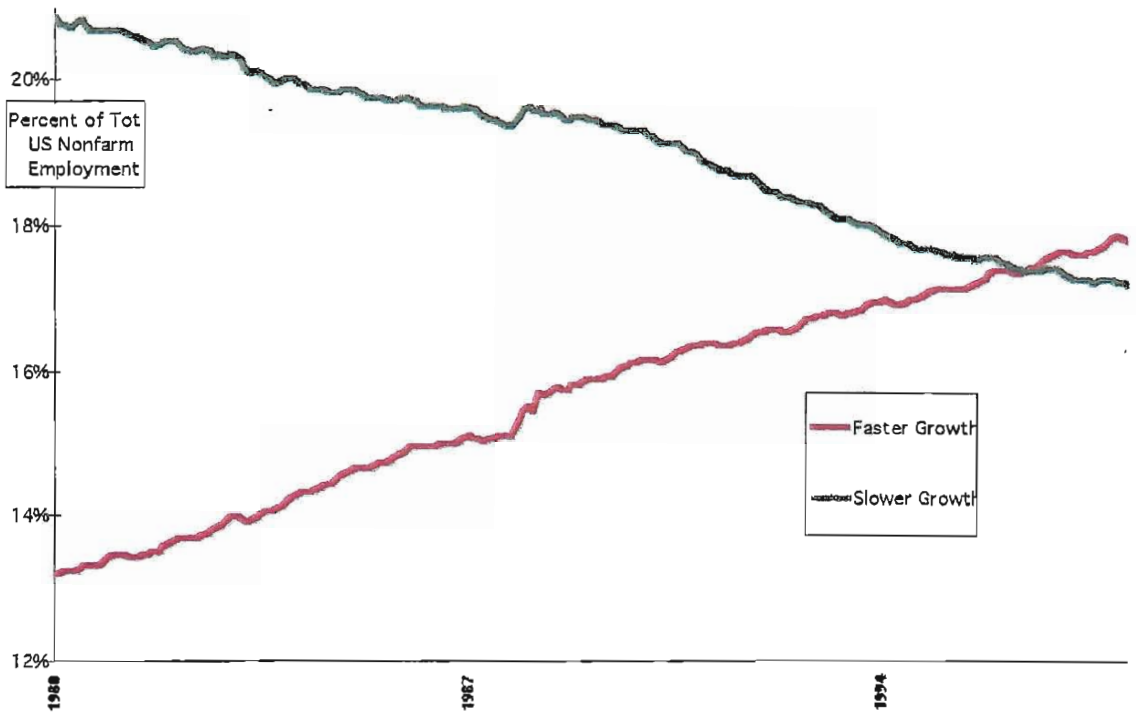
statistics were computed from three month rolling averages of seasonally unadjusted local area and regional nonfarm employment data from January 1980 through May 1988.

[2]"Faster Growth" regions were computed in the same way as "Slower Growth" and experienced the highest level of nonfarm employment growth during 1980-1998 in a sample of more than seventy regions representing approximately 50% of total US employment. They include (by descending rate of growth) Las Vegas, Orlando, Provo, Austin, Raleigh-Durham, Phoenix, Grand Rapids, Boulder, Atlanta, Riverside-San Bernardino, Seattle, Ann Arbor, Santa Rosa, Albuquerque, Tallahassee, Dallas, Salt Lake City, Nashville, Ft. Worth, Green Bay, Tucson, San Antonio, Portland, San Diego, Knoxville, Madison, Reno, Indianapolis, Fargo, greater Washington DC, Memphis, and El Paso.

As America shifted its economy from traditional urban to outlying regions, the percentage of America's jobs accounted for by the nation's Slower Growth major urban areas fell from 21% to 17%. By the late 1990s, the percentage of US jobs in Faster Growth areas was greater than in the urban core (Figure 2).

Figure 2

Percent Total Nonfarm Jobs, 1980-1998
US "Fast Growth" and "Slow Growth" Regions



These trends are increasingly more pronounced. Surveys of entrepreneurial "hot spots" and business development activity show that, despite modest recoveries in certain older cities, most new growth continues to occur in ex-urban areas like Phoenix, Salt Lake City, Portland, and Orlando. Demographic data consistently demonstrates that ex-urban, politically conservative regions, especially in the intermountain west and southeast, are magnets for middle class and lower middle class white urban refugees while only the country's most educated elite, and recent immigrants, cluster in the nation's cities.[3]

Slower Growth urban economies generally tracked overall national trends in the 1980s even though they expanded less rapidly. In the present decade, however, America's major urban regions did much worse than the rest of the country as the relative performance of New York City and Los Angeles County compared with the US suggests (Figure 3).[4]

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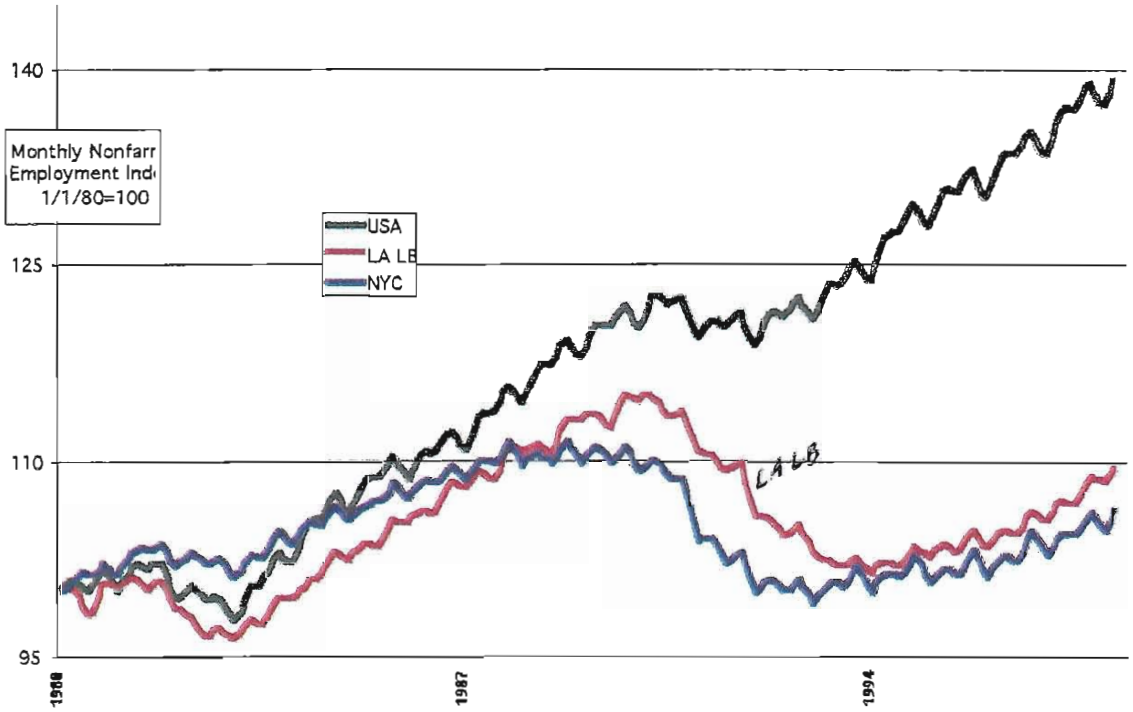
[3] See David Birch, Cognetics, Inc. (an economic research group), "Entrepreneurial Hot Spots: The Best Places in America to Start and Grow a Company" (1997). Most American jobs are now being created in ex-urban areas and "in low-wage companies than in firms paying higher wages," a fact attributed to the steady decline of larger firms—the bulwark of the urban economy. Similarly, Michigan demographer William Frey has detailed the migration of poorer, less skilled and less educated whites into states neighboring high immigration regions on both coasts, leading to dramatic, but generally less-well paid employment expansion in areas like the Southeast, Utah and Nevada, and almost no net expansion in major urban areas. See, e.g., William Frey, "The Diversity Myth," *American Demographics*, June 1998, and "The New White Flight," *American Demographics*, April 1994.

[4] Correlation coefficients for the "Slower Growth" pool of regions (see note 1, above) relative to nonfarm job growth in the "Faster Growth" regions and the nation as a whole were .992 and .966, respectively, during 1980-1989. During 1990-1998, the coefficients fell to .109 and .005. In contrast, the "Faster Growth" regional coefficient relative to the nation in the 1980s was .987, and .989 in the 1990s, a far more consistent and sustained expansion.

Figure 3
Index of Nonfarm Job Growth, 1980-1998
NYC, LA County and the US
(1/1/80=100)



(2) Stormwater Mandates and Urban-Based Growth

Southern California and the rest of the nation now face new federal mandates that may intensify such tradeoffs. In 1987, the CWA was reauthorized and amended to require that states address, for the first time, "non-point source" flows--street, storm drain, and surface runoff caused by rain. Unanticipated complexities in many cases delayed response.

The most comprehensive stormwater assessment studies, for example, consistently demonstrate that agriculture, erosion and wastewater are the major causes of storm-driven water quality impairment. Urban runoff, in contrast, generates less than 4% of the constituents measured in many communities.[5] Regional and federal authorities also grappled with the scope of enforcement for affected areas, such as watershed management, and the relative merits of waste versus "source water" assessment and protection.[6]

Despite a lack of consensus about urban stormwater affects on water quality, in the early 1990's third-party environmental groups brought lawsuits to compel the U.S. Environmental Protection Agency (EPA) to enforce non-point mandates. Partially in response, the EPA mandated that American waterways be assessed and listed according to degree of "impairment" in accordance with CWA Section 303(d). Spurred by third-party legal challenges and resulting consent decrees affecting EPA oversight of state non-point source control compliance, EPA is now compelling development and enforcement of Total Maximum Daily Load (TMDL) limits for specific constituents entering affected waters from designated areas. A growing number of communities, including many in Southern California, are, or risk becoming subject to, court-sanctioned decrees requiring such non-point source controls.

Unless carefully defined and managed, non-point source water quality programs could generate unanticipated negative social, environmental and economic consequences and greatly intensify present, adverse national trends.

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[5] A summary of the difficulties involved in defining urban stormwater runoff problems and the potentially excessive costs of mischaracterizing the issue can be found in "Defining the Urban Stormwater Runoff Problem," Feb. 1994, a report prepared for the National League of Cities by Montgomery-Watson. The report discussed the findings of the National Urban Runoff Program (NURP), which did not identify urban stormwater as a major or primary contributor to water impairment. Since NURP's findings were presented in 1983, several follow-on studies have confirmed its results.

[6] Source water protection is emerging as a leading effort in developing measurement and protection techniques for water resources emphasizing local management and control. For a summary of recent developments, see "Source Water Assessment and Protection 98," National Water Research Institute conference proceedings, April 28-30, 1998.

Depending on the kinds of constituents and measures implemented in a non-point source program, for example, total capital costs for complying with new EPA mandates have been estimated to range from as little as $150 million to over $400 billion. Estimates for annual operation and maintenance expenses similarly diverge with costs of as little as $1.1 billion to over $540 billion per year. Enforcement burdens on such crucial, high-wage, high-skill economic areas like Santa Clara County or Puget Sound might approach $14 billion per year.[7]

Key challenges include:

- *Urban economic and social dislocation.* Storm and surface water mandates disproportionately burden urban areas, strengthening trends towards industrial and residential dispersion into suburban and rural areas.

- *Economic deconcentration.* America's high-wage and high-skill economies are focused in urban communities. Diversion of industry and jobs to less developed regions drives down wages and reduces overall skill demand in the regions that most need economic growth.

- *Social equity.* Poorer Americans are heavily concentrated in developed areas and cities. Non-point source management could hinder economic activities crucial for the job base disadvantaged workers require.

- *Fragmented governance and inefficiency.* Non-point source controls are often imposed by multiple entities with jurisdiction in a single watershed. Taken together, the resulting set of measures can be much less effective and far more costly than efforts coordinated for an entire watershed.

- *Net environmental degradation.* If non-point source controls disadvantage developed areas, induce urban expansion in pristine, less-impacted regions, and misallocate resources throughout a watershed, they risk substantial net environmental losses in the biospheres they are intended to improve.

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[7] See, e.g., "Defining the Urban Stormwater Runoff Problem," (1994), Figures 1 and 2 ("Estimated Costs to Implement Best Management Practices Alternatives" and "Estimated Costs to Implement Best Management Practices Alternatives in Selected Communities"). Local cost estimates exclude capital expenses of approximately $4-5 billion in each case.

To address these concerns, this report consolidates information about surface, runoff, and storm water controls and provides an overview of analytical and response options for pursuing non-point source mandates.

Major findings include:

- *The relationship between non-point source constituent loads and beneficial use impairments is poorly understood. This problem is particularly acute when storm-driven flows are assessed because beneficial use impairments, if any, are limited in time and scope. Proposed regulatory approaches must be calibrated to the actual degree and extent of impairment relative to cost especially where discharges result from isolated, non-recurring rain events. This includes:*

  (i) Establishing water quality goals and objectives that reflect the transitory nature of stormwater impacts;

  (ii) Recognizing that the cost of attaining water quality goals for stormwater events is extremely high while the anticipated benefits remain poorly defined; and

  (iii) Developing strategies for regulating stormwater and non-point discharges that are not based on inappropriate models drawn from the regulation of point-source discharges from sewerage plants and the like.

- *To the extent they are implemented, non-point source control programs, including TMDLs, must be coordinated for entire watersheds to be effective and cost-efficient. Regulatory efforts should focus on the most pressing constituent sources within a watershed to provide protection in the most effective manner.*

- *California and other states have substantial experience with the actual costs and effectiveness of a broad range of "best management practices" (BMPs) to achieve water quality goals. Non-point source programs should utilize BMPs to reduce ancillary social and economic risks.*

- *Market-based approaches to non-point source controls maximize discharge improvements in a watershed and minimize compliance costs to reduce urban social and economic impacts. They should supplement the use of BMPs in any non-point source program.*

Chapter Two of this report discusses the concept of watershed management and its application to non-point source regulation under the CWA.

Chapter Three describes the range of BMPs available to address water quality concerns and assesses relative benefits and costs of various response options.

Chapter Four presents a summary of three market-based programs that can help achieve watershed-wide non-point source objectives in an efficient, socially beneficial manner. It draws on such examples as the Central/Coastal Orange County Subregional NCCP/HCP and the San Diego regional HCP.

Chapter Five concludes with examples of BMP and market-based non-point source control programs in the United States and summarizes the range of options available for compliance.

Chapter Two

Chapter Two

Watershed Management and Non-Point Source Discharges

There is broad recognition that non-point source management requires watershed-wide coordination. The CWA, potential and current TMDL regimes, and the tenor of most court decisions addressing stormwater issues all recognize the necessity of watershed-wide coordination. Point-source controls, in contrast, are naturally focused only on the areas directly affected by unwanted discharges. Non-point source management involves regulating water flow over vast combinations of natural and artificially altered landscape. Maximizing water quality protection and reducing compliance costs in such cases require watershed-wide coordination.[8]

A "watershed" is the land area that drains into a stream, bay, or estuary. Watersheds can be very large, such as the Mississippi River drainage, the California Sacramento-San Joaquin Delta, or the Colorado River system. They are often subject to divided political oversight fragmented among subwatersheds like Coyote Creek in Santa Clara County, California or the Los Angeles River.

Non-point pollution results when rainfall-induced stormwater flows over developed and undeveloped lands, including farms, natural areas, and urban communities, into streams, lakes or oceans. Larger watersheds, like the Mississippi, Sacramento-San Joaquin Delta, or the Colorado River, encompass vast open space, agricultural regions and heavily urbanized communities. Smaller urban subwatersheds, like Coyote Creek and the Los Angeles River, are drained more by storm drains that collect and transport rainfall from developed and paved surfaces. Rain in urban areas can cause much more intense flows than in natural or agricultural regions where infiltration occurs, but open spaces can contribute much higher particulate levels due to the larger amount of erosion they produce.

Land uses--natural open space, grazed or cultivated areas, parks and playing fields, industrial areas, mines and quarries, roads and parking facilities, and residential and commercial developments--critically affect watershed management. Non-point source contributions to water quality are

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[8] The substantial cost implications of stormwater controls were evaluated in a report by the National Research Council for Congress and the EPA. As summarized in "Defining the Urban Stormwater Runoff Problem," (1994) the study's results support "...[t]he need for local water quality strategies, preferably on an integrated watershed basis," and "...that local management options should reflect social goals and priorities relative to risks, costs and benefits."

a function of how each kind of land use interacts during rainy periods to discharge constituents into water resources.

Open spaces often include abandoned industrial sites, such as mines and quarries, that disproportionately contribute to stormwater pollution. Heavy metals naturally leach from soils during rains and contribute to water quality toxicity in downstream areas.

Agricultural areas are sources of silt, oxygen-depleting nutrients and potentially toxic fertilizers, herbicides, and pesticides in stormwater. Dairies, ranches and other animal containment areas contribute organics and pathogens. Overgrazed lands will increase erosion. Animals can increase sediment and nutrient loads in downstream waters by compacting and degrading wetlands that would otherwise be natural catch-basins for runoff. Many rural communities use septic systems that can generate high nutrient and pathogen pollution during rains if not properly maintained.

Municipal runoff includes sediment from disturbed areas and channels, nutrients and pathogens from animal droppings and litter, fertilizers, herbicides, and pesticides and oil and grease from roadways and parking lots. Some heavy metals can be found in urban runoff, but troublesome constituents like lead have been dramatically reduced with the advent of unleaded fuels.

Open spaces are usually concentrated in the upper part of a watershed. Agricultural and municipal areas often occur in lower reaches. Lands near bays, rivers, and other large water bodies generally are developed and include cities, industrial areas, and port facilities. Runoff from these areas includes point discharges from regulated treatment facilities and non-point discharges from storm drainage facilities.

In part to address the complexity of non-point source controls, in 1991 the EPA formed the Office of Wetlands, Oceans, and Watersheds. This new administration pursued listings of "impaired" waterways under CWA Section 303(d) and began requiring states to develop TMDLs governing specific constituents discharged by both point and non-point sources. TMDLs are the maximum levels of pollutants that a water body can receive from all sources within a watershed over a specific period and meet water quality standards. Once established, they define the level of discharge allocable to, and, if necessary, reductions mandated for, point and non-point sources in a watershed.

An effective non-point source program depends on cooperation and coordination among local interests, state and federal agencies. Even the measurement of point and non-point source discharges, let alone control, requires substantial inter-jurisdictional coordination. Figure 2-1 describes a

typical watershed. Table 2-1 illustrates the potential pollutants discharged from developed and undeveloped lands within a single watershed.

Watershed management and non-point source control involves a large number of constituencies with diverse economic and geographic characteristics. Constraining one interest--downstream urban communities, for example--may inadvertently encourage excessive pollution loading by others--upstream disturbed open space or agricultural regions--where TMDLs could be more effectively achieved. Addressing TMDL concerns in isolated subwatersheds managed by fragmented political and regulatory entities can cause adverse environmental as well as social and economic consequences.

To an unprecedented extent, non-point source programs must utilize built-in incentives to find the least costly, most effective means of reducing runoff constituents for entire watersheds. Before any controls, including TMDL requirements are implemented, the scope and extent of beneficial use impairment must be carefully calibrated against compliance costs. Despite accelerated non-point source water quality control efforts, for example, storm-driven mass loading estimates used by the EPA and local agencies to fashion regulatory goals are likely to be substantially overstated. As a result, compliance costs, which could total as much as $1 trillion nationwide every two years for operations and management alone, will be ineffective and unnecessary.[9]

In cases where stormwater constituencies of concern are clearly identified, controls must be flexible enough to accommodate new information and focus on reducing primary discharge contributors before, if ever, affecting the rest of the watershed. If stormwater constituent controls are imposed on isolated dischargers, as with point-source regimes, substantial social and economic costs may be incurred to reduce minor sources while more of those with damaging watershed effects are addressed. This problem may be compounded if such measures involve large, high-capital cost facilities which later prove unneeded.[10]

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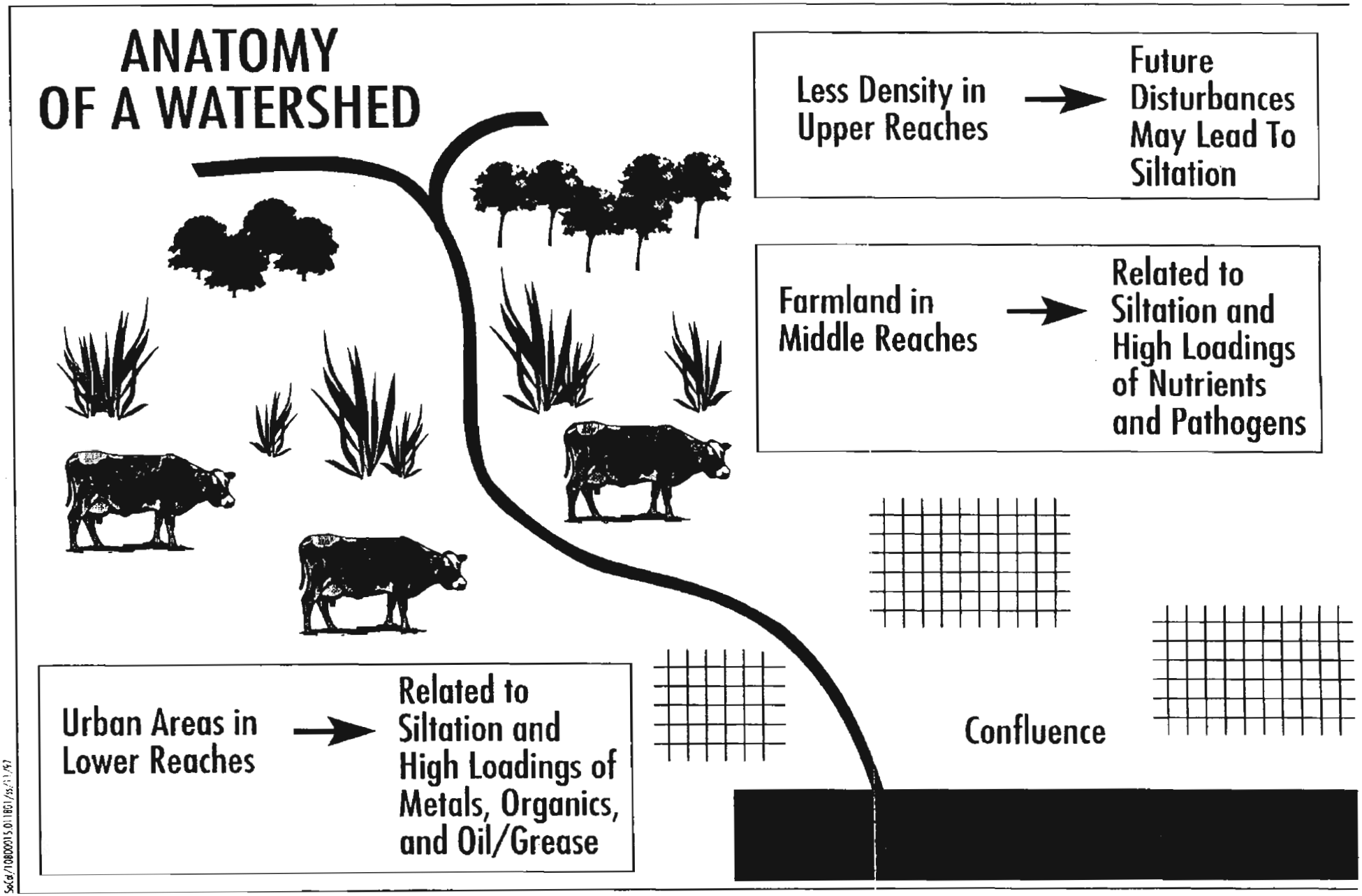
[9] See "Defining the Urban Stormwater Runoff Problem," (1994), page 5. Although EPA stormwater and wet weather effluent reduction plans were strongly influenced by the NURP data, "[r]ecent studies indicate that NURP mass loading projections may be overstated. If stormwater quality regulations are based on overstated projections, municipalities could construct unnecessary or oversized treatment facilities."

[10] See "Defining the Urban Stormwater Runoff Problem," (1994), page 5. "By identifying the specific sources of stormwater quality impairment in specific watersheds, pollution control efforts can be prioritized and targeted. This approach would save billions of unnecessary construction dollars and annual operation and maintenance dollars that are needed for other programs and services."



ANATOMY OF A WATERSHED

Figure 2-1

TABLE 2-1

GENERAL ANTICIPATED POLLUTANT DISCHARGE BY LAND USE

Land Use	Pollutants						
	Trash	Sediments	Oil & Grease	Heavy Metals	Toxics & Pesticides	Bacteria & Coliform	High BOD (1)
Residential							
Rural (septic system discharge)	•	•			•	•	•
Urban (treatment plant discharg	•	•	•	•	•		
Roads and Transportation Route	•	•	•	•	•		
Industrial							
Manufacturing & Refining	•		•	•	•		
Land Fill (2)	•	•	•	•	•		•
Waste Treatment (2)			•	•	•	•	•
Commercial	•		•	•			
Recreation & Boating	•		•			•	
Agriculture & Silviculture							
Grazing		•				•	•
Dairies & Feedlots		•					
Cultivation (crops & orchard)		•			•	•	•
Forest Management & Logging	•	•			•	•	•
Mines & Quarries		•		•			
Temporary Construction Site	•	•	•	•			

1. BOD is biochemical oxygen demand
2. Discharge of constituents from this point source would be at low levels and would be in accordance with the NPDES discharge permit.

The relative value of downstream, "end of pipe" stormwater cleanup and source water quality control is also a critical regulatory consideration. New research and recent local government experiences strongly support the importance of watershed-wide appraisals to identify the most effective water cleanup measures.[11]

The following sections of this report discuss two approaches for achieving these goals: (1) BMPs, and (2) market-based mechanisms.

[11] See Focazio, et. Al, "A National Model for Assessing the Susceptibility of Surface Water Supplies to Source-Area Contamination;" LeChevallier, et. al., "Developments of a Monitoring Strategy to Determine Variations in *Giardia* and *Cryptosporidium* Levels in a Watershed;" and Ferguson, et. al., "Surface Monitoring in Two Watersheds to Identify Sources of *Cryptosporidium* spp. and *Giardia* spp," in "Source Water Assessment and Protection 98," National Water Research Institute conference proceedings, April 28-30, 1998.

Chapter Three

Chapter Three

Best Management Practices

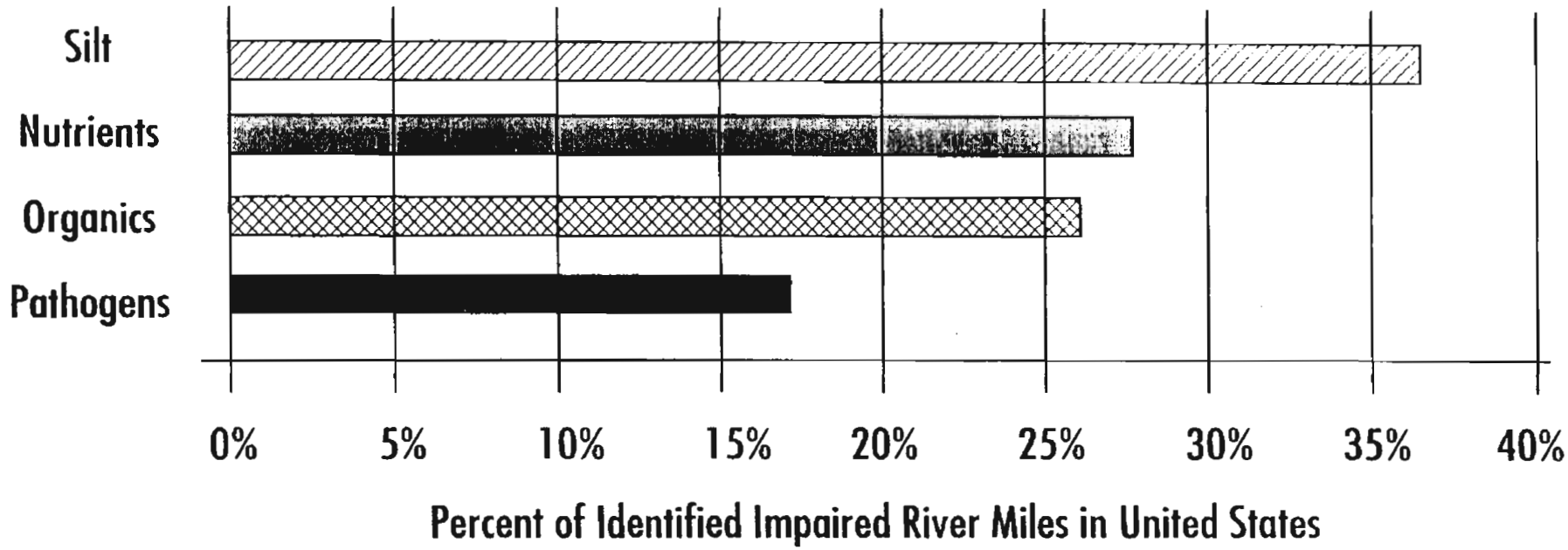
Regulatory efforts can generate unanticipated ancillary consequences. In some cases adverse results cannot be avoided: novel concerns sometimes demand untested measures with unknown costs and effects. When a regulatory program involves the multiple interests comprising a single watershed, the potential for unintended policy consequences is extremely high.

These risks can be reduced, however, by pursing non-point source controls with a set of measures--"Best Management Practices"--that have been employed in real-world situations across the United States. BMP costs and effectiveness are relatively well-known and are becoming more clear over time. BMPs provide policy makers with a range of options that can be applied to meet water quality objectives subject to quantifiable costs and benefits.

In 1994, the EPA identified the major causes of river quality impairment in the United States. The results, summarized in Figure 3-1, suggest that silt, nutrients, organic materials and pathogens transported by stormwater runoff are of primary concern.

The BMPs discussed in this Report are conservation practices that improve water quality by reducing the flow of nutrients, animal wastes, oil and grease, toxics, and sediments identified by the EPA as degrading water quality. They focus on a single constituent or group of constituents, or on specific activities that impair water quality. These BMPs are being employed in actual non-point control programs in the United States (see the summary of BMPs in Table 3-1 below).[12]

[12]Municipal and regulatory agencies were contacted to discuss the effectiveness of specific BMPs to prepare this report. In some cases, studies are currently being completed and the results are not yet finalized, but several agencies described preliminary, successful results of many BMPs. Other sources of this report include a 1992 study of BMP implementation conducted for the American Public Works Association, Southern California Chapter. The BMPs discussed in this part of the report do not include point source discharge controls applicable to municipal and industrial wastewater treatment plants.



MAJOR FACTORS IN WATER QUALITY IMPAIRMENT IN RIVERS

Figure 3-1

In general, BMPs fall into five broad categories ranked from the least to most capital intensive:

(1) **Non-structural source controls.** These include illegal discharge enforcement, street and sidewalk sweeping, and storm drain cleanups. Also effective are educational programs and project requirements that reduce rain-driven discharges, such as "pooper-scooper" ordinances to reduce animal waste, recycling programs, and construction practices that control off-site sediment flows. Public information and storm drain stenciling programs reduce motor oil, paint, pesticide, and fertilizer dumping in residential storm drains. Adding additional trash receptacles in park and open space areas, and increasing the frequency of trash collection and street cleaning, also reduce storm water discharges.

(2) **Minor Structural Source Controls.** Diversion channels, grass swales, natural channel erosion reduction and groundcover plantings all help reduce silt, sediment and other surface born non-point discharges.

(3) **Floatables and Oil Removal.** These BMPs involve parking lot and rooftop runoff storage and separation measures to remove grease and oil from stormwater.

(4) **Solids Removal.** Large-scale solids control requires very high capital expense approaches such as detention basin, clarifier, swirl concentrator, screen and wetland development to trap silt and other materials during rain events.

(5) **Metals Removal.** Much like solid, metal stormwater control measures require extensive, and expensive detention basins, wetlands, and primary clarifiers and lime precipitation facilities.

Off-site solid and metals non-point source controls require facilities or measures undertaken at one location in a watershed that reduce adverse discharges generated somewhere else. As such, they are not only expensive, but also require careful management to assure that costs and benefits are fairly allocated. It may be most efficient, for example, to locate a treatment facility outside of high-cost urban areas even though urban runoff cleanup may be the primarily goal of the project. When urban areas have the infrastructure in place to channel storm water flows it may be more beneficial to focus development and treatment in developed areas even if the adverse loads arise from rural or open spaces.

Many communities are also learning that non-point source water quality objectives can most effectively be achieved by cleaning up abandoned sites or other large load contributors that would otherwise not be remediated. These include former industrial areas with residual toxic wastes, often owned by insolvent entities, military bases, abandoned mine or other disturbed sites where exposed soils leach heavy metals into nearby rivers and streams, and agricultural, forested, and open space areas subject to wet-period erosion.

In the Northwest, the U.S. Forest Service oversees a Watershed Improvement Program targeting 35,000 acres of poorly managed forest for restoration that reduces downstream erosion. Similar programs have been in place for agriculture since the mid-1980s, including cost-share soil conservation programs and purchasing marginal lands subject to erosion when farmed.

Table 3-1 summarizes the major kinds of BMPs now being implemented in the United States and discusses their effectiveness and relative cost with respect to silt, nutrient, organic material, pathogen, litter and oil & grease control.

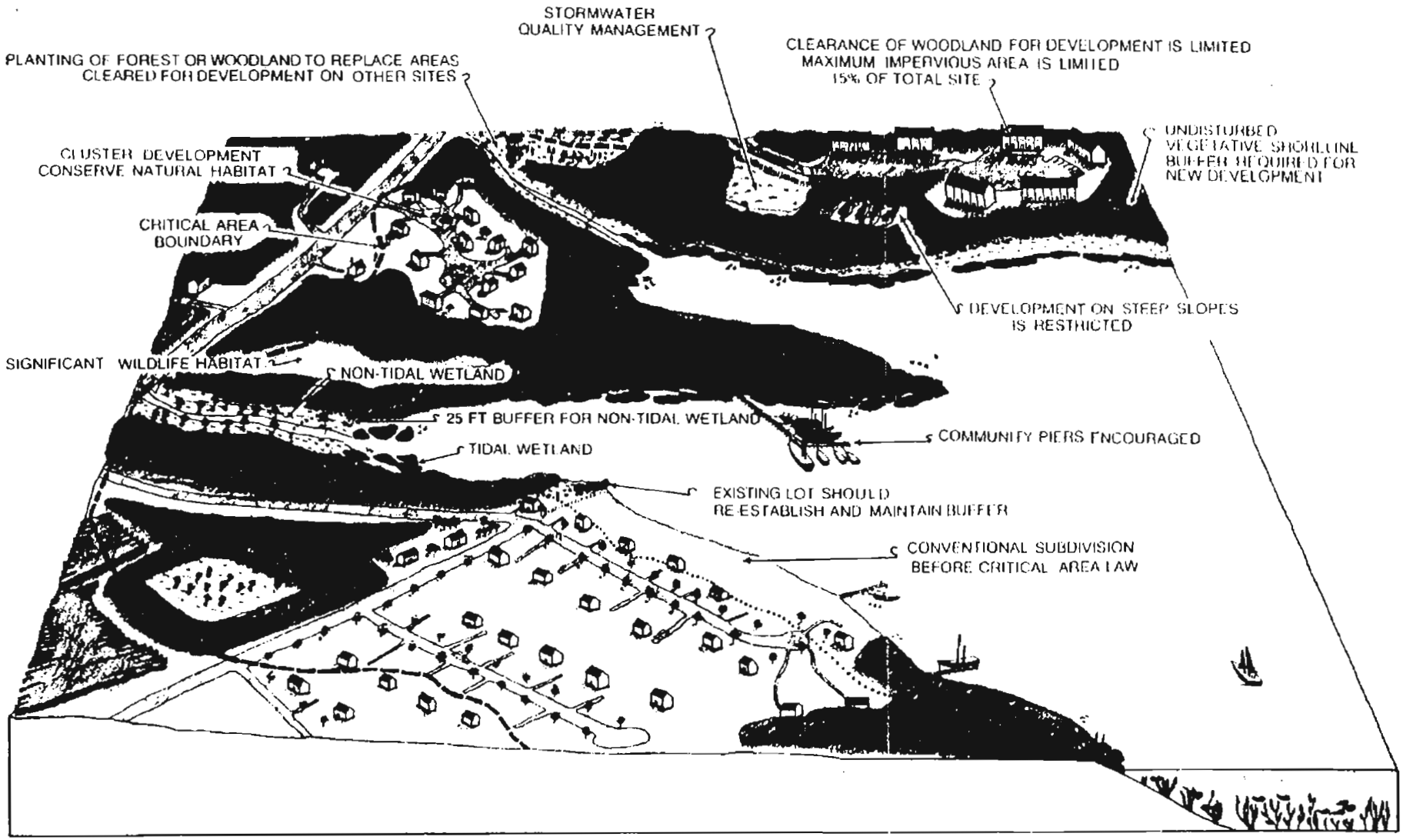
Figures 3-2 and 3-3 illustrate a coastal watershed protection program implemented in the Chesapeake bay region. Its goals are to integrate urban, agricultural, open space, and forestry uses to minimize water quality impairment.

The Chesapeake Bay experience, however, is shaped by pre-existing patterns of rural development interspersed among natural resource amenities. As Figures 3-2 and 3-3 show, the region's approach contemplates a substantial amount of urban sprawl, producing suboptimal resource and water protection results.

A better approach may be to consolidate urban development far more densely in one area of a watershed, preserving the rest of the region in a more natural state. This philosophy has informed innovative projects in California, such as the Central/Coastal Orange County Subregional NCCP/HCP, the San Diego regional HCP, and Cal-Fed, a state and federal attempt to protect the Sacramento River delta. In each case, large-scale conservation and preservation commitments are exchanged for focused development in designated areas. This generates cost-effective water quality improvements throughout the affected watershed without sacrificing economic and social activity.

TABLE 3-1
BEST MANAGEMENT PRACTICES

Type of Practice	Use of BMP			Pollutants Controlled						Relative Cost
	Municipal Areas	Construction Activities	Agricultural Areas	Silt	Nutrients	Organic Material	Pathogens	Litter	Oil & Grease	
Institutional Controls										
Educational Programs	X	X		X	X	X	X	X	X	Original cost may be high. Annual costs based upon the need to update material and cost of printing or broadcasting
Litter Control with Ordinances and Increased Placement of Municipal Trash Cans	X			X	Maybe	Maybe	Maybe	X		Costs may be low. Requires frequent collection of trash, especially in areas with high volume of pedestrian traffic and near restaurants.
Recycling Programs, including programs for Oil Recycling	X							X	X	Extremely successful to remove oil from storm drains and landfills. May be expensive if limited sources to purchase recycled materials
"Pooper Scooper" Ordinances	X						X			May be difficult to enforce if community does not support action
Restrict Paving and Use of Non-Porous Materials	X			X	X	X	X			Use of vegetation strips or infiltration materials in parking lots and walkways.
Non-Structural Controls										
Frequent Street and/or Sidewalk Sweeping	X			X		X	X	X	Maybe	Effectiveness depends upon amount of litter and silt that accumulates and frequency of storm events. Maybe cost-effective if frequent storms with high accumulation of litter between storms, or prior to wet weather season following long summer period
Frequent Storm Drain and Channel Cleaning	X			X				X		Effectiveness depends upon amount of litter and silt that accumulates and frequency of storm events. Maybe cost-effective if frequent storms with high accumulation of litter between storms, or prior to wet weather season following long summer period
Minor Structural Controls										
Storm Drain Inlet Protection	X	X		X		Maybe		X		Requires frequent removal of debris at inlet structure to avoid localized flooding or accumulation of litter
Slope Stabilization and Erosion Controls	X	X	X	X	X	X				Costs would depend upon accessibility of soils, especially for previously developed sites.
Use of Interceptor Swales and Vegetative Filter Strips	X	X	X	X	X	X			X	Effective measure. Cost may be high if adequate land is not available or if disposal site for debris is not available. Accumulated debris may require frequent removal if adjacent to developed land uses
Use of Debris Basins	X	X	X	X	X	X		X		Effective measure. Cost may be high if adequate land is not available or if disposal site for debris is not available. Accumulated debris may require frequent removal if adjacent to developed land uses
Restore Natural Channels and Establish Wetlands	X	X	X	X	X	X	X	X	X	Costs dependent upon accessibility of sites and availability of areas for restoration. Could be improve aesthetics for residents and tourists. Would require frequent removal of debris and enforcement of toxic discharge ordinances to protect habitat
Fence Open Channels and Streams	X							X		May be high cost to frequently remove debris caught in fence. May not be popular with residents and tourists that want access to stream channels.
Major Structural Controls										
Collect and Treat Storm Water to Remove Oil and Grease	X			X		Maybe			X	Costs extremely high for construction and maintenance
Sediment and Grease Traps on Storm Drain Inlets	X			X		Maybe			X	Costs extremely high for construction. Requires frequent cleaning prior to storm periods.
Use of Debris Basins	X	X	X	X	X	X		X		Effective measure. Cost may be high if adequate land is not available or if disposal site for debris is not available. Accumulated debris may require frequent removal if adjacent to developed land uses
Restore Natural Channels and Establish Wetlands	X	X	X	X	X	X	X	X	X	Costs dependent upon accessibility of sites and availability of areas for restoration. Could be improve aesthetics for residents and tourists. Would require frequent removal of debris and enforcement of toxic discharge ordinances to protect habitat



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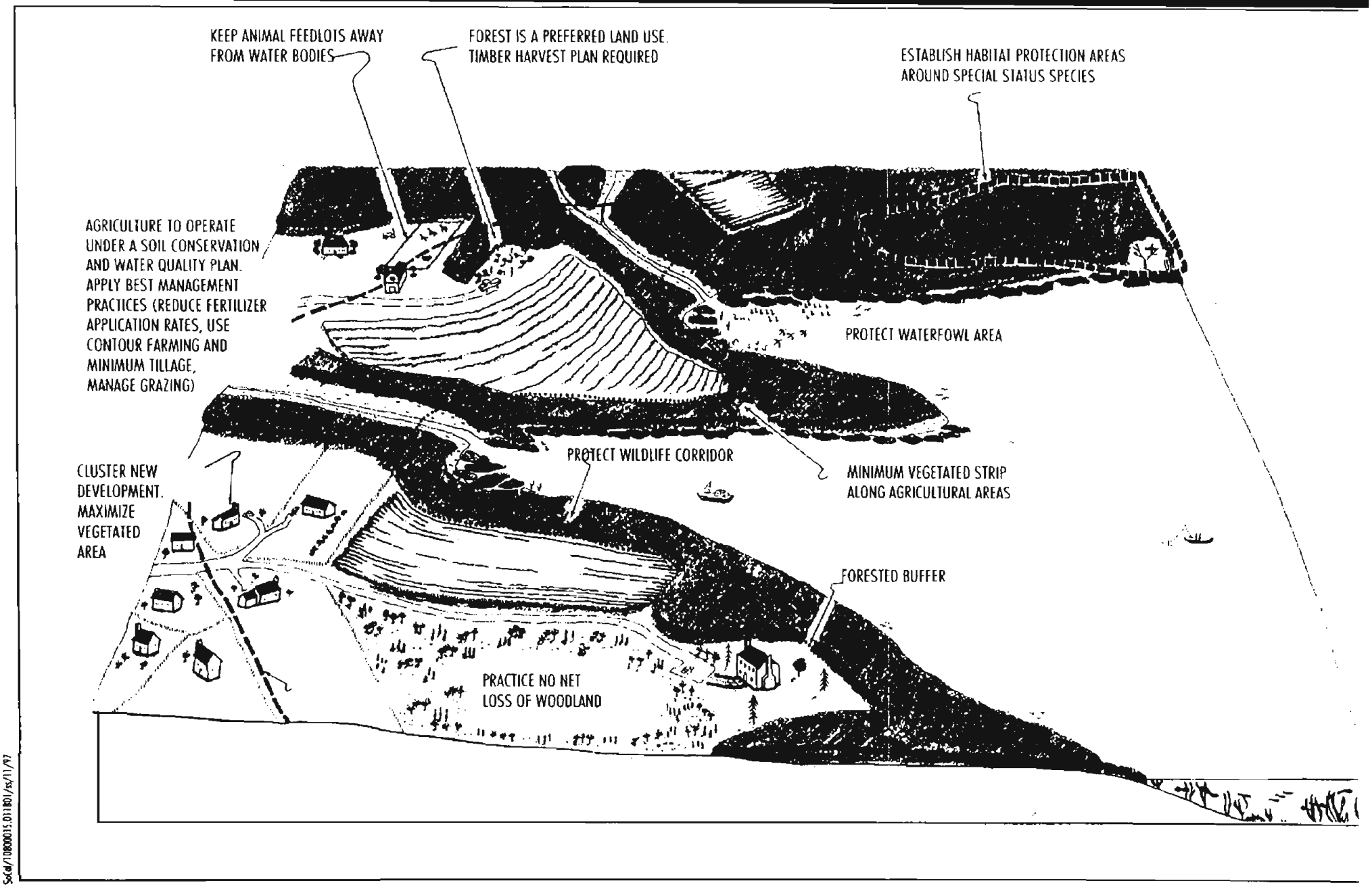
Source: Chesapeake Bay Critical Area Commission

EXAMPLE WATER-SENSITIVE SUBURBAN DEVELOPMENT APPROACH

FIGURE 3-2



Source: Chesapeake Bay Critical Area Commission

EXAMPLE WATER-SENSITIVE RURAL DEVELOPMENT APPROACH

FIGURE 3-3

As these examples show, BMPs offer an exceptionally wide range of options with known and quantifiable costs for meeting TMDL and other non-point source standards. For that reason, this report recommends that a staged program first implementing the most cost-effective BMPs form the basis for any non-point source control program implemented in response to CWA mandates.

Chapter Four

Chapter Four

Market-Based Approaches

To further reduce the possibility that non-point source control efforts generate unintended, potentially adverse social and environmental consequences, BMP-based programs should be supplemented with market-based approaches. These include:

(1) effluent trading;

(2) transferable development rights; and

(3) mitigation banking.

Each of these approaches creates incentives for all interests in a watershed--the "stakeholders"--to allocate resources in ways that maximize environmental benefits and reduce ancillary social and economic costs. They encourage stakeholders to pay for investments in a watershed that mitigate the most adverse discharge sources in exchange for development and other socially beneficial rights. Competition and markets for such rights increases the likelihood that the most pressing non-point source water quality concerns will be systematically addressed by stakeholders with cost-efficient solutions.

(1) Effluent trading

Effluent trading in the United States evolved as stakeholders learned that while it is often socially and financially prohibitive to reduce discharges from any single source, much greater benefits, at far less cost, can be achieved by investing in BMPs that reduce loads produced by other entities.

On a tributary where nutrient load reductions are difficult to achieve, for example, effluent trades allow dischargers to pay for a treatment plant upgrade elsewhere in the watershed and buy credits towards overall TMDL obligations. It is often more cost-effective for downstream municipal dischargers to fund BMPs that reduce waste generated by upstream agricultural users, such as collecting and reusing agricultural return flows, or changing crop patterns to maintain a higher level of vegetative cover.

Trading regimes create liquid markets for TMDL reduction credits that greatly improve resource allocations in geographically and economically diverse watersheds. These programs use markets to price various rural, open space, urban and agricultural discharge credits and allow stakeholders to compare the costs and benefits of different options. Over time, the stakeholder community will select measures that offer the most environmental benefits for the least social cost.

Numerous agencies and jurisdictions have extensive, positive experience with effluent trading. One example is Boulder Creek, Colorado, were the city was allowed to improve stream flow, restore riparian habitats, and install non-point source controls rather than pay for far more costly, but less beneficial treatment facilities to remove ammonia from municipal waste. As a result, streambank erosion was greatly reduced, and runoff filtration and in-stream fish habitats markedly improved.

Table 4-1 provides a representative summary of effluent trading programs throughout the United States.

(2) Transferable Development Rights

Transferable Development Rights (TDRs) allow stakeholders with development rights on sites with substantial TMDL compliance values, such as riparian land, to transfer those rights to another location. Under this approach, property owners have incentives to enhance water quality by preserving valuable resources in exchange for transfer ratios allowing higher density developments on other sites, fee exemptions or reductions, and the liquidity of TDR markets, which can produce immediate economic returns for TDR holders. Figure 4-1 highlights the basic elements of a typical TDR system.

TDRs are used in the Chesapeake Bay watershed to shift new development from agricultural to existing rural residential areas. This clusters development in compact locations, preserves agricultural land, forests, and stream buffer areas while reducing loads flowing into major tributaries.

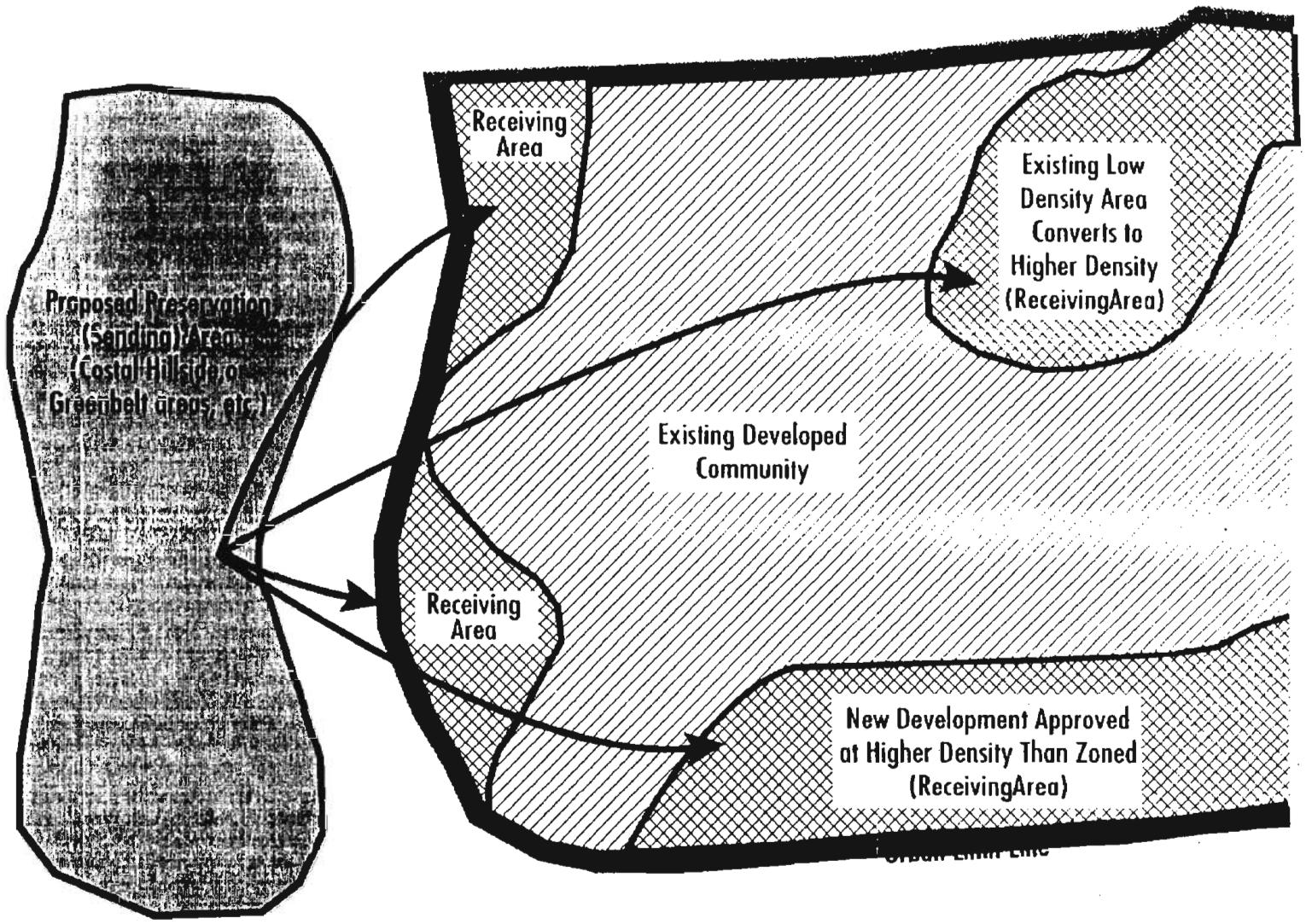
In California, TDRs are successfully employed by the Tahoe Regional Planning Agency in Lake Tahoe, City of Lake Tahoe, City of Morgan Hill, City of Cupertino, Mountain Restoration Trust for the Santa Monica Mountains, and Land Conservancy of San Luis Obispo County for the Cambria area. A detailed description of California TDR programs is provided in Table 4-2.

TABLE 4-1

EFFLUENT TRADING PROGRAMS

Project Location	Type of Trading
On-Going Trading Programs	
Arkansas Nature Conservancy, Arkansas	Non-point to Non-point
Boulder Creek, Colorado	Point Source to Stream Improvements and Riparian Restoration
Chatfield Basin, Colorado	Point to Non-point
Cherry Creek, Colorado	Point to Non-point and Point to Point
Lake Dillon, Colorado	Point to Non-point and Non-point to Non-point
Dade County, Florida	Point to Non-point
Iron and Steel Industry	Intra-plant trading
Maryland Nontidal Wetlands, Maryland	Non-point to Non-point
New York City, New York	Drinking Water to Non-point and Point, Point to Non-point, and Point to Point
Providence, Rhode Island	Point (drinking water) to Non-point
Tar-Pamlico River Basin, North Carolina	Point to Non-point and Point to Point
Trading Programs Under Consideration	
Chehalis River Basin, Washington	Point to Non-point
Chesapeake Bay Tributaries, Maryland	Point to Non-point and Non-point to Non-point
Long Island Sound, New York	Point to Point and Point to Non-point
South San Francisco Bay, California	Point to Point and Point to Non-point
Stamford, Connecticut	Point to Point and Point to Non-point
Tampa Bay, Florida	Point to Point, Point to Non-point, and Non-point to Non-point
Truckee River, Nevada	Point to Non-point and Water Quantity

Notes: Point to Point denotes trading between two point dischargers such as two industrial dischargers, and industry and a POTW, or two POTWs.
Point to Non-point denotes trading between a point discharger and a non-point discharger, such as an industry or POTW and an agricultural or forested resource area discharger.
Non-point to Non-point denotes trading between two non-point dischargers such as two agricultural areas, a quarry and agriculture, etc.
Source: U.S. EPA



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TRANSFER OF DEVELOPMENT RIGHTS APPROACH

FIGURE 4-1

TABLE 4-2

TRANSFER OF DEVELOPMENT RIGHTS PROGRAMS

Region & Name TDR Management Agency	Location	Purpose of TDR	Benefits of TDR/Comments
Northern California			
Tahoe Regional Planning Agency (TRPA)	Lake Tahoe Basin Muti-county	Protect and restore sensitive natural areas.	Minimize runoff, transfer development to less sensitive lands, ensure development remains within capacity of public service systems.
South Lake Tahoe, City of	TRPA	Remove existing dwelling units from environmentally sensitive areas.	Protects and restores Stream Environment Zone, Allows construction of appropriate housing without participation in restrictive building permit quota system
Monterey County	Big Sur	Protect Big Sur viewsheds visible from State Hwy. 101.	Dedication of irrevocable scenic easement, restricts density of development on receiving lands to 1 DU/acre.
Pacifica, City of	20-acres coastal bluff	Preserve open space and land subject to landslides, floods, and other potential hazards.	Dedication of bluff as open space and gain of 20 unused development rights inland. TDR-related projects are exempt from some city fees and some open space, parking and setback standards.
Mogan Hill, City of	El Toro Mt..	Preserve steeper hillside slopes, particularly higher elevations of El Toro Mountain.	Four programs are operated: A Hillside Combining District which promotes preservation of El Toro Mountain, Use of limited sewer system allocations to preserve El Toro Mountain, Use of City-purchased TDCs to gain exemption from City's Residential Development Control System, and developer credits for open space through purchase of TDCs.

Region & Name TDR Management Agency	Location	Purpose of TDR	Benefits of TDR/Comments
Brisbane, City of	Hillsides	Preserve steep hillsides	Density transfers encouraged for steepest portion of hillside areas. Program allows developer to receive additional density on a buildable site if an unbuildable site is dedicated as open space. Allows for one additional dwelling unit for each 20,000 sqft of hillside dedicated to open space.
Milpitas, City of	Hillsides	Preserve prominent hillside areas	Encouraged transfer of development from more prominent western hills to less noticeable eastern hills. Program since dropped because of concern for sacrificing eastern hills. Development of western hills now more difficult by limiting zoning density.
Moraga, Town of	Hillsides	Preserve higher elevations of hillsides	Program is largely unused. Developers find difficulty achieving densities allowed by zoning due to geotechnical and other concerns.
San Francisco	Downtown Historic Landmarks	Preserve historic landmarks.	building to be preserved and the floor area that would be allowed for a new building. Once development rights are relinquished, building classified as a historic landmark. downtown area.
San Mateo County	Agricultural land	Preserve agricultural land and agribusiness.	nonagricultural uses on prime agricultural land. Density credits can be acquired for building agricultural water storage facilities or consolidating parcels.
Cupertino, City of	Urban areas	Maintain acceptable traffic flow DeAnza Blvd. and Stevens Creek Blvd. commercial area.	Allows for flexibility in concentrating development while maintaining overall growth limit based on traffic and street infrastructure limitations.
Oakland, City of	Urban areas	Preserve historic properties	Allow for increase in living units or floor area ratio upon purchase of credits from abutting properties.

Region & Name TDR Management Agency	Location	Purpose of TDR	Benefits of TDR/Comments
Southern California			
Oxnard, City of	Beachfront properties	Control beachfront development.	Exempts transfer units from some city fees. In lieu of developing 1 unit on a donor site, a developer can build 6 units on the receiver
Pismo Beach, City of	Coast Areas	Protect and restore scenic resources, preserve open space, reduce hazard potential, and provide public access.	Only buildable areas qualify for participation, bluff retreats and wetlands do not qualify.
Riverside, City of	Sycamore Canyon Park	Acquire canyon land for a park. Facilitate preservation of greenbelt lands.	Adopted a specific plan which used TDR, developer built a lower density project that did not require TDR, City acquired parkland through other funding.
Santa Monica Mountains	Coast Areas and Sensitive Areas	Reduce potential landslide and fire hazards, minimize impacts on public service systems, and avoid environmental degradation.	Developers have used purchased credits to subdivide receiving parcels at higher densities, receive coastal permits, and receive permission to build. The receiving sites could not have been developed without purchase of development credits. One owner with five contiguous lots can sell TDCs for three lots and continue to enjoy these lots as open space, permanently protected
San Luis Obispo County	Hillsides	Reduce intensity of development on substandard lots on steep, highly erodible coastal slopes.	TDCs can be used to increase floor area of a dwelling unit on receiving sites. Program resulted in protection of 6 acres of land.
Belmont, City of	San Juan Hills	Reduce traffic impacts and hazards associated with development of steep slopes while preserving natural terrain and visual quality of San Juan Hills	Encourages clustering and density transfer. Conditional use permit allows clustering of homes on smaller lots and in closer proximity. Number of dwelling units allowed per acres decreases with the average slope of the parcel.
Agoura Hills, City of	Hillsides	Preserve remaining undeveloped hillsides.	Only parcels within Open Space District can be donor parcels. City has Cluster Development Ordinance which allows increases in density in return for preservation of open space. Development restrictions increase with the slope steepness.

Region & Name TDR Management Agency	Location	Purpose of TDR	Benefits of TDR/Comments
Los Angeles, City of	Central Business District	Preserve historic structures, promote housing, improve transportation, and provide open space.	Ordinance provides for increasing commercial densities on sites served by public transportation. Program requires public benefit payment on transfers to fund affordable housing, open space, and
Pasadena	Downtown Area	Preserve historic properties and mitigation effects of an ordinance that reduced density limits.	Allows recapture of some development potential lost by adoption of downtown height and density limits. Provides mechanism for landowners to capture development potential dollars while preserving historically or architecturally significant buildings.
San Diego, City of	Golden Hills Historic District	Preserve historic structures in Golden Hills Historic District.	Allows higher density development in other areas to preserve historic structures.
West Hollywood, City of	Cultural Heritage areas	Preserve cultural resources or structures of cultural significance.	Cultural Heritage Ordinance uses TDRs to preserve cultural resources. Once designated a cultural resource property cannot be demolished or altered without city approval.
Burbank, City of	Urban areas	Promote appropriate concentrations of development and maintain development capacity limits	Keeps future growth in Media District from affect public service systems and surrounding single family neighborhoods.
Irvine, City of	Urban areas	Encourage development of residential uses on sites previously approved for office uses.	Promotes residential development in Irvine Business Complex. Development rights for office uses can be transferred to an office space receiving site and increase office use of the receiving site.
Santa Barbara, City of	Urban areas	Promotes revitalization	Provides incentives for property owners to replace older buildings with new and smaller buildings. A sending site cannot remain vacant. Sending site must be used for residential development or dedicated to the city for park, parking lot or public use.

Source: Putting Transfer of Development Rights to Work in California, November 1993

(3) Mitigation Banks.

A third market-based approach to non-point control is mitigation banking. A mitigation bank allows stakeholders to buy mitigation and development credits by investing in established, off-site conservation programs. Just as with effluent trading and TDRs, this assures that resources are allocated to the most important wetland or other water quality attributes in a watershed, rather than spent preserving smaller, less valuable, and poorly managed assets.

Mitigation banks are regulated by state and federal agencies and provide stakeholders particular types of mitigation credits, such as wetland preservation, that offset similar categories of losses elsewhere. Mitigation banks have also been established for upland areas, forested buffers, or desert scrub.

Habitat Conservation Plans (HCPs) are similar to mitigation banks, but are typically on or near sites affected by development and related activities. Although HCPs do not typically offer marketable credits, they establish mitigation and preservation requirements that are exchanged for development rights. Many achieve water quality benefits through buffer and filtration zone enhancements.

An example of mitigation banking and HCP programs is the Central/Coastal Orange County Subregional NCCP/HCP. This 37,000 acre pilot project is designed to protect numerous species from extinction while providing participants with development rights in other locations. Although the project primarily involves upland habitat and species conservation, resulting water quality benefits include upper watershed protection and more concentrated, better managed downstream urban areas. Similar programs have been structured for San Diego County (150,000 acres), and are being planned for Orange County north of Camp Pendleton Marine Base and in the Sacramento River Delta region.

Table 4-3 lists representative examples of mitigation and conservation banks in California.

Market-based mechanisms comprise a powerful set of program options that should be used to meet TMDL and other non-point source requirements. Their benefits include watershed-wide coordination and the harmonization of water quality improvements with social and economic development.

TABLE 4-3

CONSERVATION AND MITIGATION BANKS IN CALIFORNIA

Region/Name of Bank	County Location	Size (acres)	Participating Service Area	Year Created	Agencies with Jurisdiction (a)	Type of Habitat or Mitigation Credits Available
Northern California						
Wildlands, Inc.	Placer	315	40-mile radius	1994	USCOE, USFWS, DFG	Vernal pool, seasonal and perennial marsh, open-water marsh, intermittent stream channel
Pleasanton Ridge	Alameda	600	Alameda, Contra Costa, and northern Santa Clara counties	on-going	DFG	Riparian and oak woodlands, red legged frog, Alameda whipsnake
Springtown Reserve	Alameda	93	40-mile radius	on -going	DFG	Seasonal wetlands, Alkaline wetlands, California tiger salamander and burrowing owl
Barten Ranch	Sacramento	1440	southern Sacramento County and northern San Joaquin County	on-going	USCOE, USFWS, DFG	Vernal pool, Wetlands, listed crustaceans
Beach Lake Mitigation Bank	Sacramento	142	40-mile radius	1993	USCOE, USFWS, DFG	Seasonal wetlands, emergent marsh
Grizzly Slough Mitigation Bank	Sacramento	488	TDB	on-going	DFG	Riparian forest, seasonal and permanent wetlands, uplands, oak woodlands
Kimball Island Mitigation Bank Site	Sacramento	110	TBD	on-going	USCOE, USFWS, DFG	Shaded riverine, mudflat, open water, emergent marsh, shrub/scrub, and riparian habitats, Delta smelt, winter-run chinook salmon
Sacramento Municipal Utility District, (SMUD)	Sacramento	1509	southern Sacramento County and northern San Joaquin County	TDB	USCOE, USFWS, DFG	Vernal pools, listed crustaceans
Medford Island Conservation Bank	San Joaquin	750	San Joaquin County and primary and secondary zones of the legal Delta	1995	USCOE, USFWS, DFG	Emergent wetland, seasonal marsh, riparian, and shrub/scrub

Region/Name of Bank	County Location	Size (acres)	Participating Service Area	Year Created	Agencies with Jurisdiction (a)	Type of Habitat or Mitigation Credits Available
Wikiup Partners	Sonoma	12	Sonoma County north of Petaluma	1995	USCOE, DFG	Seasonal wetlands
Southern California						
Boden Canyon (Environmental Trust)	San Diego	40	Western San Diego County	1995	USFWS, DFG	Coastal sage scrub, chaparral, oak woodland, riparian woodland
Carlsbad Highlands Conservation Bank	San Diego	263	San Diego County	1995	USFWS, DFG	Coastal sage scrub, chaparral, oak, riparian, native grassland
Crestridge Habitat Management Area	San Diego	311	Coastal and foothill areas, San Diego County	1995	USFWS, DFG	Coastal sage scrub, Southern mixed chaparral
4S Ranch Mitigation Bank	San Diego	569	Western San Diego County	on-going	USFWS, DFG	Coastal sage scrub, eucalyptus woodlands, Southern mixed chaparral, sycamore alluvial woodland
Lake Hodges	San Diego	280	TDB	1994	USFWS, DFG	Coastal sage scrub, chaparral, California gnatcatcher
McGinty Mountain	San Diego	235	TDB	1994	USFWS, DFG	Coastal sage scrub, Chaparral
Madura Mitigation Site	San Diego	35	TDB	on-going	USFWS, DFG	Coastal sage scrub, Southern mixed chaparral, California gnatcatcher
Manchester Avenue Conservation Bank	San Diego	124	TDB	on-going	USFWS, DFG	Southern maritime chaparral, Coastal sage scrub
Marron Valley Preserve	San Diego	562	TDB	1995	USFWS, DFG	Chaparral, riparian, Diegan sage scrub
O'Neal Canyon	San Diego	600	TDB	1993	USFWS, DFG	Coastal sage scrub, chaparral, Tecate Cypress
Poway (SANREX) Mitigation Bank	San Diego	880	TDB	1994	USFWS, DFG	Coastal sage scrub, chaparral, live pad woodland, riparian, native grassland, California gnatcatcher
Ramona Vernal Pool Preserve	San Diego	85	TDB	1992	USFWS, DFG	Vernal pool, wetland
Rancho San Diego	San Diego	1840	San Diego County	1996	USFWS, DFG	Coastal sage scrub, chaparral, maritime succulent scrub
Rancho San Miguel	San Diego	1186	Western San Diego County	on-going	USFWS, DFG	Coastal sage scrub, chaparral, maritime succulent scrub
San Vicente Conservation Bank	San Diego	320	Western San Diego County	1996	USFWS, DFG	Coastal sage scrub, chaparral

Chapter Five

Chapter 5

Conclusion

Non-point source watershed management affects a diverse range of geographic, social, and economic interests. The potential for unintended consequences--excessive expenditures with few realized benefits; social and economic disruption; diverted development producing net environmental losses--might occur is extreme. By utilizing known and tested strategies, non-point source mandates can be comprehensively addressed while minimizing unwanted results.

This report suggests that non-point source TMDL compliance programs learn from and be based on prior experience throughout the United States. The following strategy is recommended:

- *Utilize existing BMPs to develop programs.* Existing BMPs comprise a set of highly effective tools with quantifiable benefits and costs. Non-point source management programs should rely on such measures as described in this report, start with less costly and intrusive measures, and incorporate additional BMP options as necessary to achieve water quality goals.

- *Employ market-based mechanisms to achieve watershed management.* The multiplicity of jurisdictions and stakeholders involved in a single watershed means that site-by-site, politically fragmented management will almost certainly generate unintended, adverse environmental and social consequences. Market-based options--effluent trading, TDRs, and mitigation banking--provide flexible, powerful tools that induce competition to make investments consistent with regulatory goals among interests seeking development or other economic rights that can maximize watershed-wide discharge reductions and minimize unintended social and economic results.

The management strategy contemplated by this report is not new; it has been effectively employed in a variety of watersheds to improve water quality. BMPs and market-based mechanisms are being utilized to achieve non-point source goals in ways that harmonize environmental, social and economic concerns. Examples include:

(1) Chesapeake Bay Nutrient Load Reductions. The Chesapeake Bay is a large estuary degraded by nitrogen and other nutrient loads from point sources (23%), non-point sources (68%), and air deposition in the bay and its tributaries (9%).

To address this concern, Maryland, which formed the Chesapeake Bay Commission in 1985, and Virginia enacted land use controls and density restrictions for areas within 1,000 feet of the bay's mean high tide. Commercial, industrial, and high density residential areas are concentrated in designated areas to help maintain natural vegetation buffers.

A key element of the Chesapeake Bay program is nutrient trading, which allows point to point, point to non-point, and non-point to non-point exchanges along multiple waterways. This strategy focuses attention on the most pressing water quality needs while balancing the costs of compliance with anticipated benefits. Virginia's nutrient trading program is a major factor for its compliance with Chesapeake Bay load reductions.

(2) Prince George's County, Maryland, Development Management. Agencies in Prince George's County are addressing environmental and development objectives to enhance lot yields, reduce development costs, encourage development and economic growth and also preserve sensitive areas and incorporate BMPs for stormwater management. In one case, a traditional, storm drain channeled project was reconfigured to allow for on-site runoff storage and infiltration. Many of the reconfigured lot features were easy to design and install, reducing infrastructure maintenance and development costs. This approach reduced expenses for both the developer and the community while achieving substantial water quality benefits.

(3) Urban Greenbelt and Open Space Programs. Agencies in Washington, DC, Baltimore, Portland and Seattle are beginning to integrate land use planning, BMPs and market mechanisms to encourage greenbelt and other natural infiltration areas in urban communities. The techniques they employ include cluster development incorporating common park and open space areas, and increasing development densities to maintain economic yields, increase open space and improve water quality. This approach disperses and filters non-point source pollutants before they reach streams or rivers instead of concentrating contaminated runoff at a single location.

The integrated non-point source water management approach advocated by this report is summarized in Figure 5-1 and Table 5-1.

As the matrix illustrates, BMPs and market-based mechanisms offer a rich, flexible set of tools for addressing water quality concerns. As Southern California and the rest of the country grapple with new non-point source mandates, it is possible to reduce the risk of unwanted and unanticipated

consequences by building on the experience of other jurisdictions and communities. Given the stakes involved, this report strongly urges that program development focus on existing BMPs and market-based approaches to watershed management.

MANAGEMENT APPLICATIONS	Conservation Banking	Habitat Restoration	Habitat Preservation	Riparian Corridor Protection	Monitoring Program	Source Reduction	Eliminates Illegal Discharge	Reduce Discharge	Sediment Control	Erosion Control	Economic Growth	Upper Reach Watershed	Lower Reach Watershed	Targets Non-Point Source	Targets Point Source	Public Awareness	Flexibility
Best Management Practices (BMPs)																	
Institutional Source Controls		●			●	●	●	●					●		●	●	↔
Non-Structural Controls		●			●	●	●	●					●		●	●	↔
Minor Structural Controls		●			●	●	●	●		●			●		●	●	↔
Physical Treatment		●			●	●	●	●	●	●			●		●	●	↔
Wetlands Program		●	●	●	●		●	●	●	●		●	●		●	●	↔
Total Maximum Daily Load(TMDLs)																	
Water Quality Standards		●			●	●	●	●	●				●		●	●	↓
Effluent Trading Programs		●			●	●	●	●	●			●	●	●	●	●	↑
Transferable Development Rights																	
City Ordinances	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	↓
Specific Plans	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	↔
Development Agreements	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	↑
Watershed Zoning		●	●	●	●		●	●	●	●		●	●	●	●	●	↔
Conservation Banking																	
Wetland Banking	●	●	●	●	●	●			●	●			●		●	●	↔
Mitigation Banking (Upland)	●	●	●		●	●			●	●		●	●	●		●	↔

WATER QUALITY MANAGEMENT MATRIX

FIGURE 5-1

CHARACTERISTICS OF WATER QUALITY MANAGEMENT APPROACHES

Type of Water Quality Management Approach	Type of Practice	Water Quality Benefits	Other Benefits	Disadvantages	Relative Cost	Considerations for Future Evaluations
BEST MANAGEMENT PRACTICES	Educational Programs	Reduction of all pollutants through increased awareness of dischargers, especially residents and small businesses who usually do not interact with regulators. May increase awareness of neighborhood "watchdog" groups	Generally popular with residents. Can be distributed through school programs to encourage youngsters to become environmentally conscious.	Can have a high annual cost.	Original cost may be high. Annual costs based upon the need to update material and cost of printing or broadcasting. Costs may be reduced if combined with other educational programs.	Determine effectiveness through public surveys. Develop methods to reduce cost of providing updated materials, possibly through sharing of information between several agencies or combining materials with other outreach programs.
	Litter Control with Ordinances and Increased Placement of Municipal Trash Cans	Reduction of litter that may add nutrients, organic material, and pathogens to streams.	Improves aesthetics of communities, and may improve property values.	May require frequent collection of trash, especially in areas with high volume of pedestrian traffic and near restaurants.	Costs may be low unless frequent trash collection is required.	Determine effectiveness through physical surveys to determine if accumulated litter is reduced with increased trash collection. Studies also should determine actual costs, including additional trash cans, collection vehicles and crews, and disposal fees.
	Recycling Programs, including programs for Oil Recycling	Could reduce oil in streams which is toxic to wildlife and vegetation.	Generally popular with residents. Reduces land fill loadings. May reduce litter in community (see above).	May require special handling needs for hazardous wastes collected with other materials. Also may require special handling needs to dispose of non-recyclable materials.	Extremely successful to remove oil from storm drains and landfills. May be expensive if limited sources to purchase recycled materials.	Determine effectiveness through physical surveys to determine if litter and oil dumping is reduced with increased collection. Studies also should determine actual costs, including additional collection vehicles and crews and disposal fees.
	"Pooper Scooper" Ordinances	Could reduce nutrients, organic material, and pathogens from animal droppings.	Improves aesthetics of communities.	May not be popular program with many residents that would be required to participate.	May be difficult to enforce if community does not support action.	Determine effectiveness through physical surveys to determine if animal wastes are reduced with ordinances. Studies also should determine actual cost of enforcement.
	Restrict Paving	Reduction in streets and parking lot areas could reduce oil and grease in streams. If paving is replaced by erodible soils or fine grained rocks, silt load in streams could increase.	Could result in increased use of vegetation which may improve aesthetics of communities.	To avoid reduction in parking spaces, multi-story parking structures may be required. These structures are expensive and may not be popular with many residents.	Alternatives considered to reduce paving would be more expensive than paving, including multi-story parking structures.	Determine effectiveness through physical surveys of materials in storm channels in areas with restricted paving as compared to more traditional areas. Studies also should determine costs for new and retrofitted construction.
	Use of Non-Porous Materials, Interceptor Swales, and Vegetative Filter Strips	Reduction in all pollutants which would be absorbed by the soils under the non-porous materials.	Would result in increased use of vegetation which may improve aesthetics of communities.	Use of non-porous materials in parking lots, sidewalks, tennis courts, and other areas would require more frequent replacement because the non-porous materials may become clogged with silt and organic matter.	Vegetation strips or infiltration materials in parking lots and walkways would be more expensive.	Determine effectiveness through physical surveys of materials in storm channels in areas with restricted paving as compared to more traditional areas. Studies also should determine costs for new and retrofitted construction.
	Frequent Street and/or Sidewalk Sweeping	Reduction in silt and associated nutrients, organic material, and pathogens absorbed by the silt particles.	Improves aesthetics of communities.	May require special handling needs for hazardous wastes collected with other materials. Also may require special handling needs to dispose of collected materials.	Effectiveness depends upon amount of litter and silt that accumulates and frequency of storm events. Maybe cost-effective if frequent storms with high accumulation of litter between storms, or prior to wet weather season following long summer period.	Determine effectiveness through physical surveys to determine if litter is reduced with increased sweeping. Studies also should determine actual costs, including additional sweeping equipment and crews and disposal fees.
	Frequent Storm Drain and Channel Cleaning, and/or Storm Drain Inlet Protection	Reduction in silt, litter, and other materials (such as animal wastes, dead animals, and vegetation) which may contribute nutrients, organic materials, and pathogens.	Cleaning of open channels improves aesthetics of communities.	May require special handling needs for hazardous wastes collected with other materials. Also may require special handling needs to dispose of collected materials.	Effectiveness depends upon amount of litter and silt that accumulates and frequency of storm events. Maybe cost-effective if frequent storms with high accumulation of litter between storms, or prior to wet weather season following long summer period.	Determine effectiveness through physical surveys to determine if pollutants are reduced with increased cleaning. Studies also should determine actual costs, including additional collection vehicles and crews, and disposal fees.
	Slope Stabilization and Erosion Controls	Reduction in silt. Could reduce nutrients and organic materials if eroded site had been subject to application of fertilizers, herbicides, and pesticides.	Improves aesthetics of communities. Reduction in erosion may contribute to increased vegetation on erodible sites. Increased vegetation would improve habitat and aesthetics.	Measures may be expensive.	Costs would depend upon accessibility of soils, especially for previously developed sites.	Determine effectiveness through physical surveys of materials in storm channels in areas with erosion controls, especially increased vegetation, as compared to more traditional areas. Studies also should determine costs for BMPs.
	Use of Debris Basins	Reduction in silt, litter, and other materials (such as animal wastes, dead animals, and vegetation) which may contribute nutrients, organic materials, and pathogens.	Debris basins may be planted with native grasses or wetland vegetation. Increased vegetation would improve habitat and aesthetics.	May require special handling needs for hazardous wastes collected with other materials. Also may require special handling needs to dispose of collected materials. May be difficult if adequate land is not available. Basins may require visual screening.	Cost may be high if adequate land is not available or if disposal site for debris is not available. Accumulated debris may require frequent removal if adjacent to developed land uses.	Determine effectiveness through physical surveys to determine pollutants removed in debris basins. Studies also should determine actual costs, including cleaning crews and disposal fees.
	Restore Natural Channels and Establish Wetlands	Reduction in all pollutants which would be absorbed by the soils and vegetation in wetlands.	Increased vegetation would improve habitat and aesthetics. Communities could develop residential or commercial areas surrounding new wetlands areas which may increase economic growth.	Requires upgradient removable filtration material to minimize entry of toxic materials into wetlands. Filter material may become a hazardous material. May be difficult if adequate land is not available.	Costs dependent upon accessibility of sites and availability of areas for restoration. Costs for disposal of filtration materials may be high depending upon quality of inflow. Maintenance of wetlands may be high depending upon adjacent land uses.	Determine effectiveness with surveys of pollutants in streams in areas with and without wetlands. Studies also should determine costs for construction, including disposal of filtration materials. Surveys should include economic growth opportunities.
	Fence Open Channels and Streams	Reduction in litter that would travel into streams and potential for direct discharge of pollutants by individuals that access stream, thereby reducing all pollutants.		Access to channel would be limited which may not be popular with users of the channel. Vegetation may be required to visually screen fence.	May be high cost to frequently remove debris caught in fence.	Determine effectiveness through physical surveys to determine if litter and pollutants are reduced with fencing. Studies also should determine actual costs, including additional litter collection crews and disposal fees.
	Collect and Treat Storm Water	Reduction in pollutants in streams depending upon level of treatment provided.	Will not require residents or businesses to alter existing practices.	May require special handling needs for collected materials. May be difficult if adequate land is not available. Treatment plant may require visual screening.	Costs extremely high for construction and maintenance, especially in areas with short wet weather periods with intense storms.	Determine effectiveness with surveys of pollutants in streams in areas with and without treatment. Studies also should determine costs for construction and maintenance, including disposal of materials.
	Sediment and Grease Traps on Storm Drain Inlets	Reduction in oil in streams which is toxic to wildlife and vegetation.	May reduce localized street flooding because storm drain inlets could provide additional storage for solids.	May require special handling needs for collected materials.	Costs extremely high for maintenance. Requires frequent cleaning prior to storm periods.	Determine effectiveness with surveys of pollutants in streams in areas with and without treatment. Studies also should determine costs for construction and maintenance, including collection and disposal of materials.

TABLE 5-1
CHARACTERISTICS OF WATER QUALITY MANAGEMENT APPROACHES

Type of Water Quality Management Approach	Type of Practice	Water Quality Benefits	Other Benefits	Disadvantages	Relative Cost	Considerations for Future Evaluations
Total Maximum Daily Load Approach within a Watershed or Large Portion of a Watershed	Establish TMDLs to protect beneficial uses, identify all BMPs to reduce loadings, compare costs and benefits on a watershed basis to identify most cost-effective BMPs, and determine funding mechanisms, including effluent trading, to allocate costs.	Reduction in nutrients, organic material, and pathogens.	Could improve habitat and aesthetics in areas where water quality improvements would not be cost-effective if benefits were only applied to one user.	This approach requires willing participants. May require extensive evaluation and coordination to determine proportional loadings and cost-effective program. May require monitoring program to determine if all participants are implementing program.	Initial studies and monitoring may be expensive, especially for agricultural users who have traditionally not needed to complete water quality studies or monitoring actions.	Determine effectiveness with surveys of pollutants in streams in areas with and without TMDLs. Studies also should determine costs for construction and maintenance of BMPs, monitoring program, and organizational requirements.
Land Use Planning	Establish zoning requirements to reduce disturbance of erodible soils and/or facilitate stormwater quality management. Zoning provisions may include requirements for BMPs, such as interceptor swales or non-porous materials in parking lots.	Reduction in most pollutants.	Could improve community aesthetics due to grouping of developed areas, specified open spaces which also would improve habitat, protection and improvement of historical or natural resources, and reduction in construction costs of utilities and roads.	May not apply to existing parcels, therefore application of new provisions may not be continuous. Therefore, the benefits may not be as significant. In addition, areas with new provisions may protest additional restrictions or costs.	If provisions are not applied uniformly, costs of new provisions are shared among fewer users and therefore unit costs could be high.	Determine effectiveness with surveys of pollutants in streams in areas with and without new zoning provisions. Studies also should determine costs for construction and maintenance of BMPs, and changes in economic growth opportunities.
	Transferable Development Rights to group land uses to reduce disturbance of erodible soils and/or facilitate stormwater quality management.	Reduction in most pollutants.	Could improve community aesthetics due to grouping of developed areas, specified open spaces which also would improve habitat, protection and improvement of historical or natural resources, and reduction in construction costs of utilities and roads.	May be difficult if adequate land is not available for transfer.	Capital costs must include cost of developing organization to manage transferable development rights.	Determine effectiveness with surveys of pollutants in streams in areas with and without TDRs. Studies also should determine costs for construction and maintenance of BMPs, organizational structure, and changes in economic growth opportunities.

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ABOUT THE COALITION

The Southern California Coalition for Pollution Prevention ("Coalition") is an unincorporated consortium of major companies committed to developing cooperative working relationships with agencies of government at the federal, state, regional and local levels.

Established in 1985 as the Southern California Coalition for Hazardous Materials Management, the Coalition's steering committee authorized a name change in July 1991 in recognition of the expanded needs of its membership. The Coalition is affiliated with the tax-exempt, non-partisan California Foundation on the Environment and Economy.

The Coalition works with a wide range of interests to encourage greater public awareness of the potential which pollution prevention offers our state and regional economies. Activities of the Coalition include pilot project development, sponsorship of a wide range of conferences and workshops and the publication of original research.

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